

'Central Wheat HS562' - a high yielding wheat variety for timely sown production conditions of Northern Hill Zone

Dharam Pal^{1*}, Madhu Patial¹, KV Prabhu², J Kumar^{1,7}, Santosh Watpade¹, RN Yadav³, Sanjay Kumar², RK Sharma², GP Singh^{2,8}, Rajbir Yadav², Vinod², Anju M Singh², SV Sai Prasad⁴, IS Solanki^{6,9}, M Sivasamy⁵, JB Sharma², PK Singh², Neelu Jain², Niharika Mallik², Kiran Gaikwad², Tapas Ranjan Das⁶, Vikas⁵, Jaya Prakash⁵, JB Singh², Divya Ambati⁴, Vaibhav Singh², AN Mishra⁴, Shivadhar² and Ajay Arora²

¹ICAR-IARI, Regional Station, Shimla, India

²ICAR-Indian Agricultural Research Institute, New Delhi, India

³ICAR-Indian Agricultural Research Institute, Regional Station, Karnal, India

⁴ICAR-Indian Agricultural Research Institute, Regional Station, Indore, India

⁵ICAR-Indian Agricultural Research Institute, Regional Station, Wellington, India

⁶ICAR-Indian Agricultural Research Institute, Regional Station, Pusa, India

⁷ICAR-NIBSM, Raipur, India

⁸ICAR-Indian Institute of Wheat and Barley Research, Karnal, India

⁹ICAR-Krishi Bhawan, New Delhi

Article history

Received: 12 November, 2017

Revised: 06 December, 2017

Accepted: 28 December, 2017

Citation

Pal D, M Patial, KV Prabhu, J Kumar, S Watpade, RN Yadav, S Kumar, RK Sharma, GP Singh, R Yadav, Vinod, AM Singh, SV Sai Prasad, IS Solanki, M Sivasamy, JB Sharma, PK Singh, N Jain, N Mallik, K Gaikwad, TR Das, Vikas, Jaya Prakash, JB Singh, D Ambati, V Singh, AN Mishra, Shivadhar and A Arora. 2017. 'Central Wheat HS562' - a high yielding wheat variety for timely sown production conditions of Northern Hill Zone. *Journal of Wheat Research* 9(2):115-120. doi.org/ 10.25174/2249-4065/2017/76420

*Corresponding author

Email: dpwalia@rediffmail.com

© Society for Advancement of Wheat and Barley Research

Abstract

'Central Wheat HS562' - a high yielding wheat variety was released and notified by Central Sub-Committee on Crop Standards, Notification and Release of Variety, Ministry of Agriculture, Govt of India for cultivation under timely sown, rainfed and irrigated production conditions of Northern Hills Zone (NHZ). 'Central wheat HS562' produced an average grain yield of 36 q/ha with 6.2% grain yield advantage over best check HS507 under rainfed conditions of NHZ. Similarly, it recorded an average grain yield of 52.7 q/ha with 8.4% grain yield advantage over the best check HS507 under irrigated conditions of NHZ. This variety has ability to withstand the stripe rust pressure and recorded average coefficient of infection (ACI) ranging 3.6 - 13.0 under artificial inoculation conditions. It possesses good chapatti score (7.54) and bread making quality score (6.22) out of 10 along with good amount of Fe (38.4ppm) and Zn (34.5ppm) contents. Large scale deployment of this variety in North-Western Himalayan Region through various Government and non-Government organizations is anticipated not only to enhance wheat productivity of this region but would also curtail rust inoculum flow from hills to the wheat grown in North Western Plains Zone of India.

Key words: Wheat, new variety, rust resistance, northern hills

1. Introduction

Wheat is an important winter cereal of Western Himalayan Region (Jammu & Kashmir, Himachal Pradesh, Uttarakhand, hilly regions of West Bengal and north eastern states) occupying 1.39 million hectare area (Gupta and Kant, 2012). The average productivity is about 19.5 q/ha

(average of HP, J&K and Uttarakhand) as compared to the national average of 31.7 q/ha (Singh, 2017). Low productivity is primarily due to rainfed cultivation, losses due to biotic stresses, fragmented small land holdings and un-balanced use of fertilizers. Local land races of wheat are under cultivation of very high altitudes of the Himalayas either due to local

preferences or lack of awareness about improved wheat varieties (Pal *et al.*, 2007). During the last few crop seasons, stripe rust caused by *Puccinia striiformis* f. sp. *tritici* has emerged as major threat to the wheat not only grown in hilly states but also to the wheat crop of North-Western plains. In 2010-11; in Uttarakhand hills, stripe rust severity reached up to 80S with high prevalence on the local wheat and around 40S on the non-recommended improved varieties. In Himachal Pradesh, yellow rust was observed ranging 10-80S in parts of Kangra, Hamirpur, Bilaspur and Mandi districts (Kant and Jain, 2011). This is due to the fact that the stripe rust survives during summer at the higher altitudes of Himalayas and remains prevalent throughout the year causing a serious concern in the interior valleys of Himalayas (Kumar *et al.*, 1996), foot hills of Punjab, Haryana and North-Western plains from where a large portion of wheat is harvested to feed more than 1.25 billion population of the country. The most common, very effective and eco-friendly safe method for managing biotic stresses is to develop and deploy high yielding rust resistant wheat varieties in the hills. In this direction a high yielding variety 'Central Wheat HS562' was developed and released by Central Sub-Committee on Crop Standards, Notification and Release of Variety, Ministry of Agriculture, Govt of India for cultivation under timely sown, rainfed and irrigated production conditions of Northern Hills Zone (NHZ) vide S.O. 2238(E), June 29, 2016. Large scale deployment of this newly released wheat variety in North-Western Himalayas through various Government and non-Government organizations is anticipated to increase productivity and to minimize the rust inoculum load to avoid rust pandemic or epidemic type of situation in North-Western Plain Zone of the country.

2. Materials and methods

The 'Central Wheat HS562' was developed from selection in 28TH ESWYT having parentage (OASIS/SKAUZ//4*BCN/3/2*PASTOR) at Indian Agricultural Research Institute Regional Station (IARIRS), Shimla. 'Central wheat HS562' was evaluated as advanced breeding line under Preliminary Yield Trial (PYT) consisting of 13 genotypes and two checks at Shimla during *rabi* 2010-11 and subsequently evaluated under Common Varietal Trial (CVT) consisting of 16 entries at two locations (Shimla and Katrain) during *rabi* 2011-12. The crop was raised in 6 row, 3m x 1.2m plot size in a randomized block design with three replications under rainfed conditions. Data was recorded on days to 50% flowering, plant height (cm), 1000-grain weight (g) and grain yield (q/ha) in each of the three replications. Data were

analysed using statistical procedures suggested by (Panse and Sukhatme, 1995). Thereafter, the variety was entered in under All India Coordinated Research Project (AICRP) on wheat and barley improvement during 2012-13 and was evaluated at 27 locations under rainfed and at 13 locations under irrigated conditions of NHZ during 2012-13 to 2014-15. The data on grain yield, ancillary traits, diseases, agronomic parameters and quality traits were recorded, compiled and analyzed at IIWBR, Karnal. Data on characteristic features of 'Central wheat HS562' were recorded as per DUS guidelines.

3. Result and discussion

3.1 Grain yield ability and adaptability: The performance of 'Central Wheat HS562' was assessed under preliminary yield trial (PYT) for grain yield and its contributing traits during crop season 2010-11. It recorded average grain yield of 29.4 q/ha and showed grain yield superiority over check variety VL804 (5.75%) under rainfed situation at Shimla (Table 1). It has produced an average grain yield of 33.5 q/ha and showed significant grain yield superiority over check variety VL804 (22.2 q/ha) under common varietal trial (CVT) of Indian Agricultural Research Institute, New Delhi during crop season 2011-12 at Shimla and Katrain (Table 2). Based on significant grain yield superiority over the check and rust resistance under Initial Plant Pathological Nursery (IPPSN) 'Central wheat HS562' has entered for its testing in All India Coordinated Trials during 2012-13. Under coordinated trials of AICW&BIP, it has produced an average grain yield of 36 q/ha (weighted mean of 27 locations) with 6.2% grain yield advantage over the best check HS507 under rainfed conditions in NHZ. Similarly, it recorded an average grain yield of 52.7 q/ha (weighted mean of 13 locations) with 8.4% grain yield advantage over the best check HS507 under irrigated conditions of NHZ. It has shown consistent performance across the locations, appeared 17 times out of 27 locations in first non-significant group as compared to checks HS507 (14/27), VL907 (8/27), VL804 (7/22) and HPW349 (10/22) under rainfed conditions indicating its wide adaptability (Table 3). 'Central wheat HS562' has shown grain yield potential of 58.8 q/ha under rainfed and 62.2 q/ha under irrigated conditions of NHZ (Tiwari *et al.*, 2013, 2014, 2015). It has shown its flexible adaptation with highest gain (22.5%) of grain yield under increased nitrogen level (N=80) among all the checks under timely sown rainfed condition. It also showed grain yield advantage at N=60 as compared to checks HS507, HPW349 and VL804. It occupied first rank for grain yield and showed grain yield superiority over all the checks under late sown condition (Sharma *et al.*, 2015).

Table 1. Mean performance of genotypes for different traits in preliminary yield trial (PYT) under rainfed (RF) conditions during *rabi* 2010-11 at Shimla.

Genotype	Days to heading	Plant height (cm)	1000-grain weight (g)	Grain yield (q/ha)	APR Score to rusts in (IARI-PDSN)	
					Leaf rust	Stripe rust
WBM2356	133.6	93.0	45.0	24.1	20S	10S
WBM2357	160.0	87.3	44.0	22.5	10S	20S
WBM2358	141.0	104.3	46.0	35.3	TS	60S
WBM2359	139.3	106.6	43.6	18.5	TS	0
WBM2360	141.0	77.6	45.0	26.8	40S	TR
WBM2361 (HS562)	148.6	82.0	44.3	29.4	30S	TR
WBM2362	145.6	80.6	50.6	28.0	0	TR
WBM2363	147.3	82.6	53.0	25.9	20S	0
WBM2364	145.0	78.3	43.6	23.5	80S	0
WBM2365	145.0	87.0	49.3	28.9	80S	TR
WBM2366	145.3	91.0	50.0	26.9	0	0
WBM2367	136.6	89.0	52.6	20.8	0	0
WBM2368	134.3	84.6	55.6	16.3	5MS	0
HS240 (C)	152.6	85.6	39.6	30.2	-	-
VL804(C)	145.0	80.6	45.3	27.8	-	-
CD (0.05)	4.25	6.9	2.49	5.3	-	-
CV (%)	1.76	4.7	4.7	12.5	-	-

Table 2. Performance of 'Central Wheat HS562' for grain yield and other agronomic traits in common varietal trial (CVT) under rainfed condition during *rabi* 2011-12.

Genotype	Days to heading	Plant height (cm)	1000-grain weight (g)	Grain yield (q/ha)		
				Locations		Pooled (mean)
				Shimla	Katraain	
HS562 (WBM2361)	145.0	75.0	46.0	27.8	39.2	33.5
VL804 (C)	148.0	78.5	40.0	22.3	22.2	22.2
CD (0.05)	3.69	6.74	3.94	4.0	2.8	2.4
CV (%)	1.48	4.96	5.48	12.2	6.3	9.0

Table 3. Performance of 'Central Wheat HS562' over checks for grain yield under rainfed (RF) and irrigated (IR) conditions in NHZ during 2012-15.

Testing years	No. of locations	Improved variety HS562	Grain yield (q/ha) (Checks)			
			HS507	VL907	VL804	HPW349
RF-2012-13 to 2014-15	27	36.0	33.9 (6.2)	33.3 (8.1)	31.8 (13.2)	33.8 (6.5)
IR-2012-13 to 2014-15	13	52.7	48.6 (8.4)	47.0 (12.1)	45.4 (16.0)	46.8 (12.6)
Frequency of 'Central wheat HS562' in the top non-significant group						
Rainfed		17/27	14/27	8/27	7/22	10/22
Irrigated		8/13	6/13	3/13	3/9	1/9

Weighted mean % increase over the checks are given in parentheses.

Table 4. Response of 'Central Wheat HS562' and checks to stripe and leaf rusts under artificial inoculation conditions during 2012-15.

Rust/Condition	Improved variety HS562	Response to stripe and leaf rusts* (Checks)			
		HS507	VL907	VL804	HPW349)
Stripe rust					
Natural	20S (6.04)	20S (4.1)	30S (12.7)	60S (30.0)	60S (20.1)
Artificial	40S (13.0)	60S (9.8)	80S (20.5)	80S (34.9)	40S (15.8)
Leaf rust					
Natural	20S	10S	20S	100S	5S
Artificial	40S(10.4)	60S (12.8)	40S (10.4)	80S (28.8)	10S (3.6)

Table 5. Adult plant resistance (APR) in 'Central Wheat HS562' and checks to virulent and prevalent pathotypes of stripe and leaf rusts during 2013-15.

Pathotype	Improved variety HS562	Adult Plant Resistance Score (Checks)			
		HS507	VL 907	VL804	HPW349
Stripe rust					
46S119	10MS-10S	0-5S	0-20S	0-60S	TR-20S
78S84	0-5S	TR-10S	0-40MS	0-60S	10MS-20S
Leaf rust					
77-5	TR-20S	0-10S	0-15MR	0-40S	0-5MS
104-2	5MS-20MR	0-15MR	0-15MR	15MS-50S	0-20MS

3.2 Response to diseases: 'Central Wheat HS562' showed resistance to stripe rust at Rust Hot Spot, Dalang Maidan during summer season, 2009. Under All India coordinated trials, it showed field resistance to yellow rust as compared to checks during 2012-13 to 2014-15. The variety showed ability to withstand the stripe rust pressure and recorded average coefficient of infection (ACI) ranging 3.6 - 13.0 under artificial inoculation conditions. Similarly, it recorded ACI (1.8-10.4) for brown rust under artificial inoculation conditions (Table4). It possesses race specific adult plant resistance against prevalent pathotypes of yellow rust with score (10MS-10S) for 46S119 and (0-5S) for 78S84, whereas, the score against leaf rust pathotypes was (TR-20S) for 77-5 and (5MS-20MR) for 104-2 (Table5). It also showed low incidence to leaf blight as compared to the checks (Saharan *et al.*, 2013, 2014, 2015). 'Central wheat HS562' also possesses diverse combination of rust resistance genes

(*Lr23+*, *YrA+*, *Sr8a+8b+*) as postulated at Regional Station, IIWBR, Shimla to combat rust pathogens.

3.3 Quality traits: The wheat variety 'Central Wheat HS562' has good chapatti score (7.54) and bread making quality score (6.22) out of 10 along with Glu-D1(5+10), Glu-A1(1), Glu-B1(17+18) and Glu-1 score (10) and good amount of Fe (38.4 ppm) and Zn (34.5 ppm) contents (Gupta *et al.*, 2015). Wheat variety VL892 released for late sown production of NHZ (Kant *et al.*, 2010) was also reported to possess iron (37.2 ppm), zinc (35.7 ppm), copper (4.79 ppm) and manganese (49.8) coupled with good chapatti quality (6.92), indicating that the cultivation of micro nutrient rich wheat varieties in NHZ will provide nutritional security to the people of northern hills. It was comparable with the checks for other quality parameters *viz.*, extraction rate, grain hardness index, wet and dry gluten, gluten index, biscuit spread factor and yellow pigment contents.

3.4 Varietal description: 'Central Wheat HS562' has intermediate growth habit, tapering ear shape with intermediate ear density, mean height of 101cm (IR), 97 cm (RF) and takes 175 days and 183 days to mature under rainfed and irrigated conditions, respectively in NHZ. Average thousand grain weight of this variety is 43g with amber, semi-hard and ovate grains.

3.5 Conclusion: None of the wheat varieties released so far in NHZ which has grain yield ability equal to 'Central Wheat HS562'. It has shown stable high yield, wider adaptability, good quality and good levels of field resistance to leaf and stripe rusts. This variety could be an appropriate choice to replace highly rust susceptible wheat varieties viz., HS240, VL738 and VL804 and also provide an alternative to HS507, VL907 and HPW349 under timely sown production conditions of NHZ. Deploying 'Central Wheat HS562' at large scale in North-Western Himalayan Region would not only increase the wheat productivity of Northern Hill Zone but would also protect the wheat crop grown in North-Western Plain Zone of the country from the menace of rusts which is known to spread from hills to the plains.

Acknowledgment

The article is based on the CVRC proposal and the authors are highly thankful to all Principal- Investigators (Crop Improvement, Crop Protection, Quality & Resource Management) and Dr. Ajay Verma, Statistician, IIWBR, Karnal and all the cooperators of NHZ for their contribution. Authors are also thankful to Director, ICAR-NBPGR, New Delhi for their help in developing the variety.

References

1. Gupta, HS and L Kant. 2012. Wheat improvement in Northern hills of India. *Agricultural Research* 100-116 (DOI 10.1007/s400003-012-012-z).
2. Gupta RK, D Mohan, Sewa Ram, Sneha Narwal and Indu Sharma. 2015. *Progress report of All India Coordinated Wheat and Barley Improvement Project 2014-15, Wheat Quality* Vol. IV, Indian Institute of Wheat and Barley Research, Karnal, India, pp221.
3. Kant L, Pant SK, Mahajan V, Gopinath KA and HS Gupta. 2010. Performance of micronutrients-rich, rust-resistant early-maturing, high-yielding wheat (*Triticum aestivum*). *Indian Journal of Agricultural Sciences* 80(3): 203-207.
4. Kant L and SK Jain. 2011. Wheat yellow rust resurgence in the Northern hills and Tarai regions. *ICAR News* 17(3):14.
5. Kumar J, SK Nayar, M Prashar and S Nagarajan. 1996. Mapping of *Puccinia stiformis* race flora in Ladakh and other valleys of the interior Himalaya. *Cereal Rusts and Powdery Mildew Bulletin* 24: 98-104.
6. Pal D, S Kumar and JC Rana. 2007. Collection and characterization of wheat germplasm from North – West Himalaya. *Indian Journal of Plant Genetic Resources* 20(2):170-173.
7. Panse VG and PV Sukhatme. 1995. Statistical methods for agricultural workers. ICAR, New Delhi, pp. 1-359.
8. Saharan MS, R Selvakumar and Indu Sharma. 2013. *Progress report of All India Coordinated Wheat and Barley Improvement Project 2012-13, Crop Protection*, Vol. III, Indian Institute of Wheat and Barley Research, Karnal, India, pp252.
9. Saharan MS, Sudheerkumar, R Selvakumar, S Katare and I Sharma. 2014. *Progress report of All India Coordinated Wheat & Barley Improvement Project 2013-14, Crop Protection*, Vol. III, Indian Institute of Wheat and Barley Research, Karnal, India, pp261.
10. Saharan MS, Sudheer Kumar, R Selvakumar, S Katare, P Jasrotia and I Sharma. 2015. *Progress report of All India Coordinated Wheat and Barley Improvement Project 2014-15, Crop Protection*, Vol. III, Indian Institute of Wheat and Barley Research, Karnal, India, pp269.
11. Sharma RK, Subhash Chandra Tripathi, Subhash Chandra Gill, Rajendra Singh Chhokar, Raj Pal Meena, Ajay Verma and Indu Sharma. 2015. *Progress report of All India Coordinated Wheat and Barley Improvement Project 2014-15, Resource Management*, Vol. II, Indian Institute of Wheat and Barley Research, Karnal, India, pp124.

12. Singh GP. 2017. *Director's Report of AICRP on Wheat and Barley 2016-17*, ICAR-Indian Institute of Wheat and Barley Research, Karnal, Haryana, India, pp87.
13. Tiwari V, R Chatrath, G Singh, BS Tyagi, S Sareen, Raj Kumar, SK Singh, Satish Kumar, CN Mishra, K Venkatesh, Vikas Gupta, Ajay Verma and Indu Sharma. 2013. *Progress report of All India Coordinated Wheat and Barley Improvement Project 2012-13, Crop Improvement*, Vol. I, Indian Institute of Wheat and Barley Research, Karnal, India, pp318.
14. Tiwari, V, R Chatrath, G Singh, R Tiwari, BS Tyagi, S Sareen, Raj Kumar, SK Singh, Satish Kumar, CN Mishra, K Venkatesh, Vikas Gupta and Indu Sharma. 2014. *Progress report of All India Coordinated Wheat and Barley Improvement Project 2013-14, Crop Improvement*, Vol. I, Indian Institute of Wheat and Barley Research, Karnal, India, pp307.
15. Tiwari V, R Chatrath, G Singh, R Tiwari, BS Tyagi, S Sareen, Raj Kumar, SK Singh, Satish Kumar, CN Mishra, K Venkatesh, Vikas Gupta, Ajay Verma and Indu Sharma. 2015. *Progress report of All India Coordinated Wheat and Barley Improvement Project 2014-15, Crop Improvement*, Vol. I, Indian Institute of Wheat and Barley Research, Karnal, India, pp282.