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Varietal Release

HI 1636 (Pusa Vakula), high yielding, bio fortified bread wheat variety for high fertility conditions of Central Zone

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Indian wheat production has crossed a milestone of more than 100 million tonnes for the last four crop seasons. This magnum rise in wheat production of the country production is attributed to increase in area, productivity and production in some of the important wheat growing states viz., Madhya Pradesh and Jharkand (Sendhil et al., 2019). The rise of productivity in these states is mainly due to the adoption of high yielding new varieties, increase in wheat area and high seed replacement rate etc. HI 1544, GW 322, Raj 4238, HI 1634 and MP 3465 bread wheat varieties which are popularly grown among the farmers of central zone with high breeder seed indent. However, still potential exists for improvement in some wheat states viz., Rajasthan, Madhya Pradesh and Chhattisgarh. Adoption of new high yielding, adaptable, abiotic stress resistant wheat varieties will help the farmers to increase yields and export potential of the country. Breeding for timely sown, high fertility conditions, release and cultivation of these varieties among farmers of central zone will enhance the production and productivity of the zone and in turn the nation.

Development and Notification of HI 1636: HI 1636 was developed from cross DL788-2/HW4032 at ICAR-Indian Agricultural Research Institute, Regional Station, Indore through modified pedigree method. It was released by Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, Government of India vide notification No. S.O.8 (E) dated 03.01.2022 for commercial cultivation under timely sown irrigated conditions of central zone.

Yield superiority and adaptability of HI 1636: Pooled analysis of yield data over three years of co-ordinated trials indicated that Pusa Vakula (HI 1636) showed mean yield of 56.6 q/ha (weighted mean among 41 locations); potential yield of 78.8 q/ha and appeared 18 out of 41 times in first

top non-significant group (ICAR-IIWBR, 2021 & Table 1). It has yielded more than 60.0 q/ha at 16 out of 41 locations over three years of testing. It has shown wider adaptation and significantly superior performance to the tune of 4.44% and 6.57% over bread wheat check varieties GW 322 and HI 1544, respectively and 2.81% over qualifying variety GW 513 (Table 2 & ICAR-IIWBR, 2021a).

Table 1: Summarized yield data of coordinated trials in Central Zone

Items	Year of testing	No. of trials/ location	Proposed variety	Check Varieties		Qualifying Variety	CD
			HI 1636	HI 1544	GW 322	GW 513	
Mean yield (q/ ha)	NIVT 4 (2018-19)	9	59.3	55.5	56.0	60.1	2.8
	AVT I (2019-20)	18	60.2	58.8	57.4	62.0	1.1
	AVT II (2020-21)	14	50.3	52.8	53.4	53.0	1.1
	Weighted Mean (3 years)		56.6	56.0	55.7	58.5	
	Weighted Mean (1st & 2nd year)		59.9	57.7	56.9	61.4	
% increase/ decrease over the checks & qualifying variety	NIVT 4 (2018-19)			6.8*	5.9*	-1.3	
	AVT I (2019-20)			2.4	4.9*	-2.9	
	AVT II (2020-21)			-4.7	-5.8	-5.1	
	Overall Weighted Mean (3 years)			1.1	1.6	-3.2	
	Overall Weighted Mean (1st & 2nd year)			3.8	5.3	-2.4	
Frequency in the first top non-significant group	NIVT 4 (2018-19)		6/9	3/9	3/9	5/9	
	AVT I (2019-20)		10/18	8/18	7/18	10/18	
	AVT II (2020-21)		2/14	4/14	5/14	6/14	
	Pooled for three years		18/41	15/41	15/41	21/41	

* Significantly superior

Table 2: Adaptability to agronomic variables -grain yield (q/ha) (Agronomical Trial 2020-21)

Experiment / Item	Sowing time	Proposed Variety	Check Varieties			Qualifying Variety
		HI 1636	HI 1544	GW 322	HI 8713 (d)	GW 513
Yield (q/ha)	Timely	48.98	48.21	48.97	50.53	48.47
	Late	47.05	41.89	42.97	44.24	44.94
	Mean	48.01	45.05	45.97	47.39	46.70
% loss in comparison with Timely Sowing	Timely : Late	3.9	13.1	12.3	12.4	7.3
% superiority over checks & qualifying variety	Timely		1.60	0.02	-3.07*	1.05
	Late		12.32*	9.49*	6.35*	4.70*
	Over mean		6.57*	4.44*	1.31	2.81*

CD (P=0.05) :Sowing(A)=0.76; Genotypes(B)= 0.94; B within A= 1.33, A within B = 1.40

*Significantly superior

Data based on Bilaspur, Gwalior, Indore, Jabalpur, Junagadh, Powarkheda, Udaipur and Vijapur

Resistance to major disease and pests: Pusa Vakula was evaluated in various pathological nurseries over three years, which showed that it has multiple disease resistance viz., resistance to all three rusts and other diseases (Table 3). HI 1636 exhibited seedling resistance to all the 23 stem rust and 27 leaf rust pathotypes and postulated to have leaf rust resistance gene *Lr24*. It also showed high levels of adult plant resistance to prevalent and virulent stem rust pathotypes 40A, 11 and 117-6; and leaf rust pathotypes 77-5, 77-9 and 104-2. It was not affected by other major insect pests and diseases (ICAR-IIWBR, 2021b).

Table 3: Reaction to major diseases during 2019-20 and 2020-21

Disease Reaction	Proposed variety		Checks				Qualifying variety	
	HI 1636		HI 1544		GW 322		GW 513	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
Black (Stem) Rust								
HS	5MR	10S	10S	30S	40S	30S	5MS	10MS
ACI	0.5	3.3	2.8	5.3	15.8	8.3	2.3	3.3
Brown (Leaf) Rust								
HS	60S*	20MS	40S	40MS	80S	20MS	60S	20S
ACI	8.0	4.0	5.1	5.8	14.6	7.3	8.8	3.2
Powdery Mildew (0-9)								
HS	9	9	9	9	9	9	9	9
AV	5	6	4	5	4	6	5	5
Leaf Blight (dd)								
HS	99	89	89	99	89	79	89	99
AV	46	46	57	56	45	46	56	57
Karnal bunt (%)								
HS	10.0	29.2	42.9	64.5	15.0	8.5	14.3	12.5
AV	4.5	14.7	11.6	21.8	5.0	4.8	5.6	6.5
Flag Smut (%)								
HS	10.5	12.5	23.1	33.9	7.5	9.7	11.1	20.0
AV	4.6	9.1	12.2	21.4	4.6	8.6	3.7	12.4
Loose Smut (%)								
HS	-	-	45.0	54.8	66.5	22.2	-	-
AV	-	-	17.9	40.2	43.9	14.3	-	-

HS = Highest score, ACI = Average coefficient of infection, AV: Average

Excellent grain quality of HI 1636: Grains of HI 1636 recorded high Zinc content (44.4 ppm) and high protein content (11.3%), compared to checks and qualifying variety GW 513 (Table 4). End product evaluation showed that it is having an excellent chapati making quality (8.24). It recorded high test weight of 80.6 kg/hl and high sedimentation value of 42.6 ml. It has good protein content (11.3%) and protein quality (*Glu* score of 6/10) for high molecular weight subunits and presence of 2+12 subunit of Glu-D1, and 7+8 of Glu-B1, reflecting higher gluten strength (ICAR-IIWBR, 2021c). Presence of good levels of essential micronutrients like zinc and iron content makes Pusa Vakula, a "zinc bio fortified high yielding bread wheat" suitable for chapati preparations.

Table 4: Data on Quality traits of HI 1636

Quality Parameters	HI 1636	Check Varieties		Qualifying variety
		HI 1544	GW 322	GW 513
Nutritional Quality				
Protein (%)	11.3	11.4	10.6	10.7
Fe (ppm)	35.7	39	35.2	36.3
Zn (ppm)	44.4	43	45.1	38.7
HMW subunits				
Glu-D1	2+12	2+12	2+12	5+10
Glu-A1	N	N	2*	N
Glu-B1	7+8	7+8	7+8	17+18
Glu-1 Score	6	6	8	8
Grain Characteristics				
Grain appearance (1-10)	6.9	6.9	6.6	7
Test weight (kg/hl)	80.6	82	79.5	81.7
Grain Hardness index	68.5	74.6	80.9	68.3
Sedimentation value (ml)	42.6	43.6	40.6	40.8
Wet Gluten (%)	34.5	33.9	33.5	34.7
Dry Gluten (%)	10.8	10.5	10.3	10.7
Gluten Index	52	48	45	57
End Product evaluation				
Chapati Quality	8.24	7.81	7.83	8.36
Bread Loaf Volume (ml)	527	505	511	517
Bread Quality	5.49	5.09	5.3	5.38
Biscuit Spread Factor	6.5	6.8	6.7	6.8

Conclusion

Based on the three years national Co-ordinated trials by ICAR-IIWBR, HI 1636 (Pusa Vakula) was proposed for identification in 2021 during All India Wheat workers meet and was released by the Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops and notified vide No. S.O.8 (E) dated 03.01.2022 for commercial cultivation under irrigated, timely sown conditions of the central zone, which is the potential area for wheat crop and comprises states like Madhya Pradesh, Chhattisgarh, Gujarat, Rajasthan (Kota and Udaipur Divisions), and Western Uttar Pradesh (Jhansi Division). Pusa Vakula is a high yielding, adoptable, disease resistant and bio-fortifed bread wheat variety which will be a good choice for the farmers of central zone and can also contribute to increase production and productivity of wheat in central zone.

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