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Director's Message

I extend my warm greetings and appreciation to the whole wheat and barley researchers for taking utmost care with incredible R&D support despite the incidence of the pandemic (COVID-19) to overcome all hindrances and showcasing a remarkable progress in wheat and barley improvement during the past season, 2019-20. I also applaud the extraordinary synergy between researchers and farmers for accomplishing their duties diligently and digitally which is being reflected on achieving the record wheat and barley production of 108.75 and 1.82 million tonnes, respectively (2020-21).

I am glad to share that ICAR-Indian Institute of Wheat and Barley Research (IIWBR), Karnal has initiated several pre-emptive measures for strengthening the multi-disciplinary and multi-location research to sustain and elevate the production and productivity of wheat and barley crops with a focus on enriching the nutritional quality. In this succession, first time, the All-India Wheat and Barley Research Workers meet was organised successfully at Karnal through virtual mode. In the online meeting, the Varietal Identification Committee has identified 10 wheat varieties and one barley variety for different production environments of India. To cater the seed demand from the farmers and stakeholders, ICAR-IIWBR established the online seed delivery portal for booking and rapid distribution of the seeds of latest wheat and barley varieties to the farmers across the country. During this period, MoU with 266 seed companies have been made to strengthen the seed delivery system. Moreover, the institute has also transformed its outreach activities, advisories and extension services to virtual mode by capitalizing the social media and other digital platforms in this pandemic situation. The institute received several awards during the reporting period including the Krishi Sansthan Samman Award by the Mahindra Group for outstanding contribution in transforming the Indian agriculture from scarcity to surplus. At this point, I also thank and acknowledge all our collaborators for their committed research in wheat and barley improvement and fulfilling the needs of diverse stakeholders. I also congratulate other Award winners from the ICAR-IIWBR in various forums and scientific meetings by bringing glory to the institution. It is pretty much certain that with the dynamic teamwork of all the employees, collaborators, farmers and stakeholders, we will be able to achieve the targets and showcase consistent progress.

I would like to appreciate the efforts of the editors of this volume of Wheat and Barley Newsletter that offers the glimpses of the research activities, meetings and events, distinguished visitors, awards and recognitions, and HRD programs executed at the ICAR-IIWBR in pellet form. I hope that this newsletter will serve as a common platform for sharing the updates of the on-going activities pertaining to wheat and barley research with an annotation that we look forward to another year of remarkable growth and development with significant milestones aligning with the mandate of the organisation.

Jai Kisan, Jai Vigyan!

(GP Singh)

RESEARCH NOTES

Co-expression of regulatory genes to improve abiotic stress tolerance in wheat

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To improve abiotic stress tolerance of wheat, modern approaches like molecular breeding and transgenesis are used to pyramid the traits. The present study attempts to over express three stress responsive transcriptional regulators (TRs) *viz.,* AhBTF3, AhNF-YA7 and EcSAP-ZF to enhance cellular tolerance of wheat under multiple abiotic stress conditions. *Agrobacterium* strain (EHA105) harbouring binary vector pi12GW having three abiotic stress-responsive genes *(AhBTF3, AhNF-YA7* and *EcSAP-ZF)* in addition to *AKR1* as a selectable marker gene was utilized to transfer calli obtained from mature embryos. The standard transformation protocol was followed. The gene transformation was done in wheat genotype HD3086 to generate putative transgenic plants. The callus induction, regeneration and plantlet recovery efficiency was 86% for multiple genes construct infected explants. The putative transgenic plants tolerant to glyphosate were confirmed for transgene integration and expression. Genomic PCR assay using different combination of gene specific primers conferred the integration of the transgenes into wheat genome (Figure 1). On the basis of PCR positives for transgene insertion, overall 16% transformation efficiency was achieved. The southern analysis and molecular validation were also done for validating the copy numbers and expression of the genes. The putative transgenics at T_1 generation were further characterized by challenging them to different abiotic stresses including drought, heat and salt stress tolerance using excised leaf assay (Figure 2) and identified few promising lines for multiple abiotic stress tolerance based on different physiological and biochemical studies.

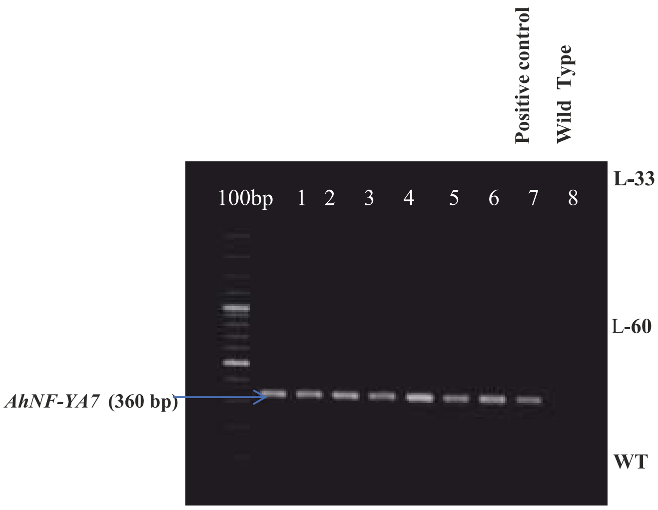

Figure 1. PCR confirmation of transgenic plants using gene specific primers

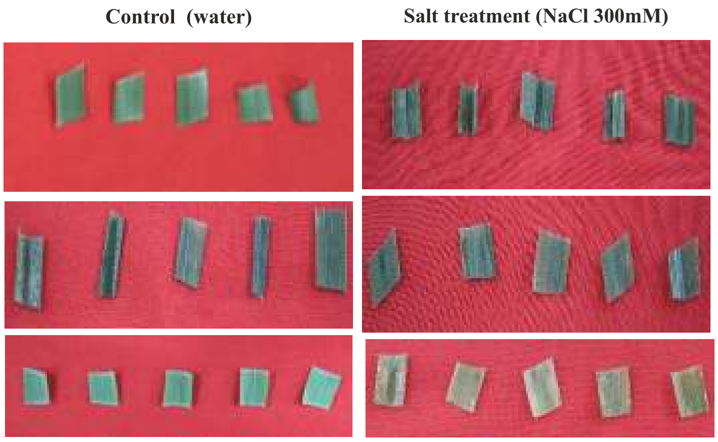

Figure 2. Excised leaves of wild type and putative transgenic plants subjecteed to salt stess

Yield realization in large scale demonstrations of DBW 187 (Karan Vandana)

CN Mishra, Amit Sharma, Satish Kumar, Bhumesh Kumar and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

Karan Vandana (DBW187) is the latest plant breeding innovation developed by the wheat researchers of the ICAR-Indian Institute of Wheat and Barley Research, Karnal. The variety had shown wider adaptability as it has been recommended for about 20.0 million hectares (66.7% of total wheat area of the country) of wheat area that falls in the states of Punjab, Haryana, Delhi, Rajasthan (except Kota and Udaipur divisions), Jammu and Kathua districts of Jammu & Kashmir and parts of Himachal Pradesh (Una dist. and Paonta valley) Uttarakhand (Tarai region), Uttar Pradesh (except Jhansi division), Bihar, Jharkhand, West Bengal and plains of North-Eastern states [*vide* notification number S.O. 1498 (E) dated 1st April, 2019 for NEPZ and S.O. 99(E) dated 6th January, 2020 area extension for NWPZ].

During the year 2018-19, demonstrations at farmers' fields were carried out in Eastern India wherein 1200 farmers were provided mini kits of DBW 187 and they harvested high yield which has led to high demand for this variety. The story of yield realization by a women farmer was published on the website of Indian Council of Agricultural Research (ICAR) (https://icar.org.in/content/women-farmer-gorakhpur-harvests highest-yield-latest-wheat-variety-karanvandana - dbw-187-0) that attracted huge fan following and is becoming popular by each passing day. To meet the growing seed demand of the variety, ICAR-IIWBR has initiated the large scale seed production program in collaboration with other public research organizations and private seed companies. During the year 2019-20, the large scale seed production was carried at 45 public sector organisation (including SAUs and KVKs) and 163 private seed growers that are spread through out the major wheat producing area and engaged in delivering the genetic gain of the variety to the farmers. Response of 105 respondents who have cultivated wheat on 1 ha of land have been collected through Google Form during the month of July 2020 and the results are summarized (Figure 3 & 4). The respondents were from all major wheat growing states *viz.,* Haryana (54), Punjab (34), Uttar Pradesh (12), Rajasthan (3) and Uttarakhand (2). Across the states, the average yield was highest in Punjab (65.3q ha^{-1}) followed by Haryana (64.8q ha^{-1}) and Uttar Pradesh (64.4q ha^{-1}) however the highest potential yield was recorded in Uttar Pradesh (83.0q), followed by Haryana (80.0q ha^{-1}) and Punjab (72.5q ha^{-1}).

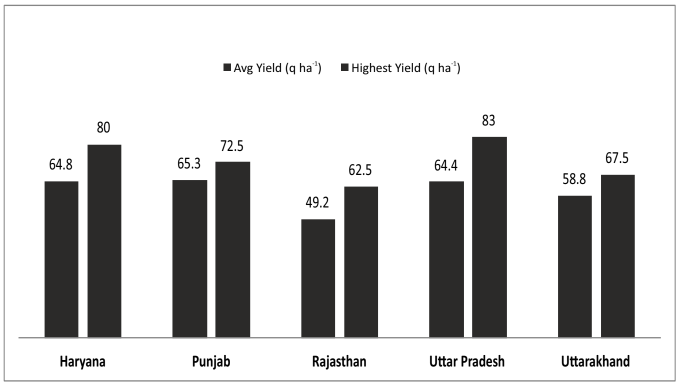

Figure 3. State-wise yield levels of DBW 187.

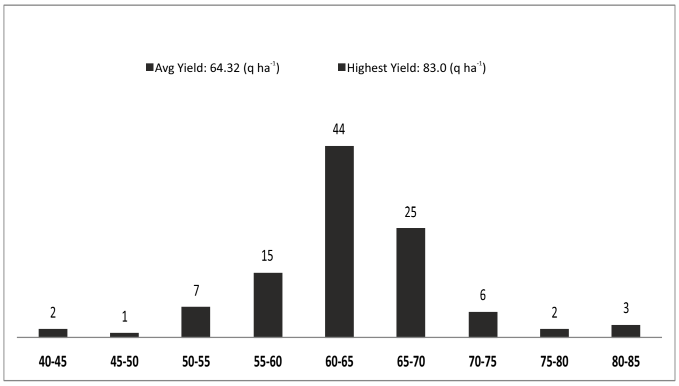

Figure 4. Yield levels of DBW 187 attained by individual farmers.

Pre-breeding for "Quality Improvement: High Zinc, Iron and Protein Content in Wheat"

BS Tyagi, Vikas Gupta, Gopalareddy K, Ashish Ojha, Gyanendra Singh, Sindhu Sareen and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

Worldwide more than two billion people suffer from iron (Fe), zinc (Zn) and/or other (multiple) micronutrient deficiencies (WHO, 2016). All living organisms require essential mineral micronutrients to maintain metabolism and humans obtain these from their diet. Micronutrient deficiency retards the growth and development of both crops and humans. Zinc deficiency causes many health problems in humans like, lower immune system, diarrhea, appetite, psychological disorders, delayed growth and even affects fetal development during pregnancy. The micronutrient deficiency is prevalent in most of the developing countries because of the predominance of cereal based dietary habits, which are poor in micronutrients. In India, around 48% of children below 10 years of age have zinc/iron or some other micronutrient deficiency. Wheat is one of the important staple food crop grown and consumed in India. However, variability in the primary gene pool is very low for grain Zn and Fe content and most of the cultivated wheat cultivars have low grain Fe and Zn contents. Wild relatives have been identified to be a potential source grain micronutrients variability. Keeping this in view, a breeding program with wild sources was initiated at ICAR-IIWBR in collaboration with Nottingham University, UK.

Table 1: Promising genotypes for higher grain zinc, iron and protein content

Name	Cross/ Pedigree details	Karnal Mean of 2018-19 and 2019-20			Hisar Mean of 2018-19 and 2019-20			Overall Mean		
		Zn (ppm)	Fe (ppm)	Protein (%)	Zn (ppm)	Fe (ppm)	Protein (%)	Zn (ppm)	Fe (ppm)	Protein (%)
BFKW-1	Chinese. Spring / *Ae. mutica* (P 213004)	46.0	41.0	16.5	45.2	43.8	18.3	45.6	42.4	17.4
BFKW-2	Macoun / *Th. bessarabicum* (EC787708)	47.1	45.2	16.3	48.4	46.2	17.1	47.8	45.7	16.7
BFKW-3	Pavon 76 /*Ae. Mutica* (P 2130012)	55.0	51.3	16.5	53.6	53.0	17.1	54.3	52.1	16.8
BFKW-4	Highbury / *S. anatolicum* (P 208/142)	51.3	52.8	18.2	50.1	51.8	19.5	50.7	52.3	18.9
BFKW-5	*Th. Bessarabicum* (EC787708)/ cv Margarita	44.4	43.4	17.4	46.7	42.1	18.7	45.6	42.8	18.1
BFKW-6	SYN207//PBW502/16/621-50	48.6	44.3	15.2	47.4	45.8	16.0	48.0	45.1	15.6
BFKW-7	Chinese spring / *Th. bessarabicum* EC787708/HD3086	55.1	52.5	16.5	53.2	54.1	17.7	54.2	53.3	17.1
BFKW-8	PDW 314 /Cv Icarasha	43.3	42.1	15.2	43.4	40.8	15.3	43.4	41.5	15.2
BFKW-9	PARAGON/WH1105/GW322	53.6	52.2	18.5	52.6	52.0	17.5	53.1	52.1	18.0
BFKW-10	PARAGON/WH1105//DBW88	52.3	55.5	18.4	51.7	52.2	18.2	52.0	53.8	18.3
BFKW-11	Chinese spring/ cv Margarita	50.3	49.6	16.5	51.6	47.0	15.5	51.0	48.3	16.0
BFKW-12	Pavon 76 / *Ae.mutica* (2130012) /HD 3086	51.7	50.3	18.1	50.7	51.2	17.5	51.2	50.8	17.8
BFKW-13	*T. sphaerococcum* (EC10511) / DBW 90	45.7	41.4	14.8	43.9	43.1	16.0	44.8	42.3	15.4
BFKW-14	*T. sphaerococcum*/ Pavon 76	47.2	45.0	16.4	48.5	46.5	17.4	47.8	45.7	16.9
Check 1	DBW187 (A)	35.6	37.0	13.6	36.0	37.6	13.8	35.8	37.3	13.7
Check 2	HI8498 (D)	40.4	44.2	12.5	40.8	45.4	13.0	40.6	44.8	12.8

BFKW: Bio-Fortified Karnal Wheat

The wild germplasm and the already developed amphiploids were used in crossing program to improve Indian wheat varieties for micronutrients. Out of 200 cross combinations, fourteen genotypes along with two check varieties [HI 8498 (durum) and DBW 187(bread wheat)] were selected and evaluated for zinc, iron and protein contents. The experiments were conducted for two years at two locations (Hisar and Karnal) following randomized complete block design. Zinc and iron estimations were performed using the Oxford instruments X-Supreme 8000 fitted with 10 place auto sampler, holding 40 mm aluminum vials. While the protein was estimated by using non-destructive spectra machine at 12% moisture level. The mean of two years data for each is presented in the Table 1.

Wide variation was observed in most of the genotypes for grain protein, zinc and iron contents. All the 14 genotypes were found superior with respect to the grain zinc, iron and protein contents compared to the bread wheat check DBW 187. Ten genotypes were found superior for all the three traits in comparison to the durum check HI 8498. Highest protein content of 18.9% was found in the genotype BFKW-4 (Highbury / *S. anatolicum* (P 208/142) followed by BFKW-10 and BFKW-5. Similarly, highest grain Zn content of 54.3 ppm was found in BFKW-3 followed by BFKW-7 (54.2 ppm) whereas, the genotype BFKW-10 (53.8 ppm) had the highest grain iron followed by BFKW-7 (54.2 ppm). All these genotypes are now stable and are being further utilized in the crossing programme. It was concluded from the experiments that these identified genotypes can be used as donors in hybridization programmes to develop higher Zn, Fe and protein rich wheat genotypes.

Evaluation of advanced wheat bulks with multiple rust pathotypes under controlled environment

Hanif Khan, OP Gangwar, SC Bhardwaj, Pramod Prasad, Om Parkash, CN Mishra, Gopalareddy K, Raj Kumar, SS Yadav, Sudheer Kumar and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

The rapid appearance of new races of rust pathogens with virulence for widely deployed rust resistance genes in wheat has lead to increased focus on diversification and pyramiding resistance genes in wheat. Rust resistant wheat lines using donors for widely effective under-utilized resistance have been developed through concerted efforts of breeders and pathologists at ICAR-IIWBR, Karnal and its regional station, Shimla. A total of 320 advanced bread-wheat lines including some CIMMYT selections were subjected to Seedling Resistance Test (SRT) under environment controlled glasshouse against most prevalent and virulent pathotypes of yellow (*Pst*), brown (*Ptr*) and black (*Pgr*) rusts at ICAR-IIWBR Regional Station, Flowerdale, Shimla. A set of differential for each rust and five check varieties (HD3086, DBW187, DBW90, WH1142 and DBW303) were also used along with test genotypes. For SRT three *Pst* pathotypes *viz.,*110S119, 238S119 and 47S103 (T); mixture of five *Ptr* pathotypes (77-1, 77-5, 77-9, 12-5 and 104-2) and mixture of five *Pgr* pathotypes (11, 40A, 21A-2, 117-6 and 122) were used. Out of 320 genotypes, 59 (18.4%) were immune or resistant to all the three *Pst* pathotypes, 158 (49.4%) were resistant against all the 5 *Ptr* pathotypes and 245 (76.5%) were resistant against all the *Pgr* pathotypes. Among these 31 genotypes (Table 2) were resistant against all the 13 pathotypes of three

Table 2: Wheat genotypes with complete resistant scores against all the three rust diseases

Genotype	Pedigree	*Pst*			*Ptr*	*Pgr*
		110S119	238S119	475103	Mix	Mix
RWP1001	PBW703 (*Yr10+Yr15*)/DBW95	0;	0;	0;	;-	2=
RWP1003	HSB2949/PBW 703 (*Yr10+Yr15*)	0;	0;	0;	0;	2=
RWP1165	HD2967/PBW698 (*Yr10+Yr15*)	0;	0;	0;	;-	2-
RWP1166	HD2967/PBW698 (*Yr10+Yr15*)	0;	;-	0;	;-	0;
RWP1178	RAJ3765/DPW621-50	0;	0;	0;	;-	;-
RWP1186	PBW703 *(Yr10+Yr15)*/RV50 *(Rht13)*	0;	0;	0;	; 1	0;
RWP1187	PBW703 *(Yr10+Yr15)*/DBW95	0;	0;	0;	;1	2=
RWP1191	PBW698 *(Yr10+Yr15)*/HD3070	0;	0;	0;	;-	2=
RWP1197	HSB2949/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	0;
RWP1216	19-20 EPC402 *(Sr26)*	;-	;	0;	1,2+	2=
RWP1306	52nd IBWSN 1004	;-	;-	0;	;1	2=
RWP1308	52nd IBWSN 1033	;-	;-	0;	;1	;
RWP1358	14 STEMRRSN 6018 *(Sr22)*	;-	0;	0;	;-	0;
RWP1375	HD2967*2/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	2=
RWP1385	HD2967*2/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	2=
RWP1386	HD2967*2/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	;-
RWP1387	HD2967*2/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	;-
RWP1388	HD3086/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	;-
RWP1389	HD3086/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;	2=
RWP1393	DBW112/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;	;-
RWP1396	DPW621-50/PBW698 *(Yr10+Yr15)*	0;	0;	0;	;-	2=
RWP1397	DPW621-50/PBW698 *(Yr10+Yr15)*	0;	;-	0;	;-	2=
RWP1405	HD2967/PBW698 *(Yr10+Yr15)*	0;	;-	2-	;-	1,2
RWP1406	HD2967/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;	2=
RWP1408	HD2967/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	2-
RWP1419	DBW14/NIAW34//ELLISON	;-	;	0;	;	;
RWP1420	RAJ37645/DPW621-50	2-	;2-	0;	;	0;
RWP1425	DBW39/FLW26 *(Lr42+Yr27)*	0;	0;	0;	;-	;-
RWP1426	DBW39/FLW26 *(Lr42+Yr27)*	0;	0;	0;	;-	;-
RWP1429	HSB-4 *(Yr15)*/HI1563 *(Lr24/Sr24)*	0;	0;	0;	;1	0;
RWP1443	DBW112/PBW703 *(Yr10+Yr15)*	0;	0;	0;	;-	2=

rusts. Important major rust resistant genes such as *Yr10, Yr15, Yr24, Yr27, Lr24/Sr24, Lr42, Sr22, Sr26, Sr31/Lr26/Yr and Lr34/Sr55/Yr18* are carried by some of these genotypes from their donor parents. All these 320 genotypes are under evaluation for the agro-morphological traits, adaptability under different sowing conditions, yield and component traits, field resistance to three rusts and other major biotic and abiotic stresses.

Evaluation and identification of promising wheat genotypes for grain yield and disease resistance

Vikas Gupta, Arun Gupta, Charan Singh, Gopalareddy K, BS Tyagi, Gyanendra Singh and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

Wheat is an important staple food and most widely grown cereal of the world as well as in India. The world's population is increasing day by day and to feed such huge population increasing wheat

Table 3: Genotypes showing superior performance in the 37th SAWSN evaluated at Karnal during 2019-20

Pedigree	Days to heading	Plant height (cm)	1000-grain weight (g)	Grain yield (g)	Yellow rust
ATTILA/3*BCN//BAV92/3/PASTOR/4/ TACUPETO2001*2/ BRAMBLING/5/ PAURAQ/6/FRNCLN*2/TECUE #1	102	100	38	405	0
MERCATO/BECARD//BOKOTA	103	103	38	377	0
KACHU/KIRITATI//2*SUP152/BAJ #1	97	100	35	357	20S
SUP152/AKURI//SUP152/3/MUCUY	103	100	40	350	0
MUTUS*2/MUU//2*MUCUY	104	101	46	346	20MS
FITIS	103	99	33	331	0
QUAIU*2/KINDE//BORL14	103	102	38	317	20S
BORL14/3/WBLL1*2/BRAMBLING*2// BAVIS	105	100	38	312	0
VILLA JUAREZ F2009//KIRITATI/2* TRCH/3/WBLL1*2/ BRAMBLING/4/ BORL14	103	100	39	309	20MS
Local Check (DBW 187)	103	99	39	289	0

production and productivity is of utmost importance. Breeders utilize the available variability to create variation, followed by selection of superior progenies and finally fixed breeding lines are developed and further tested at multi-locations for yield assessment. The best performing lines are later released as varieties for commercial cultivation. In the present experiment, a set of 283 lines received from CIMMYT, Mexico in the form of Semi-Arid Wheat Screening Nursery (SAWSN) were evaluated for yield and key agronomic traits at ICAR-IIWBR, Karnal. The genotypes were planted as per the augmented design due to large number, in which each genotype was planted once while the check variety (DBW 187) was replicated in each block. Each genotype was planted in a paired row plot of 1.5 m length with 0.2 m spacing between rows. All the standard agronomical practices (dose of fertilizer, irrigation at all critical stages and roughing) were followed to raise a normal crop from sowing to harvesting. Data was recorded for days to heading, plant height, thousand grain weight and grain yield (single row plot). Analysis of variance indicated significant differences among the genotypes for all measured traits. Days to heading varied from 94-108 days (CV = 2.49%) plant height ranged from 92-104 cm (CV = 2.10%), thousand grain weight ranged from 10-50 g (CV = 16.88%) and grain yield varied from 27 g - 405 g (CV = 41.63%). The yellow rust incidence varied from 0 to 80S. The top ten genotypes performing better are presented in Table 3. These identified lines can be evaluated for further assessment of yield in large plots to be nominated for testing in national trials.

Empowering rural youth for self-reliance in seed sector

AK Sharma, CN Mishra, Umesh R Kamble and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

Three days training programme entitled "Empowering rural youth for self-reliance in seed sector" was successfully organized through virtual mode under HRD component of ICAR Seed Project by ICAR-Indian Institute of Wheat and Barley Research, Karnal during 24th -26th November, 2020. In the referred course, a total of 118 applications were received through online mode and after screening these applications, 59 participants from 15 states *viz*., Haryana, Uttar Pradesh, Punjab, Rajasthan, Uttrakhand, Gujarat, Madhya Pradesh, Bihar, Jammu & Kashmir, Assam, Delhi, Andaman and Nicobar, Telengana, Andhra Pradesh, and

Himachal Pradesh etc. were selected. Keeping in view, the importance of entrepreneurship development in seed sector, a series of lectures covering diverse theme areas of seed production, processing and storage, marketing, seed quality enhancement, seed certification, seed entrepreneur-ship and development of FPO's were organized.

In this programme, 7 experts from ICAR-IIWBR, Karnal, one expert from Department of Agriculture Cooperation & Farmers Welfare, 3 resource persons from ICAR-Indian Agricultural Research Institute, Regional Station, Karnal and one expert from the seed certification and seed testing laboratory shared their experiences and knowledge to the participants of the programme. Further, one resource person managing NGO shared his views and practical experience for handling seed enterprise. Further, one technical bulletin in Hindi for wheat seed production, comprising practical aspects has also been designed and shared with participants as a ready reckoner for seed production. Feedback was collected from participants regarding training programme and after successful completion of training programme, certificates were shared with participants via email. The participants were highly satisfied with the programme and motivated to adopt the seed business.

Evaluation for durum wheat genotypes for yield and component traits

Vikas Gupta, Arun Gupta, Charan Singh, Gopalareddy K, BS Tyagi, Gyanendra Singh and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

Durum wheat (*Triticum turgidum* L. var. *durum*) is the only tetraploid species of wheat of commercial importance that is widely cultivated today. Durum wheat is preferred over aestivum wheat because of its unique qualities such as hardness, high protein content, yellow pigment and gluten strength which are required for making pasta, macaroni, daliya, laddu, churma, sevaiyan and suji-halwa etc. In India, durum wheat is cultivated mainly in the states of Madhya Pradesh, parts of Gujarat, southern Rajasthan and Bundelkhand region of Uttar Pradesh. The demand for durum wheat products has increased in the recent years due to consumers preference for high-quality end-products. The durum wheat cultivation is also exposed to several biotic and abiotic stresses which affects the grain yield. Increasing production and productivity is important to meet the future demands because of increasing population pressure. In view of this, a set of advanced breeding lines received from CIMMYT, Mexico in the form of International Durum Screening Nursery (51st IDSN) were evaluated

Table 4: Genotypes showing superior performance in the 51st IDSN evaluated at Karnal during 2019-20

IDSN number	Days to heading	Plant height (cm)	Thousand grain weight (gm)	Grain yield (g)
121	106	86	34	297
35	101	93	39	274
31	108	86	46	246
26	103	93	37	239
138	107	85	42	228
114	105	90	36	226
108	102	96	46	222
65	104	93	36	220
103	103	90	38	215
Check (DBW 187)	105	83	48	282

at ICAR-IIWBR, Karnal for yield and other few important traits. A set of 159 genotypes were planted in paired rows of 1.5 m length with a row to row spacing of 20 cm following the augmented block design. All the recommended package of practices were followed to raise a healthy crop and single rows were harvested for each genotype for grain yield data recordings. Data was recorded for days to heading, plant height, thousand grain weight, grain yield and disease incidence. Significant differences were observed among genotypes. Wide variation was observed for measured traits; days to heading varied from 100-115 days (CV = 2.98%), plant height ranged from 82-105 cm (CV = 5.59%), thousand kernel weight ranged from 18-54 g (CV = 15.49%) and grain yield varied from 57-297 g (CV = 40.28%). Incidence of yellow rust was observed and only a few entries exhibited susceptible reaction. The ten best performing lines identified based upon yield are presented in Table 4. These high yielding lines identified can be further evaluated in multi-locations to identify high yielding and stable lines so that they can be further pushed for testing under national trials.

Physio-biochemical characterization of NWPZ wheat varieties for temperature stress tolerance

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Thermal stress is a major abiotic stress in many cereal crops including wheat and is highly complex in mechanism to comprehend. Among the different wheat growing zones of India, a large area in NWPZ is affected by temperature stress and also abrupt increase in temperature were observed in recent years at different growth stages of wheat. Hence, the present study aims for precise screening of NWPZ, timely sown wheat varieties for their thermal stress tolerance. Physiological and biochemical characterizations were done in seven NWPZ timely sown wheat genotypes (WB 2, HD 3086, DBW 88, DPW 621-50, HD 2967 and PBW 550) with two checks (Raj 3765 and Raj 4014) for temperature stress tolerance at seedling stage. The experiment was done in completely randomized design (CRD) with three replications for each genotype. The pots were filled with appropriate potting mixture of soil, sand and FYM in the ratio 2:1:1 (v/v). After 21

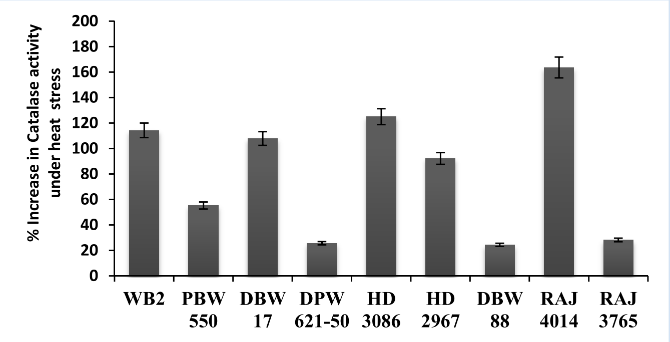

Figure 5. Per cent increase in catalase activity under heat stress condition compared to control in wheat genotypes

days of sowing, heat stress was induced by keeping them in the growth chamber at 37°C for 3 hrs. All the study traits exhibited significant variations among all genotypes under heat stress conditions. Chlorophyll content index (CCI), relative water content and chlorophyll fluorescence were significantly reduced under heat stress, whereas proline content and electrolyte leakage increased in heat-treated plants. There was significant increase in the activities of catalase, glutathione peroxidase, malondialdehyde and ascorbate peroxidase enzymes under stress conditions. On the basis of relative variations in these studied physio-biochemical traits among the genotypes, it is observed that PBW 550 and DBW 88 showed relatively high tolerance for heat stress, DPW 621-50 and HD 2967 were moderately heat tolerant and varieties HD 3086, WB 2 and DBW 17 were relatively less tolerant to heat stress (Figure 5). Our previous studies have shown that seedling level stress tolerance has high correlation with adult level stress tolerance under field. Hence, this study information can be used in wise selection of genotypes for sowing in NWPZ based on weather forecast of the location.

Bacterial endophyte(s) identified for the management of head scab of wheat

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Head scab (HS) caused by *Fusarium graminearum* is a vicious disease that causes huge yield and quality losses in wheat throughout the globe. At present, the management of this fungal disease is mainly reliant on the application of chemical fungicides. Unfortunately, the agrochemicals are not the ideal solution for the management of HS disease in wheat. Firstly, HS appears on wheat plants at flowering stage and overlaps with the rains in the cropping season in India. As a result, fungicides are easily washed away by rainwater, which reduce the management efficiency of the applied fungicide. Secondly, there is a rising concern about the adverse effects of chemical fungicides, particularly about their toxic effects on humans and animals. Therefore, alternative management strategies are obligatory to provide food to the consumers free from residual agro-chemical as well as for maintaining environmental safety. Under such situations, biological control of HS is acknowledged as one of potential alternative management option that is environmentally benevolent, sustainable, and compatible with other disease management tactics. With this background information, research efforts have been made to screen antagonistic bacteria having potential to manage HS and a total of 112 bacterial

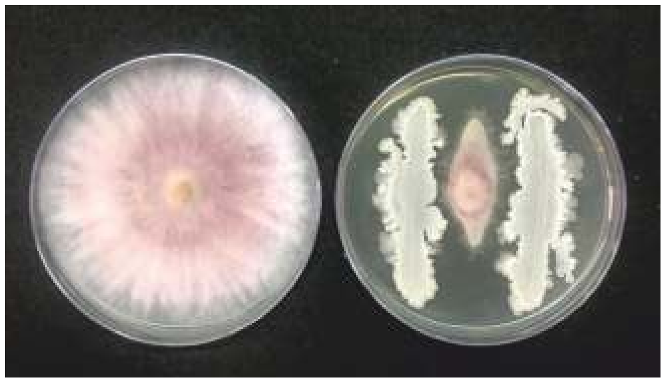

Figure 6. *In-vitro* antagonistic effects of *Bacillus amylo-liquefaciens* NOK109 on *Fusarium graminearum*

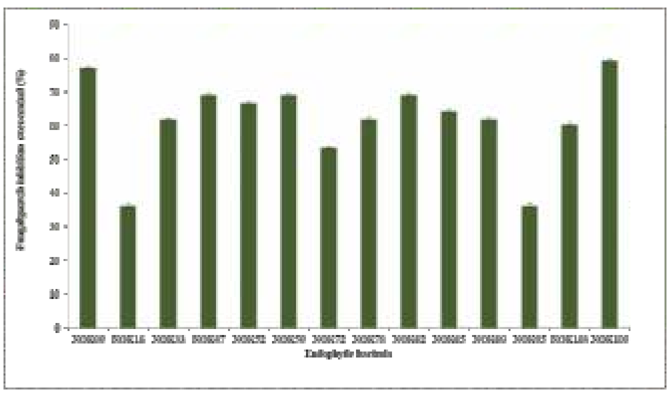

Figure 7. Antagonistic effects of bacterial endophytes on *Fusarium graminearum* observed under *in vitro* dual assay.

endophytes were isolated from the stems, leaves, roots and spikelets of five wheat cultivars *viz*., HD 2967, PBW 343, Agra Local, K-65 and A-9-30-1. Among them, fourteen bacterial strains (NOK09, NOK16, NOK33, NOK47, NOK52, NOK59, NOK72, NOK78, NOK82, NOK85, NOK89, NOK95, NOK103 and NOK109) were identified as antagonists and showed a wide range of efficacy in their ability to inhibit *Fusarium graminearum* in dual culture assays (Figure 6). The per cent mycelium growth inhibition of *F. graminearum* over control ranged between 36.2 –79.4% (Figure 7). An *in-vivo* experiment for confirming the antagonistic potential of NOK109 in wheat field was conducted during 2020-21 cropping season and results confirmed that NOK109 could suppress the disease severity of HS and it was at par with recommended chemical fungicide i.e. Propiconazole @ 0.1%. The 16S rDNA sequence analysis revealed that NOK109 is a strain of *Bacillus amyloliquefaciens*. Over all, the research investigation clearly indicates that NOK109 has a good antagonistic effect on *F. graminearium* and lays a strong foundation for the application of the strain as a biological agent in the field to manage HS.

Fluxapyroxad plus Pyraclostrobin as a new combination of molecules for the management of yellow rust and spot blotch diseases of wheat

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Yellow rust (*Puccinia striiformis* f.sp. *tritici*) and spot blotch (*Bipolaris sorokiniana*) of wheat are the most economically important fungal diseases affecting wheat. Foliar fungicides can effectively manage stripe rust and spot blotch when applied at the time of disease occurrence and again after 10 to 15 days depending on prevailing weather condition and disease pressure. Fungicides, including new formulations, have been tested every year for management of these diseases. Currently recommended Propiconazole @ 0.1% has been used for more than three decades to control these diseases. Unfortunately, the emergence and spread of fungicide resistance often occurs in populations of fungal pathogens following the widespread use of fungicides. Strong selection pressure due to frequent use of fungicides is thought to underlie the cause-effect relationship between fungicide use and resistance evolution. In some cases, the strength of selection can lead to rapid development of resistance within the fungal population even after limited use of the fungicide. For these reasons, screening and identification of new fungicides become a critical part of effective and sustainable management under commercial production, and moreover their strategic alternation and combination in management programs can provide enhanced and better control choices. In this regard, field experimental trials were conducted in ICAR-IIWBR to investigate whether foliar application of the combinations of Fluxapyroxad and Pyraclostrobin could provide more efficacious management of both yellow rust and spot blotch diseases compared to either single application of fungicides. The experiment was conducted for two consecutive crop season. The results indicated that two applications of 200 g ha^{-1} of Fluxapyroxad (167 g lt^{-1}) + Pyraclostrobin (333 g lt^{-1}) 500 SC resulted in significantly ($p < 0.05$) less yellow rust (ACI= 8.0 to 9.33) and spot blotch disease severity (17.28 to 18.22) compared to the equal number of applications of either fungicide applied individually. The average per cent disease severity in all the treatments varies from 8.67 to 66.67% The minimum yellow rust severity (ACI) were 8.00 and 9.33 recorded in treatment with 200 g ha^{-1} of Fluxapyroxad (167 g lt^{-1}) + (333 g lt^{-1}), while maximum infection level of 60.00 and 73.66 were observed in untreated control during both field experimentation in two consecutive cropping seasons. All the other tested fungicides *viz.*, 557 g ha^{-1} of Fluxapyroxad (300 g lt^{-1}), 500 g ha^{-1} of Pyraclostrobin 20% WG and 1 ml lt^{-1} of Azoxystrobin (18.2 % w:w) + Difenoconazole 11.4% (w:w) were found statistically superior over control (untreated) in reducing the yellow rust severity. All the treatment showed significant increase in wheat grain yield over control. Similarly, spot blotch disease severity was recorded on double digit (00 to 99) scale and average severity in different treatments varies from 10.56 to 70.53. The minimum spot blotch disease severity was recorded in treatment with 200 g ha^{-1} of Fluxapyroxad (167 g lt^{-1}) plus Pyraclostrobin (333 g lt^{-1}) which was statistically at par with 300 g ha^{-1} of Fluxapyroxad (167 g lt^{-1}) plus Pyraclostrobin (333 g lt^{-1}) and 400 g ha^{-1} of Fluxapyroxad (167 g lt^{-1}) and 1 ml lt^{-1} of Azoxystrobin (18.2 % w:w) + Difenoconazole 11.4% (w:w), while maximum infection (70.53) was observed in untreated control. All the fungicides tested were found statistically superior over control (untreated) in reducing the spot blotch diseases. There was no adverse effects of Fluxapyroxad (167 g lt^{-1}) plus Pyraclostrobin (333 g lt^{-1}) in any treatment even at highest dose (400 g ha^{-1}) and more over no negative effect on wheat yield by the pre-mixed fungicide application of Fluxapyroxad and Pyraclostrobin. Overall, two foliar application of Fluxapyroxad (167 g lt^{-1}) plus Pyraclostrobin (333 g lt^{-1}) 500 SC at the standard dose (200 g ha^{-1}) was effective in controlling both yellow rust and spot blotch diseases of wheat.

Antibiosis effect of various wheat genotypes on the biology of corn leaf aphid, *Rhopalosi phum* maidis (Fitch)

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Wheat crop is attacked by an aphid complex which comprises of mainly four species *viz.*, *Rhopalosiphum maidis* (Fitch), *Rhopalosiphum padi* (L.), *Sitobion miscanthi* (Takahashi) and *Sitobion avenae* (Fabricius). Among these, corn leaf aphid (*R. maidis*) is the single most serious biotic stress in North Western plains of India. *R. maidis* belongs to the order Hemiptera, sub-order Homoptera and family Aphididae. It is a polyphagous pest which feeds on corn (*Zea mays* L.), sorghum (*Sorghum bicolor*), barley (*Hordeum vulgare* L.), oats (*Avena sativa* L.), wheat (*Triticum aestivum* L.), and many more plants of the families gramineae, cyperaceae and typhaceae. The mild climate between end of January and beginning of March is highly favourable for corn leaf aphid (CLA) infestation. Both nymphs and adults cause damage by sucking sap from the leaves, stems and earhead. Due to rapid multiplication of aphids, it covers the entire surface of the shoots and as a result of continuous desapping by such a large population, the yellowing, curling and subsequent drying of leaves take place which ultimately lead to reduction in number and size of earhead. Insecticides are used extensively to control aphid infestation but there are disadvantages with this method, such as negative effects on the ecosystem, notably on non-target beneficial insects and the risk of resistance development.

In view of the above situation, there is a need to develop alternative control measures such as breeding for host plant resistance. Growing insect-resistant cultivars is an environment friendly,

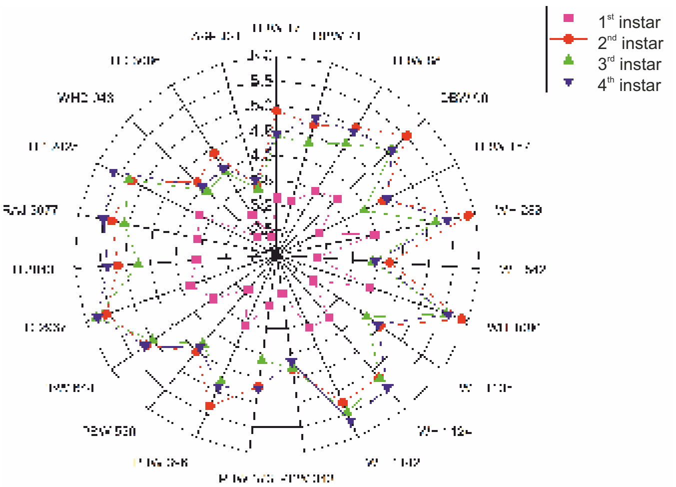

Figure 8. The RADAR graph depicting the duration of different nymphal instars of *R. maidis*

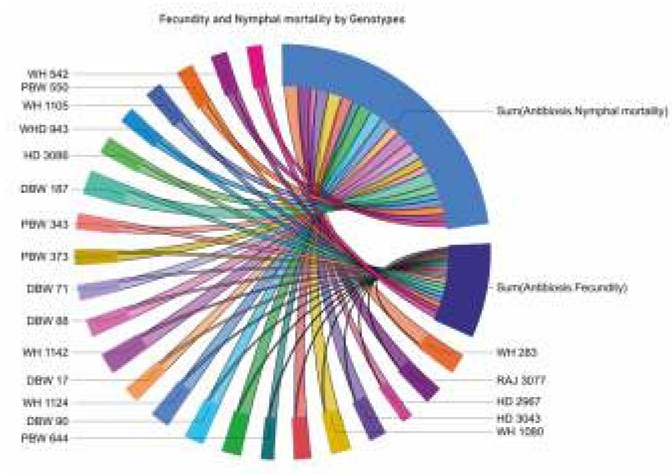

Figure 9. The Chord diagram demonstrating the fecundity and nymphal mortality of different nymphal instars of *R. maidis*

efficient and easy to use method for the farmer. The resistant mechanisms of crop to insect pests can be classified as antixenosis, antibiosis and tolerance traits. Antibiosis is the negative effect of plant biology on pest physiology. It can result in the reduction of insect life span and reproduction as well as increasing the insect mortality. Therefore, the present study was planned to access the impact of antibiosis resistance on the biology of CLA. Experiment was performed in the glass house and the biological parameters of CLA *viz.,* nymphal duration (Days), fecundity (nymphs/female) and nymphal mortality (%) were studied on 23 wheat genotypes. The genotype 'A-9-30-1' was taken as susceptible check.

Among the four instars, the nymphal duration of first instar was minimum and ranged from 2.38 ± 0.09 (A-9-30-1) to 3.97 ± 0.06 (WH 283). First instar nymphal duration was also significantly higher in case of WH 1080 (3.93 ± 0.07) and HD 2967 (3.81 ± 0.04) (Figure 8). The duration of second instar varied from 3.44 ± 0.05 to 5.86 ± 0.07. It was maximum on WH 1080 and minimum on A-9-30-1. The duration of third instar varied from 3.38 ± 0.06 to 5.77 ± 0.08. It was maximum on HD 2967 and minimum on susceptible test genotype & A-9-30-1. The nymphal duration of fourth instar ranged from 3.56 ± 0.04 (A-9-30-1) to 5.75 ± 0.10 (HD 2967). Fourth instar duration was also significantly higher in case of WH 1142 (5.64 ± 0.07) and UP 2425 (5.63 ± 0.13) (Figure 8).

The fecundity of CLA varied from 40.72 ± 0.29 to 9.58 ± 0.36 nymphs/female on test genotypes. Fecundity was maximum on the susceptible check A-9-30-1 and minimum on WH 283 (Figure 9). The genotypes *viz.,* WH 542 (35.44 ± 0.68), PBW 550 (34.75 ± 0.38) and WH 1105 (34.44 ± 0.58) also demonstrated higher fecundity. Similarly, nymphal mortality ranged from 36.84 ± 0.43 to 92.19 ± 0.97 which was minimum on the susceptible check A-9-30-1 and maximum on DBW 187 (Figure 9). Mortality was also high on the genotypes viz., WH 283 (92.15 ± 1.37), WH 1080 (90.25 ± 0.35) and WH 1142 (89.01 ± 0.25).

Primary and secondary metabolites found in plant phloem exudates influence aphid development and reproduction on resistant plant of wheat and can reduce the aphid attack on wheat cultivars. The data revealed that the developmental period was lower in susceptible check as compared to other genotypes because it was deficient in defense compounds such as phenols, tanins, proline, alkaloids, flavonoids etc. and was observed to be more suitable for aphid development. The increase in developmental period of CLA as compared to the susceptible check might be due to the antibiosis effect on aphid biology. The nymphs required longer time to complete the life stages on resistant genotypes as compared to the susceptible check. Due to the same reason, highest fecundity and lowest nymphal mortality was observed in case of the susceptible check. Resistant genotypes observed lower fecundity and higher nymphal mortality. However, some genotypes such as DBW 187 demonstrated high fecundity as well as nymphal mortality. It may be due to the reason that the level of antixenosis resistance was lower in these genotypes but demonstrated strong antibiosis resistance because of the presence of higher levels of secondary metabolites and nymphs were not able to complete the life cycle. The study clearly indicates that the antibiosis resistance can be incorporated in breeding programmes to develop aphid resistant wheat cultivars and the use of pesticides can be eliminated completely and effectively.

Identification of wheat genotypes for higher water productivity under deficit irrigation

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Wheat is a primary staple food crop of India and currently cultivated on about 30 mha area. As 80% of the annual rainfall is received during southwest monsoon months (July to September), wheat is predominantly cultivated under irrigated conditions. Recent decades have experienced a steady increase in the depth of the groundwater table in wheat growing regions of Indo-Gangetic plains. During the last three decades underground water levels in study region have fallen from 8 to 16 m below ground level and in rest of India, it has declined from 1 to 8 m below ground level. Intensive cultivation of irrigated wheat in 30 mha area is mainly causing the depletion of groundwater resources in India. This calls for urgent technological interventions to improve the water productivity of wheat for sustaining the profitability of farmers.

With the objective to identify and develop higher water use efficient genotypes, an experiment was conducted with 31 genotypes under deficit irrigation conditions. The genotypes were planted following split plot design. The amount of irrigation water was calculated with the help of CROPWAT 8.0. The amount of applied water was measured by the inbuilt water meter in pipe line of the drip system. All agronomic and relevant physiological observations were recorded for all 31 genotypes studied (DBW 243, DBW 313, 40 ESWYT 21, DBW 360, DBW 325, RWP-2018-326, DBW 317, RWP-2018-32, 40 ESWYT 32, 40 ESWYT 39, DBW 368, RWP-2019-14, 40 ESWYT 25, 40 ESWYT 26, 40 ESWYT 43, 40 ESWYT 17, 40 ESWYT 37, 40 ESWYT 33, 40 ESWYT 07, DBW 313, DBW 322, DBW 373, 40 ESWYT 50, RWP-2018-31, DBW 321, DBW 348, DBW 369, RWP-2018-223, DBW 166, DBW 316 and RWP-2018-296). Under soil moisture regimes of 80 per cent of ETo, genotypes 40 ESWYT 21 (5213 Kg ha^{-1}), DBW 360 (5063 Kg ha^{-1}), DBW 243 (4662 Kg ha^{-1}), DBW 313 (4826 Kg ha^{-1}), 40 ESWYT 21 (4578 Kg ha^{-1}), DBW 325 (4638 Kg ha^{-1}) and RWP-2018-223 (4613 Kg ha^{-1}) produced

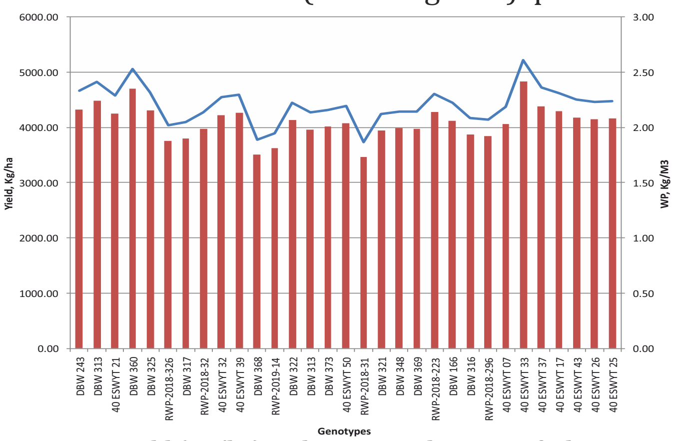

Figure 10. Yield (Kg/ha) and water productivity of wheat genotypes under 80% of ET soil moisture conditions

desirable yield with water productivity ranging from 2.12 to 2.42 Kg/m^2. The same set of genotypes grown under higher soil moisture stress *viz.,* 60 per cent of ETo, it was found that DBW 243 (4260 Kg ha^{-1}), RWP-2018-32 (4336 Kg ha^{-1}), 40 ESWYT 39 (4208 Kg ha^{-1}), DBW 322 (4047 Kg ha^{-1}), DBW 313 (4438 Kg ha^{-1}), DBW 369 (4060 Kg ha^{-1}), RWP-2018-223 (4398 Kg ha^{-1}), DBW 166 (4076 Kg ha^{-1}), DBW 316 (4146 Kg ha^{-1}), 40 ESWYT 07 (4118 Kg ha^{-1}), 40 ESWYT 33 (4610 Kg/ha^{-1}), 40 ESWYT 37 (4562 Kg ha^{-1}) and 40 ESWYT 17 (4216 Kg ha^{-1}) produced desirable yield with water productivity ranging from 2.50 to 2.85 Kg m^{-2} (Figure 10).

Effect of storage on anthocyanin content in colored and amber wheat

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Anthocyanins are water soluble, natural pigments representing flavonoids and responsible for the red, purple and blue colors of many fruits, vegetables and cereal grains in plant kingdom. Recently, anthocyanins are receiving fair attention due to reports of various health benefits and nutraceutical effects associated with them because of their antioxidant and bioactive properties. However, anthocyanins have also been reported to be less stable being affected by the factors such as light, oxygen, temperature, pH, digestion and bioavailability. Therefore, comparative study is required for antioxidant potential of colored and amber wheats to assess their advantage, if any. In this investigation, three colored genotypes and three released varieties of amber wheat were used for the estimation of anthocyanin content in fresh flour and after 10 days of storage at room temperature and also their antioxidant activity. All the genotypes were grown at Karnal during 2019-20.

Anthocyanin content was measured for wheat genotypes from acidified ethanolic extracts (pH 1.0) using freshly ground whole meal flour and 10 days old flour stored at room temperature. As expected, colored wheat exhibited significantly high concentration of anthocyanin. However, there was significant reduction (around 40%) in anthocyanin content after 10 days of storage at room temperature (25 °C) in colored wheat varieties (Table 5). These results showed that anthocyanins are degraded very fast after making the flour. There is possibility of even further degradation of anthocyanins at higher temperatures while cooking and processing. There are several studies showing that anthocyanins are heat labile and hence reflect no utility for human consumption of colored wheat. This indicated no advantage of high anthocyanins for human beings in colored wheat in terms of antioxidant activity. Further studies are being

Table 5: Percentage reduction in anthocyanin content after storage of whole meal flour for 10 days at room temperature

Genotype	Anthocyanin content (mg Kg^{-1} kuromanin chloride equivalent dry weight basis)		% decrease
	Freshly ground flour	10 days old flour	
NIVT-1A127	31.2±0.19	19.4±0.23	37.8
NIVT-1A119	84.9±2.45	56.1±0.36	33.9
NIVT-1A107	81.7±2.73	48.3±1.26	40.9
PBW550	7.0±0.21	6.7±0.25	4.0
DBW187	6.8±0.66	6.0±0.26	13.0
DBW222	5.4±0.15	5.0±0.17	7.7

(Mean±SEm); n=4

Table 6: Phenolic content and antioxidant activity of freshly ground whole meal flour from 6 wheat genotypes

Genotype	Phenolic content (µg gallic acid equivalent /g dry weight basis)	DPPH radical scavenging activity (n mols trolox equivalent/ g dry weight basis)	ABTS radical scavenging activity (n mols trolox equivalent/g dry weight basis)
NIVT-1A127	1274±35	510±48	4642±134
NIVT-1A119	1775±14	884±7	4658±166
NIVT-1A107	1598±28	912±26	4717±173
PBW550	1434±23	1143±23	3782±134
DBW187	1437±21	900±10	4018±44
DBW222	1586±09	989±15	4709±115

(Mean±SEm); n=4

conducted to study the effect of cooking/baking on various wheat products and their anthocyanin and antioxidant levels.

Methanolic (80%) extract was taken for estimating phenolic content, DPPH and ABTS radical scavenging capacity of 6 varieties (Table 6). Phenolic content varied from 1274 µg gallic acid equivalent/g to 1775 µg gallic acid equivalent/g on dry weight basis and showed no significant difference among colored and amber wheat. There was slightly higher DPPH activity in amber wheat as compared to colored wheat, while the ABTS activity was comparable in both colored and amber wheat varieties (Table 6). Data showed that there was as such no advantage of the colored wheat *vis-à-vis* amber wheat in terms of phenolic content and total antioxidant activity.

Overall, the study showed that anthocyanins are not stable during storage and also no advantage of colored wheat vis-à-vis amber wheat in terms of phenolic content and total antioxidant activity.

DWRB 197: An interesting material for barley beta glucan degradation studies

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Annually around 5-6 lakh tonnes of barley is utilized by malting industry in India, which is further processed in brewing and other malt based products as per the reports published in 2020. The barley required for malting industry is of special type having specific grain quality traits. To address the requirements of barley malt industry, in recent years, breeding programme under AICRP on Wheat and Barley has shifted its gears towards the development of genotypes with lower β-glucan content and higher diastatic power. Further, breeding efforts to identify potential trait donors for these traits as well as to understand the factors affecting malt barley grain quality under Indian growing conditions are under way. In this direction, researchers has got success in identifying a potential barley genotype (DWRB 197) possessing lower wort beta glucan content despite very high beta glucan content in grain. Interestingly, DWRB 197 has relatively better diastatic power relative to the checks and therefore can be an interesting material for further biochemical and molecular studies on beta glucan degradation during malting and mashing and on activities of individual amylasis.

The genotype was analysed for grain and malt quality traits from the crop grown in multilocation AICRP barley trials for two years (IVT-MB2018-19 and AVT–MB2019-20) in North Western Plains Zone (NWPZ) and results are presented in Figure 11 and 12 and Table 7 and 8. The grain and wort beta glucan contents were analysed from Karnal (two years i.e., IVT and AVT) and Hisar (one year i.e., AVT), because of high cost of analysis. The diastatic power was analysed from the malt samples from three locations (Karnal, Hisar and Bathinda) in first year (i.e. IVT 2018-19) and eight locations (Karnal, Hisar, Durgapura, Modipuram, Ludhiana, Pantnagar Bawal Bathinda) in second year (i.e. AVT 2019-20).

The preliminary data on grain and wort beta glucan contents indicate that the wort made from DWRB 197 has lowest beta glucan (409 ppm) despite having the highest grain beta glucan (6.7%) as compared to the three checks (Figure 11). This suggests relatively greater breakdown of this non-starch polysaccharide during malting process in DWRB 197, while in the check varieties the break down/ reduction in wort beta glucan from grain beta glucan was in the same order of the grain beta glucan content. This observation opens the door for future studies on the differential activities of the beta glucanase in Indian barley germplasm, which will be taken up in detail in coming seasons.

The genotype DWRB 197 has numerically higher diastatic power as compared to check varieties, over the samples analysed from 11 locations over two years (Figure 12). The other grain and malt

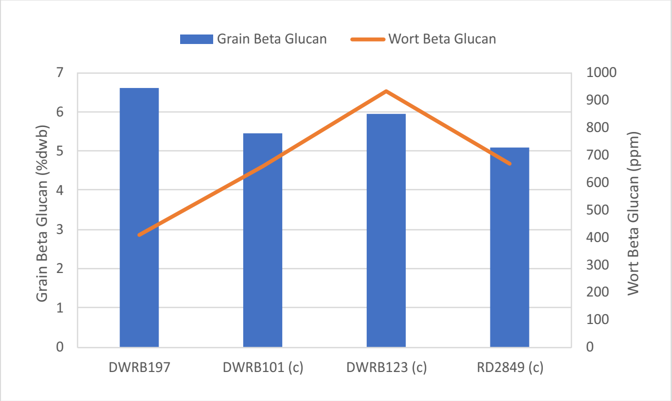

Figure 11. Average grain and wort beta glucan in different genotypes

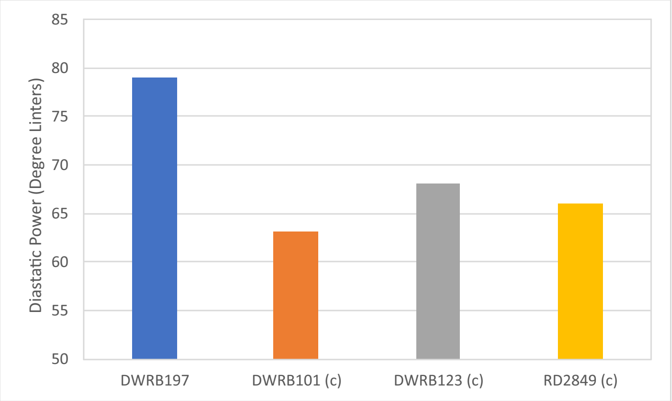

Figure 12. Avearge Diastatic power (oL) in malt of different genotypes

Table 7: Average grain quality traits of DWRB 197 and checks during 2018-19 and 2019-20

Genotype	TW**	TGW	Bold	Thin	Protein	Husk	Germ
DWRB197	64.5	49.0	94.0	0.8	11.3	11.7	98.0
DWRB101 (c)	66.0	49.0	92.5	1.2	10.7	10.5	98.0
DWRB123 (c)	66.0	53.5	95.0	1.0	10.6	11.1	99.0
RD 2849 (c)	66.0	48.5	90.5	1.5	10.5	11.2	98.0

*Average values of two years (2018-19 & 2019-20) over different locations in North Western Plains Zone
**TW = Test Weight (Kg Hl^{-1}); TGW = Thousand grain weight (g); Bold = Bold grains percentage (> 2.5 mm); Thin = Thin grain percentage (< 2.2 mm); Protein = Grain protein (% dry weight basis); Husk = Husk content percent dry weight basis; Germ = Percent germination after 72 hours at 18°C in 4 ml water test

Table 8: Average malt quality traits of DWRB 197 and checks during 2018-19 and 2019-20

Genotype	FB**	FR	HWE	FAN	KI
DWRB197	64.0	196.0	77.5	201.0	39.5
DWRB101 (c)	62.5	209.5	79.5	201.0	38.0
DWRB123 (c)	50.0	205.0	79.0	163.5	38.5
RD 2849 (c)	63.0	215.5	79.5	190.5	39.0

*Average values of two years (2018-19 & 2019-20) over different locations in North Western Plains Zone
**FB = Malt Friability (%); FR = Filtration Rate (ml hr^{-1}); HWE = Hot Water Extract (%fgdwb); FAN = Free Amino Nitrogen (ppm); KI = Kolbach Index (%)

quality traits across two years on total of 11 locations are given in Table 7 and 8, respectively.

Over all the information indicates that DWRB 197 is a potential genotype for the two very important malting quality traits being sought by industry and may serve a base in barley programme to be improved further to get a commercially acceptable malting type cultivar. Also, the potential variability for beta glucan degradation in the germplasm opens the doors for further basic studies as well as its utilization in breeding programme.

Strategy to improve nitrogen use efficiency through nanofertilizer

Ajit Singh Kharub, Subhash Chander, RS Chhokar and Dinesh Kumar

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Nitrogen is the most important and the least soil available plant nutrient which is required in large quantity for chlorophyll synthesis by the cereals. Nitrogen use efficiency (NUE) has a significant importance in grain formation. Nutrient efficiency is the increase in yield of the harvested fraction of the crop per unit of nutrient supplied. Through efficiency itself, soil nitrate-N is converted into grain N. The nitrate-N comes from fertiliser, crop residues, manures, and soil organic matter, but it is the efficiency of conversion of fertiliser into grain that is generally of the greatest concern to growers. The NUE has been reported to be varying between 30-50% depending on the crops and the management. In wheat and barley, it is reported to be around 40- 45%. The management strategies for enhancing NUE are genetic improvement through N utilization efficient genotypes, adoption of the best crop management practices such as right dose, right time, right method and right source of N fertilizer, optimum water and weed management, site-specific N management, balanced use of NPK and adequate amount of deficient secondary micro-nutrients, integrated use of nutrients, use of water-soluble fertilizers through fertigation and use of neem-coated/ super-granules/ innovative N fertilizers along with the deployment of recently introduced nano-fertilizers.

Nano-fertilizer is a way to increase nutrient efficiency and improve plant nutrition in comparison to traditional fertilizers. A nanofertilizer is any product that is made with nanoparticles [1 -100 nanometres (nm) in size]. Nano materials can increase crop yield by increasing fertilizer nutrient availability in soil and nutrient uptake by plants. These environment - friendly products have potential to reduce usage of conventional chemical fertilisers besides raising crop output. Nano-nitrogen, which is developed as an alternative to urea, has the potential to cut the requirement of urea by 50 per cent as reported by experts. Nano-fertilizers offer benefits in nutrition management through their strong potential to increase nutrient use efficiency. Nutrients either applied alone or in combination, are bound to nano-dimensional adsorbents, which release nutrients very slowly as compared to conventional fertilizers. Nano-fertilizers have also been supported to have higher NUE owing to higher transport and delivery of nutrients through plasmodesmata (~50–60 nm size channels) for transportation of ions between cells.

Benefits of Nano fertilisers

- Nano-fertilizers feed the crop plants gradually in a controlled manner in contradiction to rapid and spontaneous release of nutrients from chemical fertilizers.
- Nano-fertilizers are more efficacious in terms of nutrients absorption and utilization owing to considerably lesser losses in the form of leaching and volatilization.
- Nanoparticles record significantly higher uptake owing to free passage from nano sized

pores and by molecular transporters as well as root exudates. Nanoparticles also utilize various ion channels which lead to higher nutrient uptake by crop plants.

- Due to considerably small losses of nano-fertilizers, these can be applied in smaller amounts in comparison to synthetic fertilizers which lead to lower risk of environmental pollution.
- Comparatively higher solubility and diffusion impart superiority to nano-fertilizers over conventional synthetic fertilizers.
- Heavy transportation and logistics are not required for nano-fertilizers.

Limitations

1. Production, durability and availability of nano-fertilizers in required quantities is the foremost limitation in wider scale adoption of nano-fertilizers as a source of plant nutrients.
2. Lack of recognized formulation and standardization which may lead to contrasting effects of the same nano-materials under various pedo-climatic conditions.
3. There are many products claimed to be nano but in fact are submicron and micron in size. This dilemma is feared to remain persistent until and unless uniform size of nanoparticles (1–100 nm) gets implemented.
4. The higher cost of nano-fertilizers is a hurdle in the way of promulgating them for crop production under varying pedo-climatic conditions across the globe.

Considering the above facts in view, it is the need of hour to initiate the multi-locational field trials of this technology on barley and wheat crops so as to have definite conclusion and standardization of this new emerging technique of plant nutrition. In this direction the trials have been initiated at ICAR-IIWBR, Karnal during *rabi* 2020-21.

DWRB 217: A six-row hulless barley genotype resistant to stripe rust

Jogendra Singh, Sudheer Kumar, OP Gangwar, Dinesh Kumar, Lokendra Kumar, Chuni Lal, Rekha Malik, Ajit Singh Kharub and RPS Verma

ICAR-Indian Institute of Wheat and Barley Research, Karnal

DWRB 217 (evaluated as DWRNB 25) is a six-row hulless barley genotype, which was selected from exotic barley breeding material (INBYT-HI-2, ICARDA in 2013) received from ICARDA, Morocco (Figure 13). The genotype (entry number 2 of the INBYT-HI) is a cross of PETUNIA2/ML12. DWRB217 was evaluated for morpho-physiological traits at ICAR-IIWBR, Seed and Research Farm, Hisar, and screened for stripe rust (*Puccinia striiformis* f. sp. *tritici*) reaction in Initial Barley Disease Screening Nursery (IBDSN) at five locations namely, Bajaura, Ludhiana, Durgapura, Jammu and Karnal during (2016-17) under artificial epiphytotic conditions. The tested genotype DWRB 217 (DWRNB 25) showed highly resistance stripe rust reaction (TMR) in IBDSN at adult plant stage (Table 9). The check cultivars as well as infector showed high susceptible reaction

Figure 13. DWRB217 (DWRNB25), a six-row hulless barley genotype highly resistant to stripe rust at seedling as well as in field screening

Table 9: Stripe rust reaction of DWRB 217 (DWRNB 25) at adult plant stage during 2016-17

Genotype	Durgapura	Ludhiana	Bajaura	Jammu	Karnal	ACI	HS
DWRB 217	TMR	0	0	0	0	0.08	TMR
Karan16 ©	60S	5S	60S	0	20S	29.0	60S
NDB 943©	100S	60S	80S	80S	80S	80.0	100S
PL 891©	40S	0	30S	20S	0	18.0	40S
Infector	100S	60S	100S	80S	80S	84.00	100S

Table 10: Stripe rust reaction of DWRB 217 (DWRNB 25) at adult plant stage during 2019-20

Genotype	Durgapura	Ludhiana	Bajaura	Jammu	Karnal	Hisar	Almora	ACI	HS
DWRB 217	5MR	10S	0	10MS	5MS	0	NG	4.0	10S
Karan16 ©	60S	40S	20S	40S	5MS	0	10S	24.9	60S
NDB 943©	100S	80S	80S	60S	0	0	NG	53.3	100S
PL 891©	10MR	0	30S	0	60S	60S	0	22.0	60S
Infector	100S	60S	100S	80S	100S	84.00	100S	88.6	100S

ACI: average coefficient of infection; HS: Highest score

Table 11: Stripe rust reaction of DWRB 217 (DWRNB 25) at seedling resistance during 2019-20

Genotype	Pathotypes						
	57	24	M	G	Q	6S0	7S0
DWRB 217	S	MS	R	R	R	R	R
Karan16 ©	S	S	S	MS	S	S	S
NDB 943©		S	S	NG	S	S	S
PL 891©	NG	R	NG	NG	S	NG	S

against stripe rust indicating sufficient inoculum load for genotype screening.

The genotype was again screened for stripe rust at seven locations in National Barley Disease Screening Nursery (NBDSN) during 2019-20. DWRB 217 revealed resistance to stripe rust with average coefficient of infection (ACI) of 4.0 and highest score (HS) of 10S at adult plant stage (Table 10), while all the check varieties have shown susceptible to highly susceptible reactions in terms of ACI and HS values.

This genotype was also screened in Seedling Resistance Tests (SRT) against 7 pathotypes (M, G, Q, 6S0, 7S0, 57 and 24) for infection response during 2019-20 (Table 11). DWRB217 exhibited resistance against five currently prevalent pathotypes (M, G, Q, 6S0 and 7S0) including the two new pathotype races. It showed S and MS reactions only to the two very old pathotypes 57 and 24, respectively. This also supports the field screening results with the currently prevailing pathotypes. The check cultivars showed susceptible reaction against all 7 pathotypes except PL 891 having resistant response to pathotype 24.

The average data of AICRP huskless barley trials of 2019-20 in NWPZ indicate that DWRB 217 flowers in 92 days and matures in 135 days. Its average plant height is 106 cm and has 117 Tillers meter^{-1} The average spike length is 8.0 cm having 73 grains per spike. The grain analysis indicates that it has 38.2 g thousand grain weight and 64.2 Kg ha^{-1} test weight with protein content of 12.8%, which is good for six-row huskless grain.

Identification of promising *Aegilops* germplasm with aphid resistance

Poonam Jasrotia, Sindhu Sareen, Prem Lal Kashyap, Sudheer Kumar and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

Aphids are one of the economically important insect-pests of wheat. There are four key species that cause damage to wheat *viz.*, *Rhopalosiphum maidis* (Fitch), *Rhopalosiphum padi* L. *Sitobion miscanthi* and *Sitobion avenae* (Fabricius). Amongst these, the corn leaf aphid (CLA), *Rhopalosiphum maidis* (Figure 14), is a serious economic pest of wheat in North Western Plains Zone (NWPZ) of India. Aphids cause damage to shoots and ear heads by sucking the sap. The shoots turn yellowish in colour and the whole plant gives stunted appearance, while under severe incidence sometimes even the spikes fail to emerge causing absolute loss of grains. The aphids cause around 20–30% yield loss during outbreaks and up to 14% yield loss during early infestation at ear emergence. Under higher pest-pressure, only insecticides can give sufficient protection, but these are expensive, environmentally undesirable and have problem of development of insecticide resistance. Therefore, incorporation of genetic resistance in wheat varieties is the best alternative to manage aphids as it is sustainable, cost-effective and environmentally safe. Host plant resistance promotes cumulative protection without any environmental hazards with least management cost. Reduction in genetic diversity has been reported in modern wheat, compared with wild ancestors, which is thought to be due to population bottlenecks. In literature, it is reported that wild genotypes have prominent resistance against diseases e.g. rusts and also against insects e.g. aphids. The reports of Russian wheat aphid (*Diuraphis noxia* Mordvilko) resistance in wild wheats are available in literature. Since resistance is present in wild wheat against Russian wheat aphid, there exists a possibility of its presence against aphid species prevalent in India. Keeping this in view, the present studies were planned to identify sources of resistance against CLA, (*R. maidis*) under screen house conditions. The screening of 198 *Aegilops* accessions was done against CLA during four seasons i.e. 2017, 2018, 2019 and 2020 to determine the aphid resistance response.

Table 12: Grading and rating of foliar aphid infestation on *Aegilops* accessions

Grade	Approx. numbers of aphids/shoot	Rating
1	0	Immune
2	1-5	Resistant
3	6-10	Moderately resistant
4	11-20	Susceptible
5	21 and above	Highly susceptible

The aphid screenings was done by recording out aphid count/shoots from all these accessions, three times during the season and grades were given according to 5 point grading system described below.

On the basis of average grading of the aphid infestation, all entries were either categorized as resistant (grade 2) or moderately resistant (grade 3) or susceptible (grade 4) or highly susceptible (grade 5) to foliar aphid (Table 12). Amongst the tested genotypes, ten accessions gave resistant response to aphids and are listed in Table 13. Sixty six accessions were found to be moderately resistant (grade 3) and

Figure 14. Colony of *Rhopalosiphum maidis*

Table 13: Response of *Aegilops* germplasm to corn leaf aphid (CLA), *Rhopalosiphum maidis*

S.No.	Species	Acc. No	2017		2018		2019		2020		Average	
			Average no. of aphids shoot	Grade (Rating)	Average no. of aphids shoot	Grade (Rating)	Average no. of aphids shoot	Grade (Rating)	Average no. of aphids shoot	Grade (Rating)	Average no. of aphids shoot	Grade (Rating)
1	*Aegilops ovata*	23	2.33	2(R*)	2.9	2(R*)	2.6	2(R*)	2.3	2(R*)	2.5	2(R*)
2	*Aegilops tauschii*	59	1.2	2(R*)	1.7	2(R*)	2.4	2(R*)	2.6	2(R*)	2.0	2(R*)
3	*Aegilops tauschii*	15	2.4	2(R*)	3.4	2(R*)	3.6	2(R*)	2.9	2(R*)	3.1	2(R*)
4	*Aegilops tauschii*	3758	2.5	2(R*)	3.1	2(R*)	3.2	2(R*)	2.5	2(R*)	2.8	2(R*)
5	*Aegilops tauschii*	14336	2	2(R*)	2.2	2(R*)	2.1	2(R*)	2.7	2(R*)	2.3	2(R*)
6	*Aegilops tauschii*	14338	2.2	2(R*)	3.1	2(R*)	1.9	2(R*)	2	2(R*)	2.3	2(R*)
7	*Aegilops tauschii*	3761	2.3	2(R*)	2.8	2(R*)	2.5	2(R*)	2.1	2(R*)	2.4	2(R*)
8	*Aegilops tauschii*	9795	3.4	2(R*)	2.9	2(R*)	3.7	2(R*)	2.4	2(R*)	3.1	2(R*)
9	*Aegilops tauschii*	3806	2.2	2(R*)	2.6	2(R*)	1.9	2(R*)	1.6	2(R*)	2.1	2(R*)
10	*Aegilops tauschii*	13757	1.5	2(R*)	1.7	2(R*)	1.5	2(R*)	2.1	2(R*)	1.7	2(R*)
11	A-9-30-1 Susceptible Check	-	23	5(HS**)	33.3	5(HS**)	29.5	5(HS**)	32.1	5(HS*)	29.5	5(HS*)

*Resistant, **Highly susceptible

57 were found in susceptible category (grade 4). The differential behavior of aphid response to *Aegilops* germplasm clearly indicates that there is wide genetic diversity available among these genotypes that can be further be explored to identify aphid resistant sources and their further utilization in wheat breeding program.

DWAP 18-07 and DWAP 18-12: Promissing genotypes for water scarcity (limited irrigation) conditions of warmer areas

SK Singh, RP Gangwar, Snehanshu Singh, Amandeep Kaur, Suresh Kumar, Pradeep Sharma, Gopalareddy K and Mamrutha HM

ICAR-Indian Institute of Wheat and Barley Research, Karnal

The wheat improvement programme for warmer areas has successfully utilised shuttle breeding approach for the development of target oriented genotypes especially for water stress conditions. Wheat crop is exposed to warmer climatic conditions in all the major wheat growing zones but crop in central and peninsular experiences harsher environmental conditions due to water scarcity and higher temperatures during crop stages. Seventy elite lines including seven checks were evaluated at ten locations during 2019-20 crop season in replicated trials under timely sown irrigated (IR-TS) and restricted irrigation conditions (TS-RI). In IR-TS, all the recommended irrigations were given whereas under TS-RI condition, one pre-sowing and one irrigation at 45DAS were applied. The check varieties are the latest commercial cultivars of all the zones for various production conditions. The yield data was pooled and the SSI and percent reduction of yield under stress conditions were estimated. The pooled analysis of SSI and reduction (%) indicated wide range of variability in the experiment. In general, the genotypes having SSI <1.0 is considered as stress tolerant genotypes. The results indicated that seven genotypes showed SSI and Red (%) lower than the best check DBW 110. Two genotypes namely DWAP 1807 and DWAP 1812 showed very low SSI compared to best check variety DBW 110 and were identified as potential source for water stress tolerance under water scarcity (limited irrigation) conditions (Table 14). The performance of these genotypes for different yield component traits is shown in following table

Table 14: Pooled performance of stress tolerant genotypes for various traits under irrigated and restricted irrigation conditions

S. No.	Entry	Production condition	Days to Heading	Days to maturity	Grain filling duration	Plant height (cm)	Tillers per m row	Spike length (cm)	Spikelets per spike	Grains per spike	1000-gr. weight (g)	Stress susceptibility index (SSI)	Reduction in yield under stress (%)
1	DWAP 1807	IR	74	119	45	87	116	10	20	53	41	0.14	3.54
		RI	72	118	46	84	120	9	17	45	37		
2	DWAP 1812	IR	72	118	46	90	93	10	19	48	41	0.15	3.96
		RI	68	115	48	81	86	8	14	38	39		
3	DBW 110 ©	IR	73	118	46	89	105	10	18	61	43	0.66	17.04
		RI	70	116	47	82	79	9	15	44	41		
4	DBW 93 ©	IR	72	117	46	74	101	9	18	57	39	0.70	18.05
		RI	69	114	45	73	87	8	17	48	35		
5	HD 2967 ©	IR	73	118	46	87	115	9	19	53	41	1.04	26.59
		RI	71	114	43	80	112	9	17	52	37		
6	HD 2932 ©	IR	66	116	50	93	95	10	19	51	42	1.12	28.79
		RI	67	116	49	90	85	9	17	53	39		
7	GW 322 ©	IR	70	117	47	88	107	10	18	51	40	1.25	31.99
		RI	67	117	49	80	91	9	17	51	38		
8	MACS 6222 ©	IR	71	116	46	87	105	10	19	57	41	1.28	32.78

IR- Irrigated condition; RI- Restricted irrigation condition

under irrigated and restricted irrigation conditions along with check varieties. Although these genotypes showed reduction in values for different traits under RI condition but the reduction is low as compared to check varieties that showed their more adaptability to stressed conditions. These genotypes can be used as source of drought stress tolerance in the wheat improvement programmes for abiotic stress tolerance.

Promotion and evaluation of DBW 222 at the farmers' field - An experimental approach

Sendhil R, Satyavir Singh, Raj Kumar, Anuj Kumar, Anil Kumar Khippal, Mangal Singh, Ramesh Chand and GP Singh

ICAR-Indian Institute of Wheat and Barley Research, Karnal

Seed is the most crucial input in agriculture and a carrier of modern technology in the form of improved varieties. Demonstration of latest varieties at farmers' field is usually carried out to promote the crop variety as well as to strengthen the seed value chain with an emphasis on increasing the seed and variety replacement rate. In the context, promotion and evaluation of a recently developed wheat variety (DBW 222: Timely Sown and Irrigated) by the ICAR-IIWBR, Karnal has been adopting the experimental approach at farmers' field in Haryana and Punjab. During November 2020, 40 Kg seed of DBW 222 was given to the randomly selected farmers covering 160 acres in Haryana and Punjab to promote the latest variety among farmers. The randomised controlled trial (RCT) has been submitted to the 'Global Registry' of the RCTs for registration (https://doi.org/10.1257/rct.7102-1.2000000000000002). In addition, we selected 20 farmers in Phurlak village of Karnal district and provided with 10 Kg seed of DBW 222 in November 2020 to raise their seed crop in 0.5 acres of land under the supervision of experts with respect to monitoring and evaluation of 'experimental seed plot' condition as well as to provide training on quality seed production. The aim of the project is to extensively promote the latest wheat variety (DBW 222) among the farmers as well as to develop a 'seed value chain model' in the experimental village (Phurlak) through demonstration and subsequent replication to other wheat growing regions. The feedback derived from the beneficiaries of the project will guide the researchers, extension personnel and policy makers to devise a framework for strengthening the seed system in India.

INSTITUTIONAL ACTIVITIES

59th All India Wheat and Barley Research Workers' Meet

The 59th All India Wheat and Barley Research Workers' Meet was virtually organized by the ICAR-Indian Institute of Wheat & Barley Research, Karnal from August 24-25, 2020. The meet was inaugurated by Dr. T Mohapatra, Secretary, DARE & Director General, ICAR, New Delhi. The other dignitaries who graced the occasion were Dr. TR Sharma, DDG (Crop Science), Dr. YP Singh, ADG (FFC), Dr. AK Singh, Director, IARI, New Delhi and Dr. AK Joshi, CIMMYT Co-ordinator, India. The meeting had five sessions for reviewing the research progress of 2019-2020, five year work performance of central zone centres and planning of 2020-21 wheat crop season trials. Besides, one session on International collaborations with CIMMYT, ICARDA and HARVEST PLUS was also held wherein research program with these organizations was discussed.

Dr. T Mohapatra, Secretary, DARE & Director General, ICAR, New Delhi delivering the inaugural address during the virtual 59th All India Wheat and Barley Research Workers' Meet

VS Mathur Memorial Award Lecture

Dr Hans-Joachim Braun, Director, Global Wheat Program, CIMMYT, Mexico delivered the VS Mathur Memorial Award lecture on September 8, 2020.

Celebrated Gandhi Jayanti Utsav

Institute celebrated a week-long Gandhi Jayanti Utsav from September 25 to October 2, 2020. Number of events like importance of cleanliness, painting competition, swachhata abhiyan, yoga day, debate competition, poetry presentation on Gandhiji, tree plantation, slogan writing were organized. On 2nd October, 2020 a special programme was organized in which each and every employee of ICAR-IIWBR taken the Swachhta Oath followed by lecture by Dr. Anoop Kumar Mishra from BHU and he threw light on the philosophy of life of the Father of the Nation, Mahatma Gandhi.

Tree plantation during Gandhi Jayanti Utsav

Institute Research Council Meeting (2020)

The Institute Research Council Meeting (IRC) was held on 29th October, 2020 at ICAR-IIWBR under the Chairmanship of Dr. GP Singh, Director, ICAR-IIWBR, Karnal in virtual mode in view of the COVID-19 guidelines. The Research Project Proposal – III (2015-20 projects) presentations were made by different programme leaders. A total of ten programmes for the period 2020-25 were approved by the IRC.

Institute Management Committee

The XXVIII meeting of Institute Management Committee was held under the chairmanship of Dr. GP Singh, Director, IIWBR, Karnal in virtual mode on November 28, 2020. The agenda note was discussed in detail during the meeting.

Swachhta Pakhwada

Swachhta Pakhwada was celebrated from 16th to 31st December, 2020. During this period, three different awareness programmes were organized in villages Sikander Kheri (district Kaithal) & Kaimla and Nali- Khurd (both from District Karnal). Two “Sanitation and SWM"' activities were carried out, one in the Gehoon Vihar campus and another at ICAR-IARI Regional station residential area. A meeting was organized using video conferencing mode to share among the participants their experiences on household waste management. Participants from Karnal, Varanasi and Bangalore joined the meeting by virtual mode. Two short videos prepared on how to go for waste management were shared. Three separate competitions were organized *viz.*, essay writing, elocution and painting competition for various categories involving students, staff and contractual employees.

Distinguished Visitors

August 10, 2020: Sh. Sanjay Bhatia, Member of Parliament of Karnal Constituency visited ICAR-IIWBR, Karnal.

Awards

Dr. MV Rao Memorial Award 2020

Dr. MV Rao Memorial Award 2020 by the Society for Advancement of Wheat and Barley Research (SAWBAR) awarded to Dr. Sewa Ram for his outstanding contribution in the field of wheat quality research.

Dr. Sewa Ram receiving the Dr. MV Rao Memorial Award 2020 from Dr. GP Singh, President, Society for Advancement of Wheat and Barley Research

Dr. S. Nagarajan Memorial Award, 2020

Dr. SK Singh receiving the S Nagarajan Memorial Award, 2020 from Dr. GP Singh, President Society for Advancement of Wheat and Barley Research

Dr. SK Singh, Principal Scientist, ICAR-IIWBR, Karnal was awarded with Dr. S. Nagarajan Memorial Award, 2020 for his immense contribution in wheat and barley research.

Professor Mahatim Singh Memorial Award 2020

Dr. Mamrutha HM was awarded with Professor Mahatim Singh Memorial award 2020 by the Society for Advancement of Wheat and Barley Research, (SAWBAR)Karnal, Haryana.

Dr. Mamrutha HM receiving the Professor Mahatim Singh Memorial Award 2020 from Dr. GP Singh, President, SAWBAR

Dr. YM Upadhyaya Memorial Lecture

Dr. Ratan Tiwari, Principal Scientist delivered the Dr. YM Upadhyaya Memorial Lecture titled "Can wheat be more resilient in post genome sequence era?" organized by ICAR-IARI Regional Station Indore on 11th September, 2020 through Video Conferencing mode.

Fellow of the Indian Society of Plant Genetics Resources

Dr. SK Singh was elected as fellow of the Indian Society of Plant Genetics Resources, New Delhi for his contribution in the evaluation and conservation of wheat genetic resources.

Fellow of the Society for Advancement of Wheat and Barley Research

Dr. Anil Khippal, Dr. Sendhil R and Dr. OP Gupta were honored as elected fellow of the Society for Advancement of Wheat and Barley Research (2020).

Awards bestowed by ICAR- IIWBR

- Dr. Ravindra Kumar received "First Prize" in *Kavita Lekhan* competition organized by ICAR-IIWBR during *Rajbhasha Utsav evam Hindi Pakhwada* from September 14-30, 2020.
- Dr. Ravindra Kumar received "First Prize" in Essay Writing Competition (Hindi) organized by ICAR-IIWBR during *Rajbhasha Utsav evam Hindi Pakhwada* from September 14-30, 2020.
- Dr. Ravindra Kumar awarded "Appreciation Prize" in *Best worker* Competition (maximum use of Hindi in official work) organized by ICAR-IIWBR during *Rajbhasha Utsav evam Hindi Pakhwada* from September 14-30, 2020.

Awards for promotion of Hindi language

- Satyavir Singh, Anuj Kumar, Sendhil R, Anil Kumar Khippal, Mangal Singh, Ramesh Chand and GP Singh awarded the first prize for editing "Gehun Evam Jau Sandesh, Jan-June 2019, Vol. 8(2)" in newsletter category from Town Official Language Implementation Committee (TOLIC), Department of Official Language, MHA (Govt. of India), Karnal.
- Satyavir Singh, Anuj Kumar, Sendhil R, Anil Kumar Khippal, Mangal Singh,

Ramesh Chand and GP Singh awarded the second prize for editing "Gehun Evam Jau Sandesh, Jan-June 2019, Vol. 8(1)" in newsletter category from Town Official Language Implementation Committee (TOLIC), Department of Official Language, MHA (Govt. of India), Karnal.

- Dr. Ravindra Kumar received a Commendation Certificate from Town Official Language Implementation Committee (TOLIC), Department of Official Language, MHA (Govt. of India), Karnal on 4th August, 2020 for promoting the use of official language (Hindi) during the year 2019-20.
- Drs. Ravindra Kumar, Nisha Kant Chopra and VK Pandita received the second prize for Technical Bulletin "*Gunvattayukt beej utpadan hetu uchit krishi kriyaayen* (TB-ICN: H 169/2019) in technical bulletin category from Town Official Language Implementation Committee (TOLIC), Department of Official Language, MHA (Govt. of India), Karnal on 4th August, 2020.
- Raj Pal Meena, Karnam Venkatesh, Rinki, RK Sharma, Anuj Kumar and GP Singh awarded consolation prize for folder "Suxm sinchai: *Pani bachane ki nipun taknik*" in Hindi folder category by Town Official Language Implementation Committee (TOLIC), Department of Official Language, MHA (Govt. of India), Karnal on 4th August, 2020.

Capacity Building

Training organized

- Organized a three-day training programme on "Empowering Rural Youth for Self-reliance in Seed Sector" at ICAR-IIWBR, Karnal through virtual mode under the HRD component of ICAR Seed Project during November 24-26, 2020.
- Trainings (online) on barley for malting uses and cultivation of improved varieties was given to the farmers of Haryana and Rajasthan under the consultancy project of ICAR-IIWBR and ABInBev India during Oct-Dec. 2020 by the barley team led by Dr. RPS Verma.

Skill Development Programme

- ICAR-IIWBR organized a one-month summer training programme on "Skill Development and Enhancing Research Capacity of Young Scholars" during July 16 to August 17, 2020.
- ICAR-IIWBR organized a two-month training programme on "Rural Agricultural Work Experience for Skill Development" during September 14 to November 13, 2020.

National and International Days

- Women Day celebration was held at village Furlak Karnal, Haryana on 15th October, 2020
- 70th Constitution Day was celebrated on 26th November, 2020
- Agricultural Education Day at ICAR-IIWBR, Karnal, Haryana was organised on 03rd December, 2020
- World Soil Day at village Nabipur Karnal,

Haryana was held on 05th December, 2020

- National Farmers Day at village Nabipur, Karnal, Haryana was held on 23rd December, 2020

Farmer Visit

Fifty Farmers from Basti, Uttar Pradesh visited ICAR-IIWBR, Karnal on November 20, 2020

Personnel

New Joining

- Dr. Sunil Kumar, Pr. Scientist joined ICAR-IIWBR Karnal on 19.08.2020 on account of his transfer from ICAR-CIPHET, Ludhiana.
- Dr. Umesh R Kamble, Scientist joined ICAR-IIWBR Karnal on 24.08.2020 on account of his transfer from ICAR-IISS, Mau.
- Sh. Gajanand Yadav, Sr. Admin. Officer joined ICAR-IIWBR Karnal on 31.12.2020 on account of his transfer from ICAR-IISWC, Dehradun.

Promotions

Scientific staff

- Dr. Amit Sharma, Sr. Scientist promoted to Pr. Scientist from RGP ₹9000 to ₹10000
- Dr. Poonam Jasrotia, Sr. Scientist promoted to Pr. Scientist from RGP ₹9000 to ₹10000
- Dr. Ankita Jha, Scientist promoted from ₹6000 to ₹7000

Technical

- Sh. Rajesh Kumar STA promoted to Technical Officer
- Sh. Bhal Singh, STA promoted to Technical Officer

Administration

- Smt. Promila Verma, Assistant promoted to Asstt. Administrative Officer
- Sh. Ramesh Chand, UDC promoted to Assistant
- Smt. Sushila, UDC promoted to Assistant

Transfer

- Sh. Sachin Agnihotri, Sr. Administrative Officer transferred from ICAR-IIWBR, Karnal to ICAR-Research Complex for NEH Region, Umiam on 30.12.2020.

Retirements

- Smt. Jamuna Devi on 31.12.2020
- Sh. Raj Kumar, SSS on 31.12.2020

भाकृअनुप
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