

ICAR-Indian Institute of Wheat and Barley Research

**Proceedings of the 25th Meeting of
Research Advisory Committee**

Held in Virtual Mode on February 23, 2021

At

ICAR-IIWBR, Karnal-132001, Haryana

Proceedings of the 25th RAC Meeting held in Virtual Mode on February 23, 2021 at ICAR-IIWBR, Karnal

The 25th Research Advisory Committee (RAC) meeting of ICAR-Indian Institute of Wheat and Barley Research organised in the virtual mode due to COVID-19 situation on February 23, 2021. The following members of RAC committee attended the meeting:

Dr. HS Dhaliwal, Former Vice Chancellor, Eternal University, Sirmour, HP	Chairman
Dr. Vidya Gupta Former Head, Biosciences Division, NCL, Pune	Member
Dr. D.V. Singh Former Head, Plant Pathology, ICAR-IARI, New Delhi	Member
Dr. A.R. Sharma, Director Research, RLBCAU, Jhansi, Former Director, ICAR-DWR, Jabalpur	Member
Dr. P. Kumar Former Head, Division of Agricultural Economics, ICAR- IARI, New Delhi	Member
Dr. N.S. Bains Director Research, PAU, Ludhiana	Member
Dr. GP Singh, Director ICAR-Indian Institute of Wheat and Barley Research, Karnal	Member
Dr. YP Singh, Assistant Director General (FFC) ICAR, Krishi Bhawan, New Delhi	Member
Sh. Ram Pal Rana, Kaithal, Haryana	Farmer Representative
Sh. Darshan Singh, Barnala, Punjab	Farmer Representative
Dr. Bhudeva Singh Tyagi, Principal Scientist, ICAR-IIWBR, Karnal	Member Secretary

The meeting was also attended by the Principal Investigators of various disciplines, Zonal Coordinators and the Scientists of ICAR-IIWBR, Karnal including the representatives of its Regional Station, Flowerdale, Shimla and Hisar.

The 25th meeting of the Research Advisory Committee (RAC) was chaired by Dr. HS Dhaliwal. Amidst COVID-19 the meeting was organised in Virtual Mode. At the outset, Dr. BS Tyagi, Member Secretary of the RAC meeting welcomed the Chairman and Members of the RAC. Subsequently, Dr. GP Singh, Director, ICAR-IIWBR greeted the RAC members and presented a comprehensive overview of wheat and barley research of the institute and AICW&BIP during the previous year. Following the presentation by the Director on significant achievement, Dr. HS Dhaliwal congratulated on the overall progress and mentioned that ICAR-IIWBR has initiated research on all frontier areas in wheat and barley research. The Chairman further shared the significant achievements of Dr. Sanjaya Rajaram in wheat improvement to the house and one minute silence was observed on account of the sudden demise of Dr. Sanjaya Rajaram in Mexico last week.

Dr. BS Tyagi, then, presented the Action Taken Report (ATR) for the recommendations given by the 24th RAC held in October 2019. The ATR was accepted by the committee and congratulated the staff for good work.

Following the presentation of the ATR, Dr. HS Dhaliwal said that to feed the growing population we need more than 1% genetic gain. He also mentioned about the identification and use of nitrogen fixing endophytes in cereals, research on dual purpose barley and work on mutation based herbicide tolerance. Following his comments, members of the RAC offered their suggestions and remarks.

Dr. DV Singh congratulated the team for identification of the Lr80 gene. Dr. P Kumar enlightened the house that the total factor productivity (TFP) is highest in wheat among all the crops and the future demand for wheat, by 2050, will surpass rice and research priorities should be set accordingly. In continuation, he said that returns on investment in wheat research should be estimated regularly to fetch additional budget from the Council. He was of the opinion that the national productivity level should be around five tonnes per hectare to fulfil the food demand by 2050.

Dr. AR Sharma was satisfied over the progress of wheat and barley research with respect to resource management and promised to offer his comments after the section wise presentation. He suggested that a summary of the salient achievements be made available to the members RAC before the meeting. Dr. Vidya Gupta appreciated the work on molecular research, especially on CRISPR/Cas-9, a promising tool on wheat improvement and congratulated ICAR-IIWBR for standardising the technique. Dr. YP Singh (ADG, FFC) said in his remarks that ICAR-IIWBR is one of the best institutes under the umbrella of ICAR for its significant contribution in research and outreach activities.

Finally, Dr. GP Singh addressed some of the queries raised by the 25th RAC like the progress in Karnal Bunt research and exports, bioavailability of micronutrients, rust situation and impact of Lr80 gene, improvement of Rotary Disc Drill (RDD), the concern of cultivating wheat at the cost of barley in Bundelkhand region, genetic diversity of tetraploid wheat over hexaploid wheat. All the members of the RAC unanimously appreciated the progress and change in the quality of publications since the past four years. Subsequently, Dr. HS Dhaliwal invited Dr. Gyanendra Singh, PI, Crop Improvement to present the salient achievements (2015-20) and proposed projects (2020-2025).

Dr. Gyanendra Singh, PI, Crop Improvement presented the progress of projects (RPP III) from 2015-2020 and newly formulated projects (RPPI, 2020-2025) of crop improvement division. He explained the house about the significant outcomes of breeding, biotechnology, seed and physiology projects in terms of varieties, technologies and publications. Dr. Dhaliwal appreciated the work of crop improvement division and asked about the collaboration of CIMMYT and ICARDA with ICAR-IIWBR. He also mentioned about the new translocations if any as has been the 1B/1R in recently released varieties. He advocated about the shuttle breeding and material sharing between cooperating centres across India, the extent of diversity of crossing lines used and application of artificial intelligence in wheat. Dr. GP Singh mentioned that >2500 lines of wheat and barley have been shared from CIMMYT and ICARDA with IIWBR and the shuttle breeding and material sharing is a continuous process between IIWBR and AICRP centres and many varieties including DDW 47, DBW 252 and DBW168 are the results of shuttle breeding. He also emphasised that IIWBR also shares elite lines with AICRP centres through national nurseries. He said that 35K

SNP genotyping has been done for crossing block genotypes and found them as highly diverse. The exploration for use of artificial intelligence in precision phenotyping and the disease forecasting are under progress. Dr. AR Sharma asked whether genotypes for conservation agriculture (CA) should be different or routinely recommended genotypes can be used in CA?. Dr. GP Singh said that the genotypes of conventional breeding are good for CA also and it has been validated at Karnal and Hisar farms and recently the developed diverse genotypes are doing well under all types of cultivation practices. Dr. Vidya Gupta asked about the previous programme of Association Mapping (AM) at IIWBR and also said if indigenous genotypes are more rust resistant. Dr. Ratan Tiwari mentioned that MAS work has been advanced to GWAS as genome sequence information is available and also added a new set of genotypes along with the exotic lines. He also mentioned that the characterization of indigenous collections for biotic, abiotic stresses and for resource use efficiency are underway and identified genic regions will be used in breeding. He mentioned that a large set of data have been developed in abiotic and biotic stress phenotyping which can be used for artificial intelligence. Dr. NS Bains emphasised that focused effort is required for application of artificial intelligence in wheat. Mechanism/basis for high yield expression in HYPT trials has to be elucidated and also enquired on presence of alternate dwarfing genes in commercial varieties. All RAC members appreciated the progress of completed projects and endorsed the newly constituted projects of the division.

Dr. Sudheer Kumar PI, Crop Protection presented the progress of crop protection projects (RPP III) from 2015-2020 and newly formed projects (RPPI, 2020-2025) of crop protection division. He mentioned the key progress of crop protection division in terms of disease and pest monitoring and research. Dr. DV Singh appreciated the work of pathologists and enquired about how the *Fusarium* blight, head scab and head blight are managed in zero tillage and the occurrence and severity of Powdery mildew in wheat. He wondered and asked the reason that why the incidence of Karnal bunt is increasing. Dr. Sudheer Kumar mentioned that genotypes are screened regularly for *Fusarium* blight, head scab, head blight and powdery mildew and tolerant genotypes are identified. Hence, they are managed well. He also mentioned that due to rainfall during anthesis the incidence of Karnal bunt was increased. Dr. DV Singh mentioned that blast is managed well but the symptoms have to be reported carefully in fields. Dr. AR Sharma asked about the pest and disease dynamics in residue management and emphasised on developing a bulletin for insect pest and disease management in conservation agriculture. Dr. Sudheer Kumar and Dr. Poonam Jasrotia explained about dynamics of pest and diseases under conservation agriculture and agreed to develop a bulletin for the same. Dr. Dhaliwal emphasised to take up work on Powdery mildew and Karnal bunt resistance breeding and to develop mapping populations for blast resistance. He also emphasised on mapping genes for aphid resistance in *Aegilops tauschii* and Dr. Vidya Gupta mentioned that proteomic studies have to be done for *bipolaris*.

Dr. SC Bhardwaj, Head, regional station, Flowerdale Shimla, presented the progress of crop protection projects (RPP III) from 2015-2020 and newly formed projects (RPPI, 2020-2025) at IIWBR, Shimla. RAC members appreciated the research work at RS Shimla and Dr. Dhaliwal reiterated the identification of tolerant lines for Powdery mildew resistance and continuous use of engineered IRS.1BL lines without sticky dough for increasing wheat yield. Dr. DV Singh also suggested that the pathology posts particularly Nematology be filled as soon as possible. Dr. GP Singh said that the information has been sent to the council.

Dr. SC Tripathi (PI, Resource Management) presented the report on significant achievements followed by the proposed project for the next five years. Dr. SC Tripathi informed the house about

various research sub-projects conducted under the resource management addressing mainly on Conservation Agriculture. He informed the house about various chemicals and their combinations being tested at experimental plots as probable weedicides for controlling weed menace in wheat as well as herbicide tolerance to some of the weeds like *Phalaris minor*. In alignment with the government “per drop more crop” mission, micro irrigation methods were evaluated and assessed for their economic feasibility. The RAC suggested soil test-based fertilizer application to increase the nutrient use efficiency, to focus on herbicide tolerance issue by developing a user-friendly kit to test at field level, integrated research on zero tillage + residue management + cover cropping + crop rotation as zero tillage reduces weed, to explore the usage of Artificial Intelligence in weed management and to make available the Rotary Disc Drill in a large scale after refinement.

Dr. Sewa Ram, PI, Quality and basic sciences, ICAR-IIWBR, presented the progress of Quality projects (RPP III) from 2015-2020 and newly formed projects (RPPI, 2020-2025) at quality division. He explained the house on significant findings in terms of identifying genotypes for different quality traits and progress in biofortification for improving Fe and Zn content in wheat. RAC members appreciated the research work on quality and basic sciences. Dr. Dhaliwal emphasised for listing the varieties with low phytase activity for larger usage and also mentioned that resistant starch research has to be given importance.

Dr. RPS Verma (PI, Barley) presented the progress of the barley coordination programme. He presented the status on production, productivity and quality in barley, new varieties and genetic stocks released, interaction with companies for sending materials to them, barley germplasm activities, working on competing with international standards of malt barley, finding entries for host resistance and new chemicals identified for insect and weeds control. At the end he emphasized that barley should be promoted for cultivation as a nutritional crop in a large area.

Dr. Anuj Kumar (PS, Social Sciences) presented the salient findings of the past research projects (2015-2020) including the impact of FLD's at farmers' field, followed by the proposed projects (2020-2025) on perspectives of crop residue management and impact assessment of ICAR-IIWBR technologies. In his presentation, he informed the house that 98 percent of allotted wheat FLDs were conducted and in the case of barley, it was 92 percent. He also presented the high yielding varieties in both wheat (HI 8759 77 q/ha in CZ) and barley (RD 2907: 67.50 q/ha at NWPZ) at different zones and levels of yield gap between demonstrated technology and farmers' practice. Further, he emphasized that FLDs were much pertinent for technology percolation, yield gain, capacity building of farmers which ultimately gets reflected on income and food security, but the MoA&FW did not sanction the wheat FLDs for the ongoing season. He also presented various outreach activities done by the unit amidst COVID-19. Dr. P Kumar highlighted the progress despite limited manpower and suggested to estimate the returns to investment, total factor productivity, sources of genetic gain, impact assessment of latest technologies, effects of climate change, demand and supply estimation along with elasticity coefficients and price policy for optimization of resources and enhanced profitability.

Post presentation of all the PI's of different divisions, there was a detailed discussion by all the Members of the RAC to offer recommendations for wheat and barley improvement. The following specific / general recommendations emerged from the 25th meeting of the RAC.

Crop Improvement

1. The ongoing shuttle breeding programme of IIWBR should be further strengthened and wheat scientists from cooperating centers may visit IIWBR, Karnal for selecting material. This is necessary as many centers lack the staff, appropriate germplasm, resources and epiphytic facilities.
2. The work on germplasm enhancement and pre-breeding through wide hybridization using secondary and tertiary wheat germplasm donors should be strengthened at IIWBR and SAUs.
3. With comfortable buffer stock in India, now the major emphasis should be on improvement of nutritional quality and biofortification in the high yielding backgrounds.
4. MicroRNAs / dsRNA techniques may be studied for various abiotic stresses.
5. GWAS work should be continued at IIWBR, Karnal. The work taken up on CRISPR-Cas 9 for gene editing as per the recommendations of the previous RAC should be further strengthened by including more traits in collaboration with other universities and institutions.

Quality and Basic Sciences

6. With comfortable buffer stock in India, now the major emphasis should be on improvement of nutritional quality in the high yielding background for traits such as biofortification for micronutrients, low phytic acid, high protein, lower hardness index, resistant starch, high anthocyanin and absence of celiac specific gliadin epitopes etc.
7. More emphasis should be given to barley improvement for yield, malting and nutritional quality as it is a crop more resilient under global warming era.
8. Any recombinant/ translocation without Secalin locus (responsible for wheat dough stickiness and poor bread making quality) should be extensively used.

Crop Protection

9. Aphid complex has been causing significant yield losses and deterioration of grain quality in wheat and barley. Some *Aegilops tauschii* (DD) accessions with aphid tolerance already identified and the other hexaploid synthetics should be used for this purpose.
10. The genetic basis for stripe rust resistance in wheat is still very narrow comprising only a few effective genes from exotic sources. It needs to be further strengthened by identifying more genes.
11. The work on breeding for powdery mildew and Karnal bunt resistance should be taken up by IIWBR in collaboration with other SAUs.

Resource Management

12. Work done by IIWBR on conservation agriculture in wheat-based systems be outscaled so that CA is followed as a general practice for cultivation of wheat. It should be promoted through the FLDs.
13. Artificial intelligence based experiments for soil conditions, fertigation, genotypes and weather conditions to be continued for predictive assessment of irrigations, epidemics and genotype selection.
14. For controlling weeds especially the species which have developed resistance to the existing herbicides, integrated management strategy involving non-chemical approaches such as

zero-till seeding, residue mulching, cover cropping with legumes and crop rotation (wherever possible) along with rational use of suitable herbicide should be followed.

15. Work on innovative application techniques of herbicide using artificial intelligence may be explored in collaboration with other institutions.
16. Roto-disc drill appears to be an improvement over the Turbo Happy Seeder as it can work in heavy residue load including sugarcane trash, wet residue or wet soil and with lower energy requirements. Therefore, this machine should be promoted and commercialized for large scale adoption across different regions of the country.

Social Sciences

17. The impact assessment of wheat barley technology be carried and the estimated returns to the investment on wheat & barley research be calculated.
18. The demand and supply elasticity for wheat and barley be estimated and projections of demand & supply for wheat and barley be made.

The 25th RAC meeting wrapped up with the remarks and thanks to all the participants by Dr.GP Singh, Director, ICAR-IIWBR, wherein he said all recommendations were noted and thanked the RAC for sharing their wisdom and appreciation over the progress of wheat and barley research. Dr. BS Tyagi delivered the vote of thanks and closed the virtual meeting of the 25th RAC.



(BS Tyagi)
Member Secretary



(HS Dhaliwal)
Chairman

Action Taken Report of 24th RAC Meeting

The 24th Research Advisory Committee (RAC) meeting was held at the ICAR-Indian Institute of Wheat and Barley Research, Karnal during October 10-12, 2019. The ATR of the recommendations given by the RAC is given here under.

SN	Recommendation	Action Taken
1.	Annual genetic gain in wheat productivity (in India) should be worked out and a strategy be developed for increasing the same.	The annual genetic gain of about 0.8% is estimated based on long term calculations (5-6 decades) and the same trend is continuing. The positive trend of productivity and production during last 4-5 years are very encouraging. New initiatives namely HYPT, targeting early sowing and varieties with wider sowing regimes will contribute to increase in annual genetic gains.
2.	Research work on biotechnology with emphasis on CRISPER-based genome editing and speed breeding be strengthened.	The CRISPR/CAS9 genome editing system has been established in wheat at ICAR- IIWBR. The validation of two negative regulator genes for Grain weight (<i>GW2</i>) and Male sterility (<i>MS1</i>) in wheat has been undertaken.
3.	Fertilizer based biofortification is a faster way to increase the grain quality. Therefore, research work on ferti-fortification of Fe and Zn through foliar spray should be undertaken and correlation between Fe/Zn & protein content should be studied in detail.	Agronomic Biofortification experiments were conducted at Karnal, Dharwad and Indore. The foliar spray of Fe and Zn led to significant increase in content of both Fe and Zn and also the improvement in grain protein content. Significant positive correlations were observed among Fe, Zn and Protein content in grains. At Karnal, two Sprays of 0.5% ZnSO ₄ (2 kg per hectare) significantly increased Zn and protein content in grains.
4.	Soil health has remained neglected for a long time and therefore nutrient balance in the soil should be worked out. Also get microbial consortia from IARI, New Delhi and establish a compost unit at IIWBR, Karnal.	Long term nutrient management experiments at IIWBR, Karnal; integrated nutrient management consisting of recommended dose of fertilizer along with FYM, green manuring and residue retention have improved the wheat based system productivity and soil fertility. This is evident from soil organic carbon has increase from 0.3% to 0.7% in a span of seven years. Composting pit has been developed and maintained at IIWBR. Work on microbiome effects on abiotic stresses and soil chemical composition is being carried out.
5.	Research work on dual purpose wheat / barley (for fodder & grain) may be started from next year in the hills.	Implemented after discussion in 59 th AICRP workshop. One treatment for cut at 70-75 days after sowing, for green forage was taken in two replications in the existing NH Zone barley trials.
6.	Yield maximizing trials should be conducted in all the zones.	High yield potential trials (HYPT) were conducted in NWPZ and now have been extended to CZ by including HYV under early sown, high fertility irrigated conditions and growth retardant application (RDF). Also a pre-HYT has been initiated this season.
7.	New genes for all the three rusts be identified and pursued relentlessly to continue to checkmate rust in India.	Rusts are the most devastating disease of wheat that can cause heavy yield losses under favourable weather. Recently a new gene <i>Lr80</i> has been identified by IIWBR, Shimla centre which is effective against leaf rust. It was identified from landrace Hango-2, collected in 2006 from the Himalayan area of Hango, District Kinnaur, in HP. It is the

		<p>6th rust resistance gene reported from India (others being <i>Lr10</i>, <i>Lr48</i>, <i>Lr49</i>, <i>Lr57</i>, and <i>Lr58</i>).</p> <p><i>Lr80</i>, is being used to develop rust resistant genetic stocks and wheat varieties will help in creating diversity and management of leaf rust in India.</p>
8.	Promote malt-specific varieties of barley and the hull less barley (varieties) as nutri-cereals to increase the profitability of barley cultivation.	<p>The new malt barley variety DWRB 182 with standard malting and brewing specifications (lower grain and wort beta glucan, higher DP and FAN) has been released from the IIWBR for NWPZ by CVRC. Recently released huskless barley variety PL 891 has been included in FLD program for popularization. The IIWBR breeding program now has separate focus for feed and food barley from the malt barley improvement program.</p> <p>Also, the framers trainings were organized on malt barley production technology in Haryana and Rajasthan, under consultancy project with M/s AB InBev Ltd. (largest brewing company in world).</p>
9.	Strengthen research work on reducing adverse effects of climate change on wheat production and productivity in the country.	<p>Shuttle breeding approach is being taken up in all the breeding programs in eastern and warmer regions.</p> <p>Identification of genomic loci for heat and drought stresses using QTL mapping and GWAS studies has been carried. QTLs have been identified (Chr 3D, 6B) in the biparental mapping population using SNP markers for heat stress tolerance using WH730 as tolerant source.</p> <p>Stable loci for yield and contributing traits for drought tolerance demarcated on chromosomes 2B and 6B.</p> <p>Similarly, MABB approach is being used for introgression of major QTLs for drought tolerance into high yield varieties such as GW366, DBW38, and HD3086. SNP markers are being converted to KASP markers.</p> <p>Intensive work is being under taken to mitigate the adverse effect of climate change through conservation agriculture experimentation as well as other agronomic management options (micro irrigation, osmoregulators, growth regulators). We are popularizing Resource Conservation Technologies (RCTs) to address this issue.</p>
10.	Research on molecular biology of herbicide tolerance (in wheat) needs to be revisited as private sector has invested huge resources in this area and IIWBR should be clear about the objective of such study.	<p>Weeds cause serious problems and resistance has been reported in several weeds of wheat crop such as <i>Phalaris minor</i>, <i>Chenopodium album</i>, <i>Rumex dentatus</i>, <i>Polypogon monospliensis</i> etc. against herbicides. Molecular characterization of weed resistance to herbicides will help in designing the DNA-based markers.</p> <p>The molecular markers will help in the early detection of these resistant biotypes and is one of the most promising strategies to prevent the spread of herbicide resistant weeds.</p>
11.	Efforts on reducing 'Adoption Lag' in wheat varieties should be intensified.	<p>The seed multiplications have now been started right from AVT-II. Early minikit trial testing is being promoted. Seed multiplication through public-private partnership and use of mass media and social media for their popularization is being done.</p>
12.	Demonstration of 'Rotary Disc Seeder'	<p>Ten demonstrations of Rotary Disc Drill for wheat seeding</p>

	should be organized at large scale in farmer's fields in and around Karnal right from this crop season.	have been organised at Nabipur and Badarpur villages of Karnal district in sugarcane crop fields under late sown condition.
13.	IIWBR should pursue with ICAR HQ to bring out a special issue of <i>Kheti</i> or Indian Farming to commemorate the achievement of the goal of 100 million tons of wheat a year before the target 2020.	The proposal for release of commemorative stamp has been submitted to the council. The IIWBR has published bulletin/technical reports on achieving 100 million tons.