Proceedings of the 29th Meeting of Research Advisory Committee

(November 18, 2024)

ICAR-Indian Institute of Wheat and Barley Research, Karnal-132001

Proceedings of 29th Meeting of Research Advisory Committee held in hybrid mode on November 18, 2024

ICAR-IIWBR, Karnal (Haryana)

(*Venue: V. S. Mathur Hall*)

The 29th meeting of the Research Advisory Committee (RAC) of ICAR-Indian Institute of Wheat and Barley Research, Karnal was organized in the hybrid mode on 18th November, 2024. The following members and invitees were present:

Dr. PL Gautam Chancellor RPCAU, Pusa, Bihar; Former Vice Chancellor, GBPUAT, Pantnagar; Chairman PPVFRA and Chairman NBA, Chennai	Chairman
Dr. AK Sharma Former Director, ICAR-NBAIM, Mau (UP)	Member
Dr. ML Jat Global Research Program Director, Resilient Farm and Food System, ICRISAT, Patencheru, Telangana	Member
Dr. PS Birthal Director, National Institute of Agricultural Economics and Policy Research, New Delhi	Member
Dr. Kuldeep Singh Head Genebank, Deputy Program Director, Accelerated Crop Improvement ICRISAT, Patencheru, Telangana	Member
Dr. Ratan Tiwari Director, ICAR-IIWBR, Karnal	Member
Dr. Sharat K Pradhan Assistant Director General (FFC), Crop Science Division, ICAR, New Delhi	Member
Sh. Rajender Singh Sandhu, Karnal, Member IMC	Member
Sh. Gurcharan Singh Sandhu, Sri Muktsar Sahib, Punjab, Member IMC	Member
Dr. Sunil Kumar Principal Scientist, ICAR-IIWBR, Karnal	Member Secretary

Dr PC Sharma could not attend the meeting due to some personal reasons. All the scientists from ICAR-IIWBR, Karnal and scientists from its Regional Stations, Shimla and Hisar, participated in the meeting.

The meeting started with welcome of the Chairman and members of the RAC by the Director of the institute.

Thereafter, Dr Ratan Tiwari, Director, ICAR-IIWBR, Karnal presented highlights of the achievements of the institute including research and other activities from preceding to the current RAC. He congratulated the scientific fraternity for achieving the yield milestone of 113.2 million tonnes from an area of 31.8 million hectares. He informed that some of the

prominent wheat varieties of the institute like DBW 187, DBW 303, DBW 327, DBW 371 and DBW 372, are contributing more than 35% of the total DAC (Department of Agriculture & Cooperation) indent for breeder seed. Forty-two biofortified wheat varieties have been notified and are being cultivated throughout India. A total of 11 wheat varieties (+area extension of 1 variety) and 1 barley variety have been released by CVRC while 12 wheat and 3 barley varieties were identified by Varietal Identification Committee. He underlined efforts on wheat improvement including, *inter alia*, stress tolerance, wheat blast management, developing climate resilient and biofortified varieties *etc*. and initiatives for reaching the farmers via various platforms. He also prioritised a few issues for consideration in future research and management at the institute. These included need for pre-breeding, training of young scientists, efforts for promotion of rotary disc drill by the government, nature friendly farming, bio-fortified varieties, nutrient/water use efficient technologies, shortage of economist and entomologist, and infrastructural / land resource constraints. The seed production of the institute has now become a role model for other crops as 23551 farmers registered for seed on IIWBR Seed portal during 2024-25. He also apprised the house about successful operation of Mega University Hub of ICAR-IARI at ICAR-IIWBR Karnal.

Dr Sunil Kumar, the Member Secretary, RAC, presented the action taken report (ATR) on recommendations of the 28th meeting of the RAC held on 27th October, 2023. The RAC members responded to the recommendations *vis-à-vis* actions taken. The ATR was accepted by the committee and appreciated the staff for the progress. As per the Directions of the Chairman RAC, a glimpse of the salient highlights of the work done on the recommendations of previous RACs was also presented, which was hailed by the RAC. After discussion on ATR, the program-wise presentations were made by Dr B S Tyagi (Pre-breeding), Dr Om Prakash Ahlawat (Biotechnology and Plant Physiology), Dr Pradeep Sharma (Crop Protection), Dr Subhash Chander Gill (Resource Management), Dr Sunil Kumar (Quality & Basic Sciences), Dr Om Vir Singh (Barley Improvement), Dr Anuj Kumar (Social Sciences), Dr Amit Sharma (Seed Program) and Dr OP Gangwar (Regional Station, Shimla) on the achievements made in the research and the future research programmes (Annexure 1).

The Chairman appreciated the progress of various projects. He commended the hard work by the farmers, researchers, and policy makers for record production during 2023-24. He lauded the work done in the field of pre-breeding, breeding, varietal development, seed program, quality improvement, resource management, plant pathology, extension and pathotyping. He suggested that Ph.D. students' research problems should be integrated with the ongoing research projects. He highlighted importance of AICRP in impacting Indian agriculture and linkage with agricultural universities. He stressed the need of regular trainings for young entrants in the agricultural system and suggested for publishing a short note on the linkage between ICAR and Agricultural Universities. The chairman underscored the need for RAC endorsements to take due note of the recommendations of Quinquennial Review Team. He

emphasized that the equipment utilized in wheat research should be upgraded with time seeing the importance of IIWBR at national and global level. He welcomed the starting of M.Sc. and Ph.D. programs by the institute. He, however, suggested to consider phasing out the undergraduate program at ICAR-IIWBR as it will require more manpower and facilities.

Dr. SK Pradhan, ADG (FFC), admired the work being done at ICAR-IIWBR, Karnal leading to record production and for spread of biofortified varieties to substantial area in the country. He suggested that work should be spearheaded to enhance productivity to cater the future needs of the growing population by 2047. He stressed to work in the direction of climate resilience, biofortification and use of gene pyramiding to achieve more durable resistance in wheat varieties. He emphasized for focussed gene deployment strategy for disease resistance. He commended the progress made in conventional breeding work and suggested that equal focus should be placed on genomics-assisted breeding and marker-assisted selection. Since, barley is also one of the important crops and thus, scientists should put effort to strengthen work on barley improvement and its industrial application.

Dr. A K Sharma opined that the work done in the field of wheat and barley was commendable. He deliberated on the wholesome changes in climate by the end of this century that will impact number of outdoor days, and sowing/harvesting seasons. He suggested pathology division to document pesticide use through drone technology in wheat. Dr. Sharma highlighted the need to study the impact of western disturbances on yellow rust and advocated for rust forecasting systems. Additionally, he proposed that, similar to stem rust behaviour documented by Dr. Nagarajan in 1975, specific information should be developed for other rusts as well.

Dr. M L Jat appreciated the work of the institute. He pointed out for devising future strategies in terms of changing climate. He advocated the importance of genetic modelling of soil microbes in maintaining soil carbon and saving of nitrogen. He suggested that regenerative agriculture aligned with breeding and management in system perspective should be taken up in future research initiatives.

Dr. P S Birthal appreciated the work done in pre-breeding, varietal development, resource management, quality, and natural farming. He emphasized the importance of yield enhancement, stability, and quality in wheat crop and therefore, felt the need to reduce the yield gap in wheat vis-à-vis enhancement in technical efficiency. It was also suggested to have statistical analysis of annual genetic gain and economic branding of nutrition rich products. Dr. Birthal offered collaboration with scientists of his institute for elucidating factors responsible for yield gap and impact analysis.

Dr. Kuldeep Singh lauded the team IIWBR and underpinned the data generation in alignment to sustainable development goals (SDGs), IPCC and biodiversity framework and

collaborations. He also emphasized the importance of developing more synthetic wheat varieties to tap the potential genetic diversity of the gene pool. He urged to keep vigil against rust and suggested the application of nano-zinc at flowering stage for zinc enhancement in grains.

Shri Rajender Singh Sandhu, a progressive farmer, highlighted the rapid changes in weather patterns and stressed the need for wheat varieties that can perform well under these fluctuating conditions.

Shri Gurcharan Singh Sandhu, another progressive farmer, appreciated the efforts of IIWBR and ICAR in supporting farmers. He expressed the need for raising awareness among farmers about the technologies provided by ICAR-IIWBR.
The Chairman and members also appreciated the contributions of Dr Gyanendra Singh (Ex-Director, IIWBR) and Dr Sewa Ram (Ex-Principal Investigator, Quality & Basic Science division) who got superannuated during 2024.

Based on the deliberations and discussion, the following general suggestions emerged:

- With good progress in conventional breeding, equal emphasis should be placed on genomics-assisted breeding with more focus on difficult to breed traits.
- The genetic base of Indian wheat varieties should be broadened by incorporating landraces and traditional varieties into the crossing programs. The institute should also consider accessing CIMMYT's genomics-based core collection of wheat and make it accessible to researchers nationwide.
- The approach of gene pyramiding to achieve durable disease resistance in wheat varieties should continue to be the essential activity.
- Development of product profiles as per market, consumer and industry requirements should be updated regularly.
- High-protein lines identified under the various projects should be incorporated into crossing programs. Parents for crossing should be carefully selected addressing, *inter alia*, the issue of hybrid necrosis.
- ICAR-IIWBR having national and global role in wheat research, must have fully equipped modern laboratories. Therefore, there is need to have assessment of status of the current equipment and support upgradation accordingly. This should be prioritized for quality analysis equipment, as major part of the quality analysis for AICRP trials is undertaken at IIWBR.
- Continuous feedback from extension workers should be sought on all aspects of wheat crops.
- The importance of climate-contextual research is needed to address the challenges posed by climate change. Given the emerging fertilizer scenario (efficiency, availability, and

cost), systematic research should be initiated on microbes to reduce fertilizer use and complement regenerative and organic agriculture.

- Factors contributing to the yield gap across different regions should be worked out. The development of weather forecasting models and gathering farmers' feedback after the demonstration and adoption of new varieties can help collecting farmer fields' data.
- Suitable varieties should be developed for inter/relay and multiple cropping systems and regenerative agriculture.
- Natural Resource Management research should be carried out and presented in systems mode rather than commodity centric approach.
- The efforts should be made on mainstreaming of the technologies developed and certified by ICAR through Ministry of Agriculture in line with CVRC process of variety release.
- The survey and surveillance of diseases should be strengthened. Survey and surveillance should be continued in the Ladakh and Lahaul region to critically monitor the pathotypes occurring there. Integrated pest management should be given emphasis.
- Organic farming programs should also be considered while formulating future research programs.
- Systematic research should be carried out on pesticide spray using drone technology in terms of dosage, efficacy, economy etc. The efforts should be made to study the challenges and constraints of the use of drones.
- Studies on improving the photosynthetic efficiency in wheat is important under the conditions of dim light during foggy periods of winter.
- Hybrid wheat research should continue by assigning researchable issues to the Ph.D. students.
- Fusarium Head Blight (FHB) screening should be done under artificial inoculated conditions rather than natural field conditions as Karnal is not a hot spot for the FHB. The FHB resistant lines identified during last year should be shared with the breeders for their best use in crossing programme.
- Rust pathotypes may be deposited in National Repository (NBAIM).
- As an effort to popularise barley crop, a short film on barley may be prepared for publicity.
- The licensing of varieties and technologies to the private sectors should be encouraged adhering the ICAR guidelines.

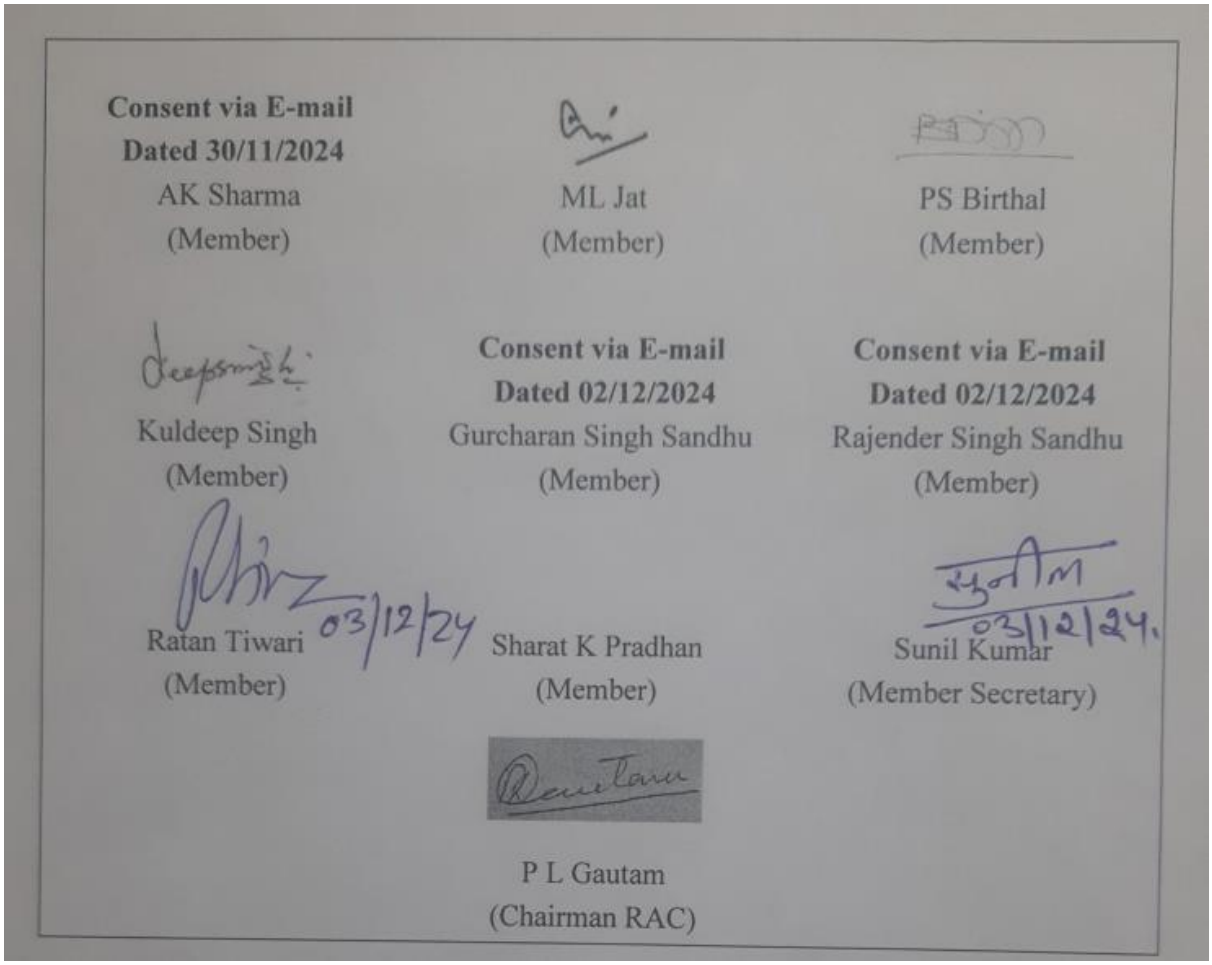
Recommendations:

After deliberations, following specific recommendations were offered by the RAC:

1. There is need to continue developing wheat varieties that are climate-resilient, better in nutrient value and high-yielding. This can best be achieved through genomic assisted breeding by combining diverse disease resistance, abiotic stress tolerance and nutrition enhancing genes.

2. Under the growing threat of climate change, there is need to revisit and redefine the wheat mega environments for future climates and prioritize target research accordingly.
3. Herbicide resistance in *Phalaris* and *Avena* is widespread. However, it is not clear whether, the mutations are in single base pair or in multiple bases in a given locus or the mutations are in multiple loci. Studies to understand the molecular/genetic basis for the herbicide tolerance in *Phalaris minor* and wild oat should be initiated.
4. Khapali wheat (*Triticum dicoccum*) is known to have low glycemic index (GI) and high protein content. QTL for low GI need to be mapped in *T. dicoccum* so that bread wheat varieties with low GI could be developed.
5. "Indian Stem Rust rules" were developed around half a century ago by Nagarajan and Singh in 1975 (Plant Disease Reporter, 59:133-136), which may be revisited under the present-day climate change/global warming conditions, using modern day tools. Also, similar to the stem rust behaviour, specific information should be developed for other types of rusts.
6. The onset of yellow rust in the North-Western and Northern Hill Zone, vis-à-vis the Western disturbance be analyzed so that disease forewarning can be worked out to help studying the global movement of yellow rust and entry of new pathotypes into the country.
7. Genotype x Environment x Management is an important aspect that should be emphasised in the changing climate to meet the food security. Dedicated research should be initiated on G x E x M targeting varieties for inter/relay and multiple cropping systems and regenerative agriculture practices.
8. Assess historical yield gaps in wheat across states and identify factors responsible for the gaps and suggest remedial measures. Track farmers for continuance and dis-adoption of technologies demonstrated in their fields and identify reasons for dis-adoption.
9. In IIWBR seed portal, the provision may be made for feedback on the performance of recommended varieties planted by the farmers during previous year.
10. Systematic efforts should be made on defining the domains of barley in view of soils, water, climate, and comparative economics to understand the potential niche of barley under current and future climates and resource scenario. Barley group should try to improve elite varieties of malt and food barley for various quality traits. There is need to reinforce barley programme with more emphasis on developing transgressive genotypes using genomic assisted breeding. Work on natural farming and organic farming should also be started in barley.
11. Newly recruited staff at collaborating institutes and SAUs should be trained regularly for data recording and analysis.

The meeting ended with the vote of thanks to the chair, members of RAC and staff of ICAR-IIWBR by the member secretary.



Consent via E-mail
Dated 30/11/2024
AK Sharma
(Member)

ML Jat
(Member)

PS Birthal
(Member)

Kuldeep Singh
(Member)

Consent via E-mail
Dated 02/12/2024
Gurcharan Singh Sandhu
(Member)

Consent via E-mail
Dated 02/12/2024
Rajender Singh Sandhu
(Member)

Ratan Tiwari
(Member)
03/12/24

Sharat K Pradhan
(Member)

Sunil Kumar
(Member Secretary)
03/12/24.

P L Gautam
(Chairman RAC)

Annexure 1 (List of projects)

Crop Improvement

Wheat improvement for enhancing genetic gain and productivity under changing climate (CRSCIIWBRCL20200020195)

Programme Leader: Dr. BS Tyagi

Project 1: Developing high yielding and climate resilient wheat varieties (PI: Dr. BS Tyagi

Project 2: Pre-breeding and germplasm enhancement (PI: Dr. BS Tyagi)

Project 3: New insights & basic studies for integrating molecular, physiological and bioinformatics tools for augmenting wheat improvement (PI: Dr. OP Ahlawat)

Crop Protection

Biotic stress management in wheat (CRSCIIWBRCL20200030196)

Programme Leader: Dr. Pradeep Sharma (PI-CP) wef 12/06/2024

Project 1: Management of biotic stresses of wheat by integrating innovative approaches (PI: Dr. Pradeep Sharma) wef 12/06/2024

2.1 Mapping phenotypic diversity in wheat and barley rust pathogens, identifying resistance sources, and upkeep of culture collection (PI: Dr. O.P. Gangwar)

Resource Management

Enhancing the productivity, sustainability and resilience of wheat-based cropping systems (CRSCIIWBRCL20200040197)

Programme Leader: Dr. SC Tripathi (PI-RM)

Quality & Basic Sciences

Wheat Improvement for Industrial and Nutritional Quality (CRSCIIWBRSL20200050198)

Programme Leader: Dr. Sewa Ram (Till 31/07/2024); Dr. Sunil Kumar (PI-QBS) wef 01/08/2024

Barley Improvement

Barley for Feed, Food and Industrial Purposes (CRSCIIWBRCL20200060199)

Programme Leader: Dr. Omvir Singh (PI-BI)

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

Social Sciences

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)

भारतीय कृषि अनुसंधान परिषद
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
कृषि भवन, नई दिल्ली – 110001
KRISHI BHAWAN, NEW DELHI-110001

Dr Ishwar Singh
PS (FFC)

Ph: 011 23389597/23046690
Email: isingh.icar@gmail.com

F. No. 13-2/2021-CS-FFC

Dated: 01.01.2025

To,

The Director
ICAR-IIWBR
Karnal

Subject: Proceedings of 29th RAC meeting of ICAR-IIWBR, Karnal-regarding.

Sir,

Kindly refer to your email dated 06.12.2024 regarding above cited subject. In this context, the approval of Competent Authority is conveyed herewith for the submitted proceedings and recommendations of the **28th RAC meeting of ICAR-IIWBR, Karnal held on 18 November, 2024 for further follow up action**.

A copy of recommendations with SMD comments is enclosed herewith for necessary action.

Yours faithfully

01-01-25

(Ishwar Singh)

Encl: As above.

+

SMD comments on the recommendations of 29th Meeting of Research Advisory Committee (RAC) of ICAR-IIWBR, Karnal (Haryana) held in hybrid mode on 18th November, 2024

S. No.	Recommendations	SMD comments
1	There is need to continue developing wheat varieties that are climate-resilient, better in nutrient value and high-yielding. This can best be achieved through genomic assisted breeding by combining diverse disease resistance, abiotic stress tolerance and nutrition enhancing genes.	Agreed as per the Institute mandate
2	Under the growing threat of climate change, there is need to revisit and redefine the wheat mega environments for future climates and prioritize target research accordingly.	Agreed
3	Herbicide resistance in *Phalaris* and *Avena* is widespread. However, it is not clear whether, the mutations are in single base pair or in multiple bases in a given locus or the mutations are in multiple loci. Studies to understand the molecular/genetic basis for the herbicide tolerance in *Phalaris minor* and wild oat should be initiated.	Agreed
4	Khapali wheat (*Triticum dicoccum*) is known to have low glycemic index (GI) and high protein content. QTL for low GI need to be mapped in *T. dicoccum* so that bread wheat varieties with low GI could be developed.	Agreed as per the Institute mandate
5	"Indian Stem Rust rules" were developed around half a century ago by Nagarajan and Singh in 1975 (Plant Disease Reporter, 59:133-136), which may be revisited under the present-day climate change/global warming conditions, using modern day tools. Also, similar to the stem rust behaviour, specific information should be developed for other types of rusts.	Agreed
6	The onset of yellow rust in the North-Western and Northern Hill Zone, vis-à-vis the Western disturbance be analyzed so that disease forewarning can be worked out to help studying the global movement of yellow rust and entry of new pathotypes into the country.	Agreed
7	Genotype x Environment x Management is an important aspect that should be emphasised in the changing climate to meet the food security. Dedicated research should be initiated on G x E x M targeting varieties for inter/relay and multiple cropping systems and regenerative agriculture practices.	Agreed as per the Institute mandate
8	Assess historical yield gaps in wheat across states and identify factors responsible for the gaps and suggest	Agreed

	remedial measures. Track farmers for continuance and dis-adoption of technologies demonstrated in their fields and identify reasons for dis-adoption.	
9	In IIWBR seed portal, the provision may be made for feedback on the performance of recommended varieties planted by the farmers during previous year.	Agreed
10	Systematic efforts should be made on defining the domains of barley in view of soils, water, climate, and comparative economics to understand the potential niche of barley under current and future climates and resource scenario. Barley group should try to improve elite varieties of malt and food barley for various quality traits. There is need to reinforce barley programme with more emphasis on developing transgressive genotypes using genomic assisted breeding. Work on natural farming and organic farming should also be started in barley.	Agreed as per the Institute mandate
11	Newly recruited staff at collaborating institutes and SAUs should be trained regularly for data recording and analysis.	Agreed as per ICAR guideline

Action taken on the recommendations of 28th RAC (27 October, 2023)

S. No.	Recommendations	Action taken
1.	Basic research should be promoted and focused on development of mega/single varieties which have multiple features such as abiotic/ biotic stress (multiple disease) and heat tolerance and biofortified as per vision 2030/2050. Advance technologies like precise phenotyping, chip-based studies, speed breeding, genome editing *etc.* may be combined to develop such varieties. Efforts be made to do high throughput gene-based identification of QTLs in wheat.	• Haplotype mapping of significant and stable SNPs (identified through GWAS)- performed to understand the genetic basis of yield traits, focusing on SNPs affecting yield. • Genomic regions governing grain protein content, agronomic characters (1000 kernel weight, NDVI, days to heading, grain filling duration, grain number/spike, grain weight/spike, plant height) and grain yield were investigated in a set of 280 elite bread wheat genotypes and checks, genotyped using a 35K SNP chip, along with multilocation precision phenotyping. The GWAS analysis showed MTAs (Bonferroni corrected) on 15 chromosomes representing all three wheat sub-genomes. • In silico analysis revealed that the SNPs were located on important putative candidate genes for agronomic traits. • One bi-parental population, HD2967/WH542 has been genotyped using 3.9K DArT SNP panel. Phenotyping of the population for grain traits was done at Karnal during 2023-24. Multi-location phenotyping will be carried out during 2024-25. • For rapid generation advancement facility at ICAR-IIWBR Karnal, a proposal has been submitted to BMGF as next phase of AGG.
2.	Efforts should be made for system-based research through collaboration with relevant NRM institutions of ICAR. IIWBR should start a focussed program for tailoring genotypes for conservation agriculture/regenerative agriculture/natural farming/ organic farming. Standardization of complete package of practices from sowing to harvesting for wheat and barley under natural/organic farming. Long term experiments be conducted under natural/organic farming for data generation including monitoring of soil health and grain/nutritional quality *etc*. A case should be made for	• For system-based research, collaboration has been made with ICAR-IIFSR. Seed of the IIWBR varieties has been supplied and collaborative work is being undertaken during the current crop season. The screening of varieties for conservation agriculture and organic farming is being undertaken. • For regenerative agriculture/natural farming, the development and screening of genotypes is scheduled from the cropping season 2024-25. However, some indications are available by experimenting with 4 genotypes during testing in the initial years. As suggested, the long-term experiments under natural/organic farming are in progress. • For larger uptake of RDD by farmers, two MOUs have been signed with machine manufacturers and in an effort to look for subsidy, interaction was made with Secretary Agriculture, UP Govt. and the procedural details were discussed.

	rotary disc drill machine to come under subsidy program of Government for its larger uptake by the farmers.	
3.	Studies should be taken up on the efficacy of pesticide sprays with drone *vs.* normal pump sprays to evaluate the saving, if any, in terms of dosage, efficacy, economy etc.	• Studies for the efficacy of pesticide sprays with suing normal pump spray is being carried out and will be taken up with drone in collaboration with extension division. • State Department of Agriculture and KVKs are extensively working on drone technologies. ICAR-IIWBR, Karnal has trained 4 of its staff as pilots for drones. In ensuing crop season, it will be undertaken on pilot basis at farmers' field. • An interaction with CEO of "DRIISHYA" (Govt. of Haryana initiative) was done to facilitate drone related activities.
4.	Survey and surveillance for crop health and pest monitoring be taken up under changing climate using modern tools like drone technology following relevant regulations.	• Survey and surveillance for crop health and pest monitoring is being initiated this year with reference to the drone technology following relevant regulations in collaboration with extension division. • One demo of drone was organized in Mar, 2024 by extension division • Crop health monitoring in Leh and Kargil districts of Ladakh UT was accomplished in the month of August (August 4-10, 2024). A total of 14 yellow rust (wheat), 03 yellow rust (barley), 01 brown rust (wheat), and 19 loose smut (wheat) samples were collected form 55 different locations of Ladakh. *Puccinia triticina* pathotype 104A (21R31) was identified in a sample collected from a village Chuchot Gongma in Leh district. Yellow rust (wheat and barley) and loose smut samples are now being analyzed.
5.	The model seed distribution system evolved by the Institute should be augmented by roping in public, private and NGO sectors.	• Public (Govt.- 17, KVKs- 15; ICAR-Institutes- 6; SAUs- 9), private (total 424 private seed companies under MoAs), FPC/FPOs (10) and NGOs (4) were roped in for seed distribution, dissemination, and deployment of IIWBR wheat and Barley varieties. • Total 23551 farmers registered for seed on IIWBR Seed portal during 2024-25
6.	Technological and scientific data of ICAR-IIWBR should be documented in English and Hindi in the form of articles, bulletins, leaflets, documentary films etc. The impact of climate resilient varieties and natural resource management technologies in wheat in	• The scientific data of ICAR-IIWBR, are regularly documented in English and Hindi in the form of research papers, articles, bulletins, and leaflets: • 1. Publications more than 6 NAAS rating: 36 • 2. Publications less than 6 NAAS rating: 2 • 3. Books: 02 (including 1 in Hindi- Gaihoon awm Jau Swarnima) • 4. Book chapters: 09 • 5. Leaflets/folders/bulletins:02 • 6. Training/lab manuals: 02

	terms of economic and ecological benefits may also be assessed and documented.	• 7. Documentary videos: 01 • 8. Radio/TV talks: 03 • 9. Gahoon awm Jau Sandesh issues published: 12 (2): Jul-Dec, 2023 • 10 Climate resilient varieties bulletin: 01 • To access the adoption and diffusion of climate resilient varieties (CRV) in Haryana and Punjab, an extensive survey of all the districts of Haryana & Punjab covering 1100 farmers, was carried out during Dec 2023. • The impact of CRV and NRM technologies in wheat in terms of economic and ecological benefits is in progress. Impact of climate resilient wheat varieties (DBW187, DBW222, DBW303 & DBW327) was assessed in collaboration with Dr Suresh Kumar (CSSRI). A draft report is being made ready on combined impact of these varieties.
7.	Explore market opportunities for commercial production of barley and develop comprehensive strategy for its area expansion. The scientific data generated/available so far for the promotion of barley should be compiled in English and Hindi and disseminated through appropriate social/print/electronic media. Efforts should be made to pursue inclusion of barley in "Shree Anna" in view of its nutritional value and potential.	• Information dissemination regarding barley has been done to extension workers, agriculture officers FPOs in Punjab, Haryana, and Uttar Pradesh on the health benefits of barley. An FPO of western UP has processed 7 q of hulless barley into *dalia* by IIWBR intervention. • Literature in Hindi, English, and Punjabi for effective communication of the health benefits of barley was prepared. • To streamline inclusion of barley in the 'Shree Anna', greater emphasis has been laid out to develop and distribute hulless barley varieties. In this effort, DWRB223 has recently been identified by VIC.