

ICAR-Indian Institute of Wheat and Barley Research

**Proceedings of the 26th Meeting of
Research Advisory Committee**

Held in Virtual Mode on March 3-4, 2022

At

ICAR-IIWBR, Karnal-132001, Haryana

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(March 3-4, 2022)**

The 26th meeting of Research Advisory Committee (RAC) of ICAR-Indian Institute of Wheat and Barley Research was organised in the virtual mode due to COVID-19 situation, during March 3-4, 2022. 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. GP Singh, Director ICAR-Indian Institute of Wheat and Barley Research, Karnal	Member
Dr. RK Singh, Assistant Director General (FFC) ICAR, Krishi Bhawan, New Delhi	Member
Sh. Ram Pal Rana, Kaithal, Haryana	Farmer Representative
Sh. Darshan Singh, Nainewal, 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 and the Scientists of ICAR-IIWBR, Karnal including the representatives of its Regional Station, Flowerdale, Shimla and Hisar.

The 26th 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. Dr. GP Singh, Director, ICAR-IIWBR also extended greetings to the Chairman and members of RAC and briefed about the research achievements of the institute. After the remarks of the Chairman and members, Dr. BS Tyagi presented the Action Taken Report (ATR) of the 25th RAC recommendations, which were accepted by the RAC.

Dr. GP Singh presented a comprehensive overview of wheat and barley research of the institute and AICW&BIP taken 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 the frontier areas in wheat and barley research.

Dr. GP Singh, Director, ICAR- IIWBR, presented the progress report of wheat and barley AICRP activities taken during the year. Dr. Singh mentioned the continuous sixth time record wheat production of 109.52 mt during 2020-21 in the country by deploying high yielding and disease resistant varieties, rust survey and surveillance and resource management practices. He presented that four states namely, Punjab

(48.62 q/ha), Haryana (48.36 q/ha), Rajasthan (36.76 q/ha) and Uttar Pradesh (36.04 q/ha) have shown higher productivity than the national average (34.64 q/ha). Dr. Singh shared the release of new high yielding wheat and barley varieties such as DBW327, DBW332, DWRB182, HI1636, GW513, and others and registration of 30 new genetic stocks for unique traits with ICAR-NBPGR. The progress on high demand of ICAR-IIWBR varieties in breeder seed chain, MoU for seed licensing (710), revenue generation (> 5.0 crores), unique seed portal, travelling seminars, capacity building, gene postulation of *Lr80* were also discussed by the Director. Dr. GP Singh further stressed upon quality traits like grain hardness, chapatti quality, sedimentation value and others of NWPZ wheat varieties are now *at par* with those of central India. He informed the house that the fine tuning and patent filing of the **improved rotary disc drill** and report on wheat and barley demonstrations are being taken on priority.

Dr. Gyanendra Singh, PI, Crop Improvement presented the highlights of the division. He informed about the release of 03 wheat varieties by CVRC and one by SVRC. Dr. Singh presented the work on pre breeding wherein wild species like *Aegilops mutica*, *Thinopyrum*, *Secale* and *Triticum* have been utilized for improving grain Zn, protein and Iron. Besides promotion of wheat lines to different NIVTs and AVTs, through conventional breeding approaches, he shared the work on marker/QTL for spot blotch and drought tolerance, endophytic bacteria, CRISPR-Cas9 editing for *Ms1* and *gw2* gene(s), wide hybridization, root physiological and anatomical studies, breeder seed indents and facilitating germplasm with the cooperating centres. The chairman and the members appreciated the work and suggested to further strengthen the work on wheat blast, Ug99, wild species, germplasm sharing, shuttle breeding, bacterial consortium preparation, SSR database, GWAS studies on network of genes and diversity of rust resistance genes.

Dr. Sudheer Kumar, PI, Crop Protection presented the progress on rust survey and surveillance, of IPPSN, PPSN, EPPSN, aphid screening and experiments on fusarium head blight, Karnal bunt, wheat rusts with other diseases. He informed the house that entries namely, DBW187, HD3249, HD2967 under IR-TS-NEPZ and DBW252, HD3293 and HD3171 under RI-TS-NEPZ conditions were included as these showed wheat blast resistance. The blast resistant varieties being grown in NWPZ namely, DBW173, DBW187, DBW222, DBW88, HD3043, HI1620, DBW303, WH1105 were also mentioned. Dr. Sudhir Kumar mentioned about the presence of *Pm35* gene for powdery mildew resistance in wheat varieties and also discussed effectiveness of chemicals like Fipronil and Trifloxystrobin for control of powdery mildew. The chairman suggested for inclusion of wild species for screening and introgression of biotic stress resistance and for more focus towards Karnal bunt work to support export from India.

Dr. SC Bhardwaj, Head, RS, Shimla presented the work on the discovery of new leaf rust gene *Lr80* from the local land race, Hango and mentioned also that the incidences of the YR races 238S119 and 110S119 increased than that the race 46S119 as observed from the sample analysis collected. Dr. Bhardwaj informed that the pathotypes, 11, 40A and 40-2 of stem rust and 77-9, 52-3 and 77-5 of leaf rust were prominent in the received samples. He informed the house about the new pathotype 57R39 and found that entries HD3407, PBW835 and PBW867 were resistant against all three rusts in SRT analysis. Dr. SC Bhardwaj discussed the presence of *Yr2+*, *9+*, *A+* and *18+* stripe rust genes, in combination of *Sr2+*, *Sr31+* of other gene(s) for stem rust and *Lr13+*, *10+*, *3+* and other leaf rust gene(s) in the Indian wheat materials. He further presented the molecular work on *Rph* gene(s) in barley. The chairman and members advised for rigorous survey and surveillance, systematic breeding for KB, biological control, nematode studies, use

of elongation factor with ITS in fusarium diversity analysis, mutation and pathogenicity for spot blotch, studies for individual tannins in entomological experiments, fungicide degradation studies and long term studies for pest and insect dynamics under conservation agriculture and zero tillage systems for crop protection division.

Dr. RPS Verma, PI, barley Improvement presented the progress of barley improvement, release of barley varieties and wide adoption and high breeder seed indents of barley variety DWRB137 for NEPZ, CZ and also release for NWPZ. He shared that 08 genetic stocks were also registered with ICAR-NBPGR for unique traits like aphid resistance, hullless and quality components. He reported the screening of the indigenous, exotic genotypes and collection of 562 genotypes from ICARDA against spot blotch, salinity, aphid resistance. Dr. Verma briefed about the experiments on N scheduling and malting quality characters. The RAC chairman suggested considering industrial traits in a holistic way for barley popularization.

Dr. SC Tripathi, PI, Resource Management presented the highlights of Resource Management division and informed that nearly 10% higher grain and biological yield under HYPT trials was recorded. He informed that the early sowing of 25 Oct. in CZ and PZ was not effective and being validated with more experimentation. He further shared the details on nano-fertilizers, cropping system, tillage practices, water use efficiency and herbicide management. Dr. Tripathi discussed that the herbicide containing Pyroxasulfone was found effective for weed control and the Pendimethalin application after irrigation was found more effective as compared with before irrigation. The wheat equivalent yields were similar under conservation agriculture and conventional tillage experiments. The chairman and members suggested to deploy micro-irrigation facilities at IIWBR farms, use of YMV resistant summer mung varieties, for organic farming experiments, long term experiments on tillage practices, pest, insect dynamics and soil quality studies in CA, demonstration of improved rotary disc drill, experiments on DSR and natural farming and to find out formulations of nano particle based fertilizers.

Dr. Sewa Ram, PI, Quality and Basic Sciences presented the work on high phytase and low phytic acid mutant lines. He discussed about the breeding work on Fe and Zn bio-fortification, bio-availability and increased zinc concentration with $ZnSO_4$ spray. Dr. Ram shared GBS sequencing of mutants and RIL lines, fortification with NaFeEDTA, amylose and amylopectin studies and studies on Celiac disease eliciting epitopes. He further presented the results of phenolic content degradation after baking of high anthocyanin genotypes and quality of pulses blended protein rich biscuits. The chairman and members enquired for any yield penalty studies of high phytase and low phytic acid mutant lines and to check the expression level of high phytase in leaves and grains for finding out precise molecular mechanisms. The RAC members also enquired about the coloured wheat flour acceptability by the consumers.

Dr. Satyavir Singh, PI, Social Sciences presented the work undertaken during the last year. 250 barley FLDs and 160 wheat demonstrations were conducted. He informed that various capacity building programmes, success stories and tribal subplan programmes were undertaken by the institute. He discussed the success stories of custom hiring centres and entrepreneurship development for the management of paddy stubbles. Dr. Satyavir Singh presented the superiority of wheat variety DBW222 and barley varieties, DWRB137, HBL713 and RD2907 in the demonstrations. Under impact assessment analysis, he reported that the wheat variety DBW187 has covered 6% wheat area with worth generation of INR599.15 crores, followed by DBW222 with 3.1% area and INR132.20 crores and barley variety with having 11% barley area with worth of Rs. 18.58 crores. The chairman and members asked for the detailed supply and demand estimates as presented during ATR. The chairman also opined that the RAC recommendations

and the Action Taken Report should be the part of Director's report for its wider coverage and implementation.

After the presentation, of work and achievements of all the divisions, a detailed discussion and interaction was held. The members of RAC opined that a summary of achievement should be provided in advance. Dr. AR Sharma was of the view that the RAC should be held in September before the sowing of wheat material and the Director Dr. GP Singh told that the earlier RAC has recommended to organise this meeting during crop season so that committee members could interact at the field level. Dr Dhaliwal was happy noting that production has increased over the last six years (109.52 MT wheat grains in 2021) due to increase in wheat productivity and area under wheat cultivation. A number of wheat and barley varieties with very high yield potential and disease resistance have been released for various wheat growing zones in the country. A new seedling leaf rust resistance gene Lr80 has been identified from an indigenous land race Hango, catalogued, mapped and tagged with molecular markers for marker assisted breeding.

After a long discussion it was decided that alongwith several previous suggestions and recommendations, the work on following new recommendations with more emphasis has to be taken up:

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. The generation and cytological status of the derivatives and the introgressed trait should be given.
2. Recombinants of 1RS.1BL without the secalin locus and with and without *Gli-B1* and *Glu-B3* are available in the Eternal University, Himachal Pradesh in HY wheat backgrounds 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.
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.
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 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.
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.

6. The work on the root endophytes', their identification and consortia for heat and drought tolerance in wheat and other crops should be emphasised.
7. Ongoing work on the identification of novel QTL using GWAS, miRNAs, biodiversity analyses and Artificial Intelligence etc. should be further strengthened.
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.
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.
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.
11. Aphid resistant stocks and the related wild species such as *Aegilops tauschii* and *Ae. ovata* identified for aphid resistance/tolerance should be used 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.
13. Epidemiology of rusts needs to be revisited in view of climate change and agronomic practices.

Dr. HS Dhaliwal and all the members of RAC appreciated the progress of the institute and the meeting ended with the formal vote of thanks by Dr. BS Tyagi.



(BS Tyagi)
Member Secretary



(HS Dhaliwal)
Chairman

Action Taken Report of 25th RAC Recommendations

ATR on recommendations of the 25th Research Advisory Committee (RAC) meeting of ICAR-Indian Institute of Wheat and Barley Research, Karnal, held on February 23, 2021 in a Virtual Mode.

SN	RAC recommendations	Action taken / Implementation
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.	120 advanced bulks from NWPZ programme were sent to SKAUST-K, Khudwani centre for yellow rust screening and utilization. 105 advanced bulks were supplied to Akola, Junagadh, Niphad, Ayodhya, Vijapur, Dharwad and Jabalpur during 2020-21 from warmer area programme. 50 advanced wheat genotypes were shared with 06 centres in NEPZ (Sabour, Coochbehar, Kalyani, Shillongani, Ranchi and Ayodhya) for evaluation under timely & late sown during 2021. Also, 122 genotypes were supplied for disease screening as part ABWB. Segregating nursery having F2 bulks was supplied to co-operating centres. A field week was organised at IIWBR for the scientists across India.
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.	400 accessions of wild wheat relatives and 100 Synthetic hexaploid wheats have been phenotyped for heat & drought tolerance and also for rust resistance. The identified lines are being utilized for introgression. About 100 new cross combinations were attempted and back-crossed. <i>Ae. Mutica</i> , <i>kotschyi</i> , <i>Thynopyrum</i> have been used in crossing program.
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.	Two new high yielding biofortified wheat varieties i.e. DBW327 (Karan Shivani) having high Fe (39.4ppm) and Zn (40.6 ppm) content and DBW332 (Karan Aditya) having high protein content (12.2%), along with high Fe (39.2 ppm) content were notified. Two new genetic stocks viz., Karan Poshan-1 with high grain zinc content (>70.4 ppm) and Karan Poshan-2 with high grain Iron content (>62 ppm) have been registered with the NBPGR and being supplied to the co-operators through NGSN for inclusion in crossing block.
4.	MicroRNAs / dsRNA techniques may be studied for various abiotic stresses.	Work on drought responsive miRNAs has been initiated with two contrasting wheat genotypes NI5439 (Drought tolerant) and WL711 (drought susceptible) and it will also be taken for other traits in coming time.
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	GWAS has been further strengthened by including traits such as spike fertility, water soluble carbohydrates and grain yield. The traits for improving grain Fe and Zn nutrition (ITPK1, VRN1, HRZ2 genes) and resistance starch (SBEII gene) have been included for SDN1 method of genome editing. A new NASF project has been proposed with IARI and ICGEB, New Delhi for further strengthening of genome editing research.

	traits in collaboration with other universities and institutions.	
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.	<p>For this purpose ICAR has initiated a project “CRP on Biofortification” for improving micronutrient (Fe and Zn) content, protein content, higher phytase and lower phytic acid levels.</p> <p>At IIWBR, high phytase and low phytic acid mutants in the background of PBW 502, have been developed and registered in NBPGR. These mutants are being used in breeding programme along with high Fe and Zn and protein lines by three way as well as double crosses. Materials are at different stages of development (F1 to F4 stages).</p> <p>High yielding lines with soft grain characteristics including Glu-D1 double null trait have been developed and registered at NBPGR and being used in crossing with released varieties. Work has been initiated on resistant starch and anthocyanin. More than 100 wheat varieties representing last 6 decades have been evaluated for CD toxic epitopes and data is being analyzed.</p>
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.	<p>Two new high yielding cultivars have been released during the year. Eight new genetic stocks for malting quality and nutritional value have been registered with NBPGR and utilised in hybridization.</p> <p>Parental lines with very low beta glucan have been identified meeting the global standards.</p> <p>One new scientist has been assigned full time with Barley work.</p>
8.	Any recombinant/ translocation without Secalin locus (responsible for wheat dough stickiness and poor bread making quality) should be extensively used.	<p>Recently 1B/1R translocation has been used less frequently and many of the recently developed wheat varieties do not have 1B/1R translocation and thus the quality of the varieties has improved significantly including reduced dough stickiness and better bread quality. Similarly sedimentation volume has increased by more than 15 cc as compared to 1B/1R translocation genotypes.</p> <p>We are trying to procure seeds of Secalin free translocation lines and crosses will be attempted at offseason nursery, at Dalang Maidan.</p>
9.	Aphid complex has been causing significant yield losses and deterioration of grain quality in wheat and barley. Some <i>Aegilops tauschii</i> (DD) accessions with aphid tolerance already identified and the other hexaploid synthetics should be used for this purpose.	<p>The screening of 198 <i>Aegilops</i> accessions was done against foliar aphids during four consecutive seasons i.e.2017-18 to 2020-21, wherein ten accessions belonging <i>Aegilops tauschii</i> and <i>A. ovata</i> were found resistant to foliar aphids. This year, screening of synthetic hexaploids against aphids has also been initiated. In barley two genetic stocks with aphid tolerance have been identified and registered.</p> <p>IIWBR Entomologist has taken it on priority and is also collaborating with the RPCAU Pusa.</p>
10.	The genetic basis for stripe rust resistance in wheat is still very	The work on identification of new rust resistance genes is being taken at IIWBR. To increase the diversity in yellow rust

	narrow comprising only a few effective genes from exotic sources. It needs to be further strengthened by identifying more genes	resistance genes from indigenous sources, besides the routine screening, 500 indigenous lines and landraces have been taken up. The lines found resistant are again screened to confirm the resistance. IIWBR, RS, Flowerdale Shimla is also working on yellow rust gene postulation and identification of new resistant gene.
11.	The work on breeding for powdery mildew and Karnal bunt resistance should be taken up by IIWBR in collaboration with other SAUs	200 lines are being screened every year at hot spot multilocations under artificially inoculated conditions or identification of resistance source against powdery mildew and Karnal bunt. Crop improvement and crop protection programs have initiated research project on resistance breeding for Karnal bunt and Powdery Mildew. The Malan and Shimla centers have been suggested to work on it.
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.	Demonstrations on CA are conducted in wheat under rice-wheat system. The wheat FLDS have not been allotted for last two years by MOAFW (2020-21 and 2021-22). However, at farmers' field near Karnal, this technology is being demonstrated.
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.	The work on these aspects involving weather based decision support system for irrigation scheduling, micro-irrigation, fertigation and genotype screening is in progress. The water requirement of the crop was calculated using a computer based programme CROPWAT 8.0, a decision support tool developed by the Land and Water Development Division of FAO. Out of 150, only 22 genotypes producing desirable yield and higher water productivity (> 2.0 kg/m ³) under soil moisture regimes of 60 per cent of CPE were selected.
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.	The experiments are being conducted involving ZT, residue retention and cover cropping for tackling the weed problem in rice-wheat system. The new herbicide options are also being explored for resistance management.
15.	Work on innovative application techniques of herbicide using artificial intelligence may be explored in collaboration with other institutions.	This work has been proposed under NePPA project of ICAR and the collaborative work will be carried out with the help of ICAR-IARI.
16.	Roto-disc drill appears to be an	The demonstrations on improved version of Rotary Disc Drill

	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.	are being conducted for its popularization. The patent has been filed and once granted, it will be commercialized, which will promote its adoption.
17.	The impact assessment of wheat and barley technology be carried and the estimated returns to the investment on wheat & barley research be calculated.	Impact assessment of wheat and barley technologies has been taken up for the wheat (DBW 187, DBW 222, and WB 02) and Barley varieties (DWRB 137) under in-house project "Promotion and Impact Evaluation of ICAR-IIWBR Technologies at Farmers Field". Using the economic surplus approach, it was found that DBW 187, DBW 222 and WB 02 respectively generated INR 599.15 crores, INR 132.20 crores, and INR 5.05 crores since their release (at constant price with base as 2011-12). For DWRB 137, it was 18.58 crores (at constant price with base as 2011-12).
18.	The demand and supply elasticity for wheat and barley be estimated and projections of demand & supply for wheat and barley be made.	The demand and supply elasticity for wheat is 0.34 and 0.22 respectively, and for barley it is 0.19 and 0.22, respectively. The demand projection (consumption) for wheat and barley is estimated about 125 mt and 2.2 mt, and the supply (production target) is around 140 mt and 2.5 mt, respectively for 2050.