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Varietal Release

VL *Gehun* 967: A high yielding, rust-resistant wheat (*Triticum aestivum* L.) variety, suitable for rainfed organic conditions of Uttarakhand hills of India

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Abstract

VL *Gehun* 967 is a rust resistant high yielding variety, released by Uttarakhand seed Sub-Committee and further notified by Central Sub-Committee on Crop Standards, Notification and Release of Variety. It has been recommended for cultivation under rainfed organic timely sown production conditions of Uttarakhand hills. VL *Gehun* 967 recorded an average grain yield of is 1.97 t ha^{-1}, which is 12.71% higher than the best check VL *Gehun* 907. This variety has recorded maximum average coefficient of infection (ACI) of 17.4 for stripe rust and 4.0 for leaf rust under artificial inoculation conditions indicating that it is resistant to both stripe and brown rust. It possesses 9.78 to 10.07% average protein, 76.37 to 79.73 kg/hl^{-1} hectoliter weight and 7.63 to 7.56 very good chapatti quality score, therefore, possessing very good quality for chapatti making and good flour recovery. The large scale cultivation of this variety in Uttarakhand hills under organic conditions would enhance wheat productivity and also help in reducing the inoculum load of rusts in hills of Uttarakhand due to its better resistance.

Key Words: Stripe and leaf rust, chapatti quality, winter x spring wheat derivative.

Introduction

Wheat is the most important winter cereal crop of Northern hills zone of India comprising the states of Uttarakhand hills, Himachal Pradesh, UTs of Jammu & Kashmir and Laddakh, hilly regions of North Eastern States and West Bengal. Wheat is cultivated in this region in around 1.39 m ha area (Gupta and Kant, 2012; Kant *et al.,* 2020), approximately 3.7% of the Country's wheat acreage. Although area and production wise, it is very small but cultivation of rust resistant varieties in this zone is one of the strategy to manage the rust inoculum load in the north-western plains, the wheat bowl of India. Uttarakhand (3.421 lakh ha) has largest area under Northern hills zone (NHZ). Around 50.2% (1.717 lakh ha) area is under hills, whereas 49.8 % (1.703 lakh ha) is under plains. The wheat productivity in plains (3.5 t ha^{-1}) is higher than the national average (3.0 t ha^{-1}) whereas, the productivity of hills (1.02 t ha^{-1}) is far below the national average (Anonymous, 2016; Chanda *et al.,* 2017). This may be attributed mainly to small and fragmented land holdings, unavailability of inputs (seed and fertilizer, etc.) at appropriate time and place, and poor extension of latest technologies. In addition to this, the prevalent varieties, *viz.*, 'VL *Gehun* 907' and 'HS 562', under rainfed as well as irrigated timely sown conditions of NHZ including Uttarakhand have started showing susceptible

reactions to the new virulent pathotypes of stripe and leaf rust pathogens under changed climatic conditions. Therefore, farmers are left with limited alternatives to cultivate the above varieties. Further, the wheat cultivation in hilly areas is constrained due to predominant rainfed cultivation and still be considered as organic by default as farmers rarely apply fertilizers and chemicals.

The most effective strategy to manage the menace of rust diseases is deploying rust resistant high yielding wheat varieties. However, for deployment, we require specific set of varieties, with wider adaptability as well as capability to yield higher under rainfed organic conditions of hills. Therefore, a breeding programme was undertaken at ICAR- *Vivekananda Parvatiya Krishi Anusandhan Sansthan* (VPKAS), experimental Farm, Hawalbagh, India (29º 36'N and 79º40' E and 1250 m above msl) in 2007-08 in order to meet demand for an appropriate high yielding and rust resistant variety for rainfed organic conditions of Uttarakhand hills.

Entry number 6065 was selected from 2nd STEMRRSN during the Wheat field day during 2007-08 at ICAR-IIWBR, Karnal. The same was evaluated at evaluation nursery at Hawalbagh and finally 5 plants were selected. During 2008-09, 3 plants were selected from progeny 6065-2. During 2009-10 progeny of plant no 4 selected and harvested as bulk. During 2010-11 it was assigned VW 20138 number and evaluated in station trials under timely sown rainfed and irrigated conditions at experimental farm, Hawalbagh, Almora, Uttarakhand following Alpha lattice design with 2 replications. Under both the conditions, it yielded better than the best check VL *Gehun* 907, therefore, further evaluated as VL 967 under IVT, AVT-I and AVT-II-timely sown rainfed and irrigated trials of All India Coordinated Project (AICW&BIP) at 28 and 15 different locations, respectively, following randomized complete block design having 4 replicates in IVT and 6 in AVT, during 2011-12, 2012-13 and 2013-14 in the states of Himachal Pradesh, the then Jammu & Kashmir and Uttarakhand of northern hills. During 2012-13, 2013-14 and 2014-15 crop season, VL 967 was also tested at 14 locations following randomized complete block design with 3 replications in Uttarakhand State Varietal Trials (SVT) under organic conditions. During the final year of testing in 2014-15, it was also tested in farmers' field. The crop was sown within the recommended sowing time of second fortnight of October under rainfed conditions. The uniform crop geometry of 6 row plot of 3 m length with 23 cm row to row distance was followed over all the locations. The crop received 60 Kg ha^{-1} N, 60 Kg ha^{-1} P and 40 Kg ha^{-1} K as a basal dose and 30 Kg ha^{-1} N as a top dressing each after first irrigation and at the jointing stage under irrigated conditions whereas under rainfed conditions 60 Kg ha^{-1} N, 30 Kg ha^{-1} P and 20 Kg ha^{-1} K was applied as basal dose. Under rainfed organic trials only 20 t ha^{-1} FYM was provided as basal dose. Data on ancillary, yield, and disease susceptibility were recorded at all the locations and compiled at IIWBR, Karnal coordinated trials. However, the SVT data was compiled by assistant director, regional agriculture testing and demonstration station (RATDS), Haldwani, Uttarakhand. The individual location as well as for pooled data was subjected to the standard analysis of variance.

Artificial epiphytotic conditions were created for disease screening in a multi-location plant pathological screening Nursery. The disease recording was done as per Nayar *et al.* (1997) at all the locations and then compiled at ICAR-IIWBR, Karnal.

It was identified for release in the SVT meeting of Uttarakhand held on 30.09.2015 at Directorate of Agriculture, Dehradun, Uttarakhand. Subsequently, it was released by Uttarakhand State Seed Sub-Committee meeting held at Dehradun on 05.02.2018.

Grain yield ability and adaptability: VL *Gehun* 967 recorded grain yield of 1.99 t ha^{-1} (14 locations' weighted mean) with 12.71% advantage of grain yield over VL *Gehun* 907, the best check, under rainfed organic conditions of Uttarakhand hills. VL *Gehun* 967 has shown stable performance over the locations, occupied top ranking position in the first non-significant group of entries including checks under organic conditions of Uttarakhand hills. Under NHZ, it recorded average grain yield of 4.39 t ha^{-1}, which was at par with the best check HS 507 (Table 1). It has shown its flexible adaptation with higher grain yield (20.4%) under late sowing (27th November) in comparison to all checks under organic irrigated timely sown condition (Table 2). It showed grain yield superiority over all the checks under late sown condition. In the farmers' field trials conducted by department of agriculture, Uttarakhand, VL *Gehun* 967 yielded 2.6 t ha^{-1} under organic hills trials.

Table1: Grain yield performance of VL *Gehun* 967 and checks under organic rainfed conditions in Uttarakhand hills.

Testing years (no of locations)	Grain yield (t ha^{-1})		
	VL 967	VL 907 (C)	UP 2572 (C)
RF-2012-13 to 2014-15 (17) Hills organic	1.99	1.76 (12.71)	1.67 (19.07)
Frequency in the top non-significant group	4/14	1/14	0/14

	VL 967	HS 507	VL 804	VL 907	HPW 349
Northern Hills Zone (Rainfed)	3.03	3.08	2.84 (6.69)	3.09	3.21
Frequency in the top non-significant group	4/28	6/28	2/28	2/23	2/23
Northern Hills Zone (Irrigated)	4.39	4.43	4.33 (1.39)	4.39	4.14 (6.04)
Frequency in the top non-significant group	2/15	2/15	0/15	0/9	0/9

Number of locations and % increase of weighted mean over checks are given in parentheses.

Table 2. Adaptability to Agronomic Variables

Name of proposed variety/Hybrid:- VL *Gehun* 967			Adaptability Zone - Uttarakhand hills				
			Production condition- Timely sown organic irrigated				
Nature of Expt.	Item		VL 967 (P)	VL 804 (C1)	VL 907 (C2)	HS 507 (C3)	HPW 349 (C4)
Sowing date experiments	Yield (t ha^{-1}) under recommended N level	i) Normal (07.11.13)	6.37	7.16	7.55	7.22	7.31
	Percentage gain or loss when sown	ii) Late (27.11.13)	7.67 (20.4 %)	7.11 (-0.7 %)	7.35 (-2.7 %)	7.38 (2.2 %)	6.82 (-6.7 %)

Response to diseases: VL *Gehun* 967 showed better resistance to stripe rust in comparison to check UP 2572 under SVT and Check VL 804, VL *Gehun* 907 and HPW 349 under AICRP trials under field conditions. VL *Gehun* 967 also has the better stripe rust resistance and recorded ACI ranging 0.09 – 17.4 under artificial conditions. Similarly, the ACI of 2.0 to 4.0 for leaf rust was recorded under artificial inoculation conditions (Table 3).

Quality traits: VL *Gehun* 967 possesses 9.78 to 10.07 % protein, 76.37 to 79.73 Kg hl^{-1} hectoliter weight and 37.33 to 37.67 ml sedimentation value. In addition, it showed chapatti making score of 7.63 to 7.56, therefore, it has very good chapatti quality and good flour recovery. It possesses 32.7 to 34 ppm iron and 35.4 ppm zinc content. The zinc content is 11.07 to 12.85 % higher than the best check (Table 4).

Table 3: Response of VL *Gehun* 967 and checks against leaf and stripe rusts under natural and artificial epiphytotic conditions in NHZ.

Rust/Condition			Reaction against stripe and leaf rusts*				
Item			Proposed variety VL 967 (P)	HS 507 (C1)	VL 804 (C2)	VL 907 (C3)	HPW 349 (C4)
Leaf Rust							
Natural	1st year (11-12)	IVT	5S	0	0	-	-
	2nd year (12-13)	AVT	NR	NR	NR	NR	NR
	3rd year (13-14)	AVT	0	0	tR	tR	0

Artificial	1st year (11-12)	IVT	10S (2.0)	5S (1.0)	60S (16.8)	20S (9.0)	60S* (12.2)
	2nd year (12-13)	AVT	20S (4.0)	60S*(12.8)	40S (16.0)	5MS (1.6)	10S (3.6)
	3rd year (13-14)	AVT	10S (3.4)	20S (4.0)	80S (28.8)	40S (10.4)	5S(1.6)
Skipe Rust							
Natural	1st year (11-12)	IVT	10S (2.0)	5S(1.0)	60S (16.8)	-	-
	2nd year (12-13)	AVT	0	0	10S	10MS	0
	3rd year (13-14)	AVT	10S (5.7)	10S (4.0)	60S (23.7)	30S (12.7)	20S (8.3)
Artificial	1st year (11-12)	IVT	10MS(0.9)	20S (3.9)	20S (6.5)	20S (5.4)	5S (0.8)
	2nd year (12-13)	AVT	20S (7.8)	20S (4.6)	60S (15.7)	40S (10.9)	20S (7.0)
	3rd year (13-14)	AVT	60S(17.4)	20S (8.4)	80S (34.9)	80S (20.5)	40S (11.0)

*Highest score, average coefficient of infection (ACI) is given in parentheses.

Table 4. Data on Quality Characteristics (Rainfed)

Quality Characte-ristics	Years	Proposed variety VL 967 (P)	HS 507 (C1)	VL 804 (C2)	VL 907 (C3)	HPW 349 (C4)
Zonal mean						
Hectolitre weight (kg/hl)	**Rainfed**	76.37	78.27	79.87	77.55	79.55
	Irrigated	79.73	80.97	81.67	78.75	80.95
Protein content (%)	**Rainfed**	9.78	10.54	9.96	10.04	9.81
	Irrigated	10.07	10.34	10.44	11.31	10.17
Sedimentation value (ml)	**Rainfed**	37.33	41.67	36.33	40	51.5
	Irrigated	37.67	39.67	37	39	52.5
Chapatti quality	**Rainfed**	7.63 (Very Good)	7.56	7.62	7.44	7.61
	Irrigated	7.56 (Very Good)	7.5	7.65	7.42	7.62
Phenol test (Max. Score 10)	**Rainfed**	6.5	5.7	5.23	6.3	4.97
	Irrigated	6.5	5.53	4.97	6.33	5.07
Iron Content (ppm)	**Rainfed**	32.7	33.17	32.27	32.27	33.73
	Irrigated	34	37.67	32.3	35.13	33.07
Zinc Content (ppm)	**Rainfed**	35.4	30.73	31.87	30.27	31.3
	Irrigated	35.4	31.37	28.1	31.37	30.17

Varietal description: VL *Gehun* 967 has semi-erect growth habit, green foliage, with medium wax on whole plant body, ear shape is tapering with medium compact ear density, average height of 75-80 cm, and maturity is 165-170 days in rainfed organic hills conditions of Uttarakhand. It has amber bold grains with 45-48 g thousand grain weight.

Demonstration at farmers' field: Farmers' field trials were conducted during rabi 2014-15 crop season. These were conducted at 6 different locations of district Almora. The average grain yield of 2.57 t ha^{-1} was recorded in these farmers' field trials. Farmers' response to this variety has been positive and they are very enthusiastic to grow this variety.

Conclusion

VL *Gehun* 967 is a high yielding disease resistant wheat variety which has performed well under inorganic rainfed and irrigated timely sown conditions under NHZ as well as rainfed organic timely sown conditions of Uttarakhand hills. It has shown stability in terms of

wider adaptability, high yield, very good chapatti quality and high resistance to stripe as well as leaf rusts. The farmers' field trials conducted in Uttarakhand have shown its potential and acceptability among the farmers. It will provide an alternative to wheat variety VL *Gehun* 907 and replacement of UP 2572 in hills. The release of VL *Gehun* 967 would increase the wheat productivity of Uttarakhand as well as provide much needed diversity for rust diseases.

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