ICAR-Indian Institute of Wheat and Barley Research

Proceedings of the 27th Meeting of Research Advisory Committee

Held in Hybrid Mode on March 13, 2023

At

ICAR-IIWBR, Karnal-132001, Haryana

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(March 13, 2023)

The 27th meeting of Research Advisory Committee (RAC) of ICAR-Indian Institute of Wheat and Barley Research, Karnal was organised in the hybrid mode on March 13, 2023. The Chairman and three members (Dr. AR Sharma, Dr. DV Singh, Dr. Gyanendra Singh) attended the RAC in physical mode, while others attended the meeting in virtual mode. This time a representative from Seed Company was also invited to attend the meeting. Following team of RAC committee attended the meeting:

Dr. H.S. Dhaliwal, Former Vice Chancellor, Eternal University, Sirmour, HP	Chairman
Dr. A.R. Sharma Director Research, RLBCAU, Jhansi	Member
Dr. D.V. Singh Former Head, Plant Pathology, ICAR-IARI, New Delhi	Member
Dr. P. Kumar Former Head, Division of Agri. Economics, ICAR-IARI, New Delhi	Member
Dr. Gyanendra Singh, Director ICAR-Indian Institute of Wheat and Barley Research, Karnal	Member
Sh. Sunil Kalra, Prabhat Seeds, Nillokheri	Invited member
Sh. Darshan Singh, Nainewal, Punjab	Farmer Representative
Dr. Bhudeva Singh Tyagi, Principal Scientist, ICAR-IIWBR, Karnal	Member Secretary

The meeting was held under the Chairmanship of Professor H.S. Dhaliwal in hybrid mode at ICAR-IIWBR, Karnal. This time, Mr. Sunil Kalra, a private seed entrepreneur, also attended the meeting as stakeholder. At the outset, Dr. B.S. Tyagi, Member Secretary of the RAC meeting welcomed the Chairman and Members of the RAC, and presented the Action Taken Report on the recommendations made by the RAC last year. The ATR was accepted by the committee and congratulated the staff for good work.

Subsequently, Dr. Gyanendra Singh, Director, ICAR-IIWBR presented the salient research achievements of the institute and work plan for the next year.

This was followed by the work presentation by respective PIs of different divisions.

The Chairman appreciated that the most of priority areas of wheat and barley research are being addressed by the Institute, and congratulated the farmers, researchers and policy makers for expected record production during 2022-23. Dr. Dhaliwal was fascinated to see the High

Yield Potential Trial and the Pre-breeding work at ICAR-IIWBR. He felt satisfaction that ICAR-IIWBR is working on bread wheat as well as durum wheats, and a number of Biofortified and climate resilient varieties have been released which are popular among farmers. The Institute is releasing pan India varieties for wheat and barley. He suggested giving little more emphasis to pre-breeding work and gene editing techniques in wheat.

Dr. A.R. Sharma was happy to note that IIWBR is dealing with all the emerging aspects of resource management including nutrient management, weed management, water-use efficiency and conservation agriculture covering tillage and residue management through the in-house research projects and externally-funded projects. Various devices like chlorophyll II SPAD, Greene seeker, and Dualax meter are being used for precise N application and show promise for precision agriculture saving 50% N in rice and wheat. Dr. Sharma opined that that paraquat + glufosinate can be an alternative to glyphosate for non-selective weed control. During the discussion, it was pointed out that herbicide combinations involving pyroxasulfone for controlling diverse weed flora and multiple-herbicide resistant *Phalaris minor* are better. Technology of ZT + residue retention further reduced weed infestation. Residue retention significantly improved yield and WUE of wheat. Rotary Disc Drill (RDD) also proved its superiority in terms of fuel saving and working with a lower HP tractor. The house was informed that natural farming experiment on wheat has been initiated wherein the yield, quality and soil related parameters will be studied.

Dr. DV Singh was happy to note that a new gene for leaf rust (*Lr*80) has been identified and characterized by ICAR-IIWBR. He emphasized to study the epidemiology of rusts and other diseases of importance. A strict vigil through survey and surveillance programme helped in averting epidemics during last six decades in the country. Post harvest analysis for Karnal bunt and other diseases should continue as knowing the status is important having its affect on trade. Work on molecular aspects and characterization of rusts pathotypes and identification of resistance genes at IIWBR, Regional Station, Flowerdale, Shimla is highly appreciable.

The members made some general suggestions as follows:

1. The Chairman emphasized to work on down regulating negatively regulatory genes for yield components, biotic and abiotic stress tolerance and nutritional quality traits through CRISPR-Cas9 and to enhance bio-availability of Iron.
2. A realistic economic analysis along with other parameters of resource-use efficiency like soil health, water, nutrients, energy, weed control etc. should be carried out in all experiments, immediately after having scientists.
3. For mitigating terminal heat stress in wheat, the practices involving early sowing, zero-tillage, residue retention, micro-irrigation (drip or sprinkler) etc., besides the deployment climate resilient varieties were found useful and should be popularised.

4. Microbial inoculants found useful for heat & drought tolerance, salinity tolerance, termite control etc. should be evaluated under field conditions on a large scale.
5. The possibility for inclusion of millets especially the minor millets in wheat-based cropping systems may be explored in terms of yield, quality, economics and climate resilience.
6. Post-harvest analysis of wheat grain samples should be continued and there is need to demarcate KB areas for facilitating export.
7. Survey and surveillance programme in collaboration with co-operators of AICW&BIP and other national/international organizations should be strengthened further by use of digital technology and immediate follow up is of utmost importance for identification of any new disease/pest or new pathotype for its effective management.
8. Due to climate change and emergence of new pests, the systematic research efforts to know their effective management need to be explored. There is need to study the disease and pest dynamics under different resource conservation technologies (RCT's) as area under zero or minimum tillage is increasing in recent years.
9. Nematodes are very important and systematic research work is required for nematode management in collaboration with SAU's and other ICAR institutes.
10. Trainings for different stakeholders should be continued

After a long discussion by the RAC, the following recommendations were made:

1. Increasing the productivity of wheat will always remain priority area of research being one of the staple foods and from export perspective. Now our efforts should be to get higher productivity using sustainable and resource-use efficient varieties and technologies.
2. All the related non-progenitor species with distantly related genomes used for introgression of useful variability for various traits be introgress with recipient wheat and durum stocks capable of inducing homoeologous chromosome pairing. The mono *5B* and *ph1b* mutant of *Ph1* gene stocks are available with the Eternal University, Baru Sahib, HP should be obtained, maintained and utilized in wide hybridization programme for introgression of useful variability without any linkage drag.
3. Recombinants of *1RS.1BL* translocation without the secalin locus for sticky dough and with and without *Gli-B1* and *Glu-B3* are available in the Eternal University, Himachal Pradesh in HY wheat background which should be obtained and used in breeding programme as the major QTL for root traits on *1RS* lead to 5-10% increase in grain yield under abiotic heat and drought stresses.
4. Terminal heat stress in wheat is becoming a recurrent phenomenon in recent years. The beneficial effect of timely sowing, zero-tillage, residue retention, micro-irrigation and use of chemical sprays along with suitable varieties need to be assessed and quantified.

5. Some of the related wild species such as *Ae. speltoides, Ae ovate and Ae. tauschii* have been reported to have heat tolerance systems. Concerted multidisciplinary and institutional efforts should be made to characterize and introgress heat tolerance in wheat.
6. CRISPR-Cas9 system for gene editing with high frequency of *Agro bacterium* mediated transformation in a HY cultivar DBW 187, IIWBR Karnal be further strengthen its collaborative efforts to identify the genes for yield components (like GW2), disease and insect pest resistance, abiotic stress tolerance and improvement of nutritional quality traits for large scale gene and genome editing.
7. Emphasis should be given to enhance bioavailability of micro-nutrients by lowering grain phytic acid and enhancing phytase activity. The newly identified high grain phytase mutant in PBW 502 with comparable yield potential should be thoroughly characterized, mapped and shared for marker assisted breeding in HYVs.
8. The work on identification of novel QTL for important traits using GWAS, miRNAs, biodiversity analysis etc should be focused to map the QTL for marker assisted selection and pyramiding.
9. The long term study on CA involving ZT and in-situ residue recycling in wheat based cropping system should be critically reviewed, and the effects on crop productivity , resource use efficiency, pest dynamics and carbon and water footprints should be worked out.
10. Rotary Disc Drill (RDD) appears to have several advantages over other available seed drills for sowing wheat in residue retained conditions. Accordingly, immediate steps are needed to commercialize RDD so that heavy residue load of the previous crops of rice, maize, sugarcane etc. can be managed using a lower HP tractor in an efficient manner.
11. Bioagents and endophytes play an important role in managing biotic stresses and also improve the soil health. Therefore, research initiatives should be taken for exploring potential bioagents, and endophytes for sustainable and eco-friendly management of biotic stresses in wheat and barley.
12. Keeping into consideration the high incidence of Karnal Bunt in certain wheat surplus states and its zero tolerance in international trades in many countries the work on the identification, mapping and pyramiding of major genes for Karnal Bunt resistance should be taken up with collaboration with other SAUs and institutions to develop KB resistant cultivars. The cultivation of durum wheat and barley should be recommended in certain KB hot spot blocks including NWPZ.
13. There is a wide spread incidence of wheat aphid infestation and use of insecticidal spray for its control. The work on the aphid resistant/tolerant accessions of two related wild species *Aegilopes tauschii* and Ae ovate identified at IIWBR should be further strengthened for introgression and development of aphid resistant wheat cultivars.
14. A number of HY wheat cultivars with resistance to wheat blast have been identified. Efforts should be made to test some of these cultivars for their possible release in north-eastern

zone to provide a belt for checking the spread of blast pathogen to other adjoining areas of wheat cultivation.

15. Barley is a short duration and abiotic stress tolerant crop with useful variability for further improvement. Keeping in view the climate change the work on development of high yielding, lodging tolerant and good chapatti making hull less barley cultivars with erect flag leaves should be strengthened.
16. With very low incidence of leaf rust and high incidence of stripe rust, the major emphasis had shifted to identify new sources for stripe rust resistance and due to very narrow base of leaf rust resistance among the wheat cultivars in India it has started appearing again in high proportion. Efforts should be made to identify and deploy diverse sources of resistance for both the rusts.
17. The United Nations Organization has declared 2023 as the international year of Millets on behest of India which is growing a number of millets for food and feed. Most of the millet crops are grown in Kharif season under rainfed and marginal areas. The development of cropping systems of wheat-millets under rainfed cultivation may be explored.
18. Nano-Urea has shown variable and inconsistent results across locations. It is essential to generate authentic data on Nano-Urea and now also on Nano-DAP as well, which are being promoted for reducing dependence on chemical fertilizers and improving nutrient-use efficiency.

The meeting ended with the formal vote of thanks by Dr. BS Tyagi.

(BS Tyagi) Member Secretary	(HS Dhaliwal) Chairman RAC

Action Taken Report of 26th RAC Recommendations

ATR on recommendations of the 26th Research Advisory Committee (RAC) meeting of ICAR-Indian Institute of Wheat and Barley Research, Karnal, held on March 3-4, 2022 in a Virtual Mode.

SN	RAC recommendations	Action taken / Implementation
1.	All the related wild and cultivated wheat species used for introgression of useful variability for various traits should be listed with standard classification and genome symbols. During the use of non-parental wild species the system of homoeologous chromosome pairing should also be mentioned.	We are using proper genome symbols (as available in literature) for the wild species. The crosses are made trait specific and the selections are made in the backcross generations for the specific traits. About 300 wild species accessions have been genotyped using GWAS analysis and MTAs have been identified for heat tolerance. Analysis for drought tolerance is underway.
2.	Recombinants of 1RS.1BL without the secalin locus and with and without *Gli-B1 and Glu*-B3 be used in breeding programme as the major QTL for root traits on 1RS lead to 5-10% increase in grain yield.	We have requested to IARI, NBPGR and NRCPB for seeds. Still we have to get the seeds, however the MTA has been sent.
3.	CRISPR-Cas9 system and its modifications for gene editing are likely to be taken out of bio safety regulation at the international level as well in India and are being widely used for crop improvement through genome editing. With a standardised CRISPR-Cas9 system in a HY cultivar DBW187, IIWBR, Karnal should initiate collaborative efforts to identify the genes for yield components (like GW2), disease and insect pest resistance, abiotic stress tolerance and improvement of nutritional quality for large scale gene and genome editing.	Government of India has exempted the SDN1 and SDN2 method of Genome editing in crops from regulation as per the **Safety Assessment of Genome Edited Plants, Office Memorandum, F. No. C -12013/3/2020- CS-III dated 30.03.2022 issued by MoEF&CC, 2022.** ICAR-IIWBR is focusing research using SDN1 mediated CRISPR/Cas9 genome editing method. Presently, working on different genes associated with improving Grain yield (GW2), Fe and Zn (ITPK1) and Nitrogen use efficiency (ARE1) in wheat. New projects have been submitted for funding with DBT, Govt. of India and to ICAR for collaborative projects with CSIR and ICRISAT for improving abiotic stress and quality traits in wheat.
4.	Due to extremely low bioavailability of micronutrients especially iron and zinc in the monogastric animals and humans their biofortification and fertification in cereal crops including wheat may not alleviate their wide	Major emphasis has been given on enhancing bioavailability of Fe and Zn by reducing phytic acid and enhancing phytase levels in wheat. High phytase and low phytic acid mutants developed in the background of PBW 502 are being used in breeding programme along with high Fe and Zn and protein lines by three way as well as double crosses using high

	spread deficiency and hence major emphasis should be given to enhance their bioavailability by lowering grain phytic acid and enhancing phytase activity. The newly identified high grain phytase mutant with enhanced yield potential should be characterised and mapped for marker assisted breeding in HYVs as a priority.	yielding varieties namely DBW 187, DBW 222, HD 3086 etc. Materials are at different stages of development (BC1F1 to F5 stages). Major QTL for phyic acid in mutant with low phytic acid has been identified on chromosome 3A explaining 43 % of variability in phytic acid. The transgressive segregants having 5 fold more phytase levels (>3500 FTU/Kg) than PBW502 and lower phytic acid (<0.9%) have been identified. Further molecular analysis is being conducted to elucidate the mechanism of high phytase and low phytic acid levels in mutants for utilization in breeding using MAS.
5.	The ongoing and newly initiated work on improvement of nutritional and processing quality of wheat and barley should be further strengthened in collaboration with NABI, CTRI, NIN and SAUs for value addition and health security.	The ongoing and newly initiated work on improvement of nutritional and processing quality of wheat have been strengthened by including NABI and NIN in EFC funded project of ICAR. We have also submitted concept note for developing collaborative project between CSIR and ICAR collaboration involving CFTRI for value addition and health security. We have also initiated one inter-institutional project funded by DBT involving NABI, IARI, PAU and Meerut University and also submitted another project involving Eternal University as well. Work has been initiated on resistant starch and anthocyanin. Crosses have been attempted using coloured wheat lines developed by NABI and materials have reached to F5 stages.
6.	The work on the root endophytes', their identification and consortia for heat and drought tolerance in wheat and other crops should be emphasised.	Presently 16 bacterial endophytes and consortia of four bacteria are under pot scale evaluation for abetting both heat and drought stress in wheat. Further, six bacterial endophytes are at field scale testing for drought stress tolerance, and besides supporting plant growth these are also helping plants against termite infestation. These will be tested for other crops only after their proven effect on wheat crop.
7.	Ongoing work on the identification of novel QTL using GWAS, miRNAs, biodiversity analyses and Artificial Intelligence etc. should be further strengthened.	Work on Genome-wide identification of drought stress is ongoing. Also work on terminal heat stress has been initiated by taking two contrasting wheat genotypes (Raj3765-tolerant and HUW510-susceptible). Differential expression of 10 selected fungal stress responsive miRNAs and their targets was carried out during *Bipolaris*- wheat pathosystem. Work on identification of novel QTLs/ gene(s) for disease resistance (stripe rust, Karnal bunt, loose smut) is being taken up through bi-parental populations. A mapping

		population (HD2967/WH542) has also been developed for studying grain shape and size.
8.	A long-term study on CA involving ZT and in-situ residue recycling in wheat-based cropping system may be initiated, and the effects on crop productivity, resource-use efficiency (water, nutrients, energy) pest dynamics (insect, disease, weeds and natural enemies), and carbon and water footprints should be worked out.	The long-term experiments on CA involving ZT and in-situ residue recycling in wheat-based cropping system have been initiated. The effects on crop productivity, resource use efficiency, pest dynamics, carbon and water foot prints are being monitored. In double no till rice-wheat system, the infestation of *Rumex dentatus* and *Medicago denticulata* increased over the time. Whereas triple no till system in maize-wheat-greengram decreased the infestation of *Cyperus rotundus.* Continuous growing of maize-wheat – green gram under CA (7 years) enhanced the maize grain yield (5-7%), organic carbon content from 0.37 to 0.60% and saving of cost of cultivation Rs 7000-8000 per ha annually over non CA.
9.	Government of India is giving a lot of emphasis on organic farming and natural farming systems and want to adopt this technology on a large scale. A model encompassing these systems along with conventional and conservation agriculture may be developed at the Institute farm.	The long-term experiments (7 years) on organic farming data showed that basmati rice can be taken with use of 30 t/ha FYM application whereas wheat yield declined to 21% over RDF. In this period organic carbon content increased from 0.7 to 1.24 % in top soil and 0.39 to 0.68% in 15-30 cm soil depth by application 30 t FYM/ha in rice as well as in wheat. Natural farming experiment has been initiated this year (2022-23).
10.	Resistance to Karnal bunt is very limited. Identification of Karnal bunt resistant lines is very interesting. Therefore, it is suggested that these sources should be confirmed under high KB pressure under optimum conditions.	A set of more than 750 wheat lines (released varieties, landraces, germplasm from CIMMYT & Australia, genetic stocks registered for disease resistance etc.) are being screened for KB resistance at Karnal, Hisar, Ludhiana & Gurdaspur using artificial inoculations. A multi-parental population using 8 recipients and 8 donors is being used as genetic resource for management of Karnal bunt in wheat. This will be used for characterization of resistance and also for identification of high yielding KB resistant lines. A total 65 lines showed resistance under artificially inoculated field condition and these are being screened again in poly-house condition under artificial inoculation, high humidity and misting to confirm the resistance.
11.	Aphid resistant stocks and the related wild species such as *Aegilops tauschii* and *Ae. ovata* identified for aphid resistance/tolerance should be used	Both *Aegilops tauschii* and *Ae. ovate* are used in crossing programme. The aphid resistant accessions of *Ae. tauschii* have also been used in crossing. The material is in BC3F2 generation.

	in crossing programme.	
12.	The wheat blast pathogen is a hemibiotroph and resistance to this type of pathogens is very rare. Therefore, the confirmed resistance sources should be used in resistance breeding.	Wheat breeding material (AVT/NIVTs) is being evaluated for wheat blast resistance in Bangladesh and Bolivia in collaboration with CIMMYT, Mexico. The main source of resistance is "2NS" translocation from *Aegilopes ventricosa* which is also present in the Indian breeding material. The released wheat varieties DBW 173, DBW 187, HD 2967, HD3043, WB 02, HPBW 01, DPW621-50, DBW39, DBW88, GW322, HD3043, HD3059, HD3090, were found to be resistant "0 Score" to wheat blast pathogen. These genotypes are used in the breeding programmes to introgress blast resistance. > 20 genotypes of IIWBR, were found to be immune having "0"score in the wheat blast evaluations. IIWBR has registered genetic stocks namely BRW3806, DBW325 and DBW308 for wheat blast resistance with ICAR-NBPGR, New Delhi
13.	Epidemiology of rusts needs to be revisited in view of climate change and agronomic practices.	• About 50 aecial samples form Berberis spp. were collected from Shimla hills, none could infect wheat, barley or oat. • Likewise, 30 grass samples collected from wheat growing areas were avirulent on wheat, barley and oat.


Welcome
Chairman
and
Members
Research Advisory
Committee Meeting
13th March 2023


Research Advisory Committee Meeting


Research Advisory Committee Meeting