

## HI 1634 (Pusa Ahilya), high yielding bread wheat variety tolerant to terminal heat stress conditions of Central Zone

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Increasing wheat area under late sown conditions in the states viz., Madhya Pradesh, Gujarat and Rajasthan of central zone is observed due to potato and cotton cultivation during *kharif* season (Khan *et al.*, 2010). Terminal heat stress occurs when mean temperature during grain filling stage goes above 31°C leads to reduced grain filling rate, photosynthetic capacity and rate of assimilate translocation in turn effecting grain number, grain size, spikelets/spike, grains per spike and grain quality (Bala *et al.*, 2014 & Mondal *et al.*, 2013). To meet the growing demand of farmers for varieties suitable to be sown under late conditions by the development of short duration varieties with high yield and resistance to black and brown rusts along with tolerance to terminal heat stress has become one of the important objectives for wheat breeders.

**Development and Notification of HI 1634:** HI 1634 was developed from cross GW 322/PBW 498 made during 2008-09 at ICAR-Indian Agricultural Research Institute, Regional Station, Indore and further handled following 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. 500 E dated 29.01.2021 for commercial cultivation under late sown irrigated conditions of central wheat growing zone of India.

**Yield superiority and adaptability of HI 1634:** Pooled analysis of yield data over three years of co-ordination indicated that HI 1634 showed mean yield of 51.6 q/ha (weighted mean among 39 locations) and potential yield of 70.6 q/ha in Gwalior during *rabi* 2019-20 under irrigated, late sown conditions (IIWBR, 2020). It showed significant yield advantage of 3.6%, 4.9%, 4.9% and 8.9% over the



checks HD 2932, HD 2864, MP 3336 and MP 4010, respectively. It has ranked first six times for higher yield among the test varieties over three years of testing (Table 1). Pooled analysis of the data showed that mean yield of HI 1634 (50.88 q/ha) was significantly superior than the

two checks HD 2864 (47.32 q/ha) and MP 3336 (45.73 q/ha) under three sowing conditions. Significant increase in grains/ear head and 1000 grain weight up to 31.8% and 7.6% respectively over all the checks had contributed to the superior yield of HI 1634.

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

Items	Year of testing	No. of trials	Proposed variety					CD
			HI 1634	HD 2932	HD 2864	MP 3336	MP 4010	
Mean yield (q/ha)	NIVT (2017-18)	7	48.1	41.4	40.7	-	-	1.9
	AVT I (2018-19)	16	52	51.1	48.8	47.2	47.4	1.3
	AVT II (2019-20)	16	52.8	52.2	53.3	51.2	-	1.2
	Weighted Mean		51.6	49.8	49.2	49.2	47.4	
% increase / decrease over the checks & qualifying variety	NIVT (2017-18)			16.2*	18.2*			
	AVT I (2018-19)			1.8	6.6*	10.2*	9.7*	
	AVT II (2019-20)			1.2	-0.9	3.1		
	<b>Overall Weighted Mean</b>			3.6	4.9	4.9	8.9	
Frequency in the first top non-significant group	NIVT (2017-18)		2/7	2/7	1/7	-	-	
	AVT I (2018-19)		10/16	6/16	2/16	3/16	2/16	
	AVT II (2019-20)		12/16	10/16	12/16	7/16	-	
	Pooled for three years		<b>24/39</b>	<b>18/39</b>	<b>15/39</b>	<b>10/32</b>	<b>2/16</b>	
<b>1<sup>st</sup> Rank among varieties over the locations</b>				<b>6/39</b>	<b>4/39</b>	<b>0/39</b>	<b>3/32</b>	<b>0/16</b>

\* Significantly superior

**Resistance to major disease and pests:** Evaluation of HI 1634 in various pathological nurseries showed that it has multiple disease resistance viz., resistance to all three rusts and other diseases (Table: 2). Seedling tests were conducted for two years at ICAR-IIWBR, Shimla for testing its resistance against bread wheat virulent leaf rust pathotypes viz., 77, 12, 104 and 162 groups and stem rust pathotypes viz., 40 and 117 groups. Based

on comparison of seedling reactions, “Pusa Ahilya” is postulated to have stem rust resistance gene *Sr31+* and leaf rust resistance gene *Lr26+*. In addition, it showed good levels of resistance to leaf blight (46), Karnal bunt (4.4), *Fusarium* head blight (3), loose smut (22.3), foot rot (5.3) and flag smut (2.7). It was not showing incidence of any of the major insect pests as per the AICRP on Wheat and Barley reports (ICAR-IIWBR, 2020a).

Table 2: Reaction to major diseases during 2018-19 and 2019-20

Disease Reaction	HI 1634		Checks							
			HD 2932		HD 2864		MP 3336		MP 4010	
	18-19	19-20	18-19	19-20	18-19	19-20	18-19	19-20	18-19	19-20
<b>Black (Stem) Rust</b>										
<b>HS</b>	5MS	5MR	20MS	20S	10S	10S	40S	30MS	10MS	-
<b>ACI</b>	1.0	0.3	8.4	11.3	2.8	2.5	15.3	9.4	2.2	-



Brown (Leaf) Rust										
HS	10S	20S	40S	20S	40S*	60S*	40S*	80S	5S	-
ACI	1.4	3.1	19.4	38.8	6.5	7.6	8.1	26.5	0.7	-
Powdery Mildew (0-9)										
HS	5	6	5	9	7	6	7	9	7	-
AV	3	3	3	4	4	4	5	5	5	-
Leaf Blight (dd)										
HS	89	89	89	89	79	89	99	89	79	-
AV	46	46	56	46	57	56	57	56	57	-
Karnal bunt (%)										
HS	6.1	12.5	13.5	10.0	12.2	8.6	10.1	13.3	15.7	-
AV	3.8	4.4	4.5	3.6	7.3	4.0	4.2	4.1	9.0	-
Flag Smut (%)										
HS	7.5	6.8	4.8	7.5	7.1	7.5	6.6	6.3	5.3	-
AV	2.7	4.6	2.1	2.5	2.1	2.5	2.0	2.1	1.7	-
Loose Smut (%)										
HS	-	42.2	-	42.2	-	37.4	-	46.6	-	-
AV	-	22.3	-	30.9	-	12.6	-	18.3	-	-

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

**Grain quality:** High grain appearance score and test weight for HI 1634 (6.9 & 81.8 kg/hl) compared to other test varieties indicate that grain was bold, lustrous and non-shriveled. HI 1634 showed high grain hardness index (81.4), protein content (12.1%) and protein quality (*Glu* score of 8/10) for high molecular weight subunits (Table 3 & ICAR-IIWBR, 2020b). End product analysis conducted

at ICAR IIWBR lab indicated that HI 1634 is suitable for *chapatti* making (7.86) along with sedimentation value of 44.8 ml, wet gluten (27.6%), dry gluten (8.8%) and gluten Index (70). Values of HI 1634 indicated its suitability for bread making (Gil et al., 2011). It has good levels of essential micronutrients like iron (39.4 ppm) and zinc content (36.6 ppm) making it rich in nutritional qualities.

Table 3: Data on Quality traits of HI 1634

Quality Parameters	HI 1634	Check Varieties			
		HD 2932	HD 2864	MP 3336	MP 4010
Nutritional Quality					
Protein (%)	12.1	12.5	12.1	12.3	12.7
Fe (ppm)	37.9	36.6	38.7	38.1	39.8
Zn (ppm)	36.0	35.4	35.0	38.1	39.9
HMW subunits					
Glu-D1	5+10	2+12	2+12	2+12	-
Glu-A1	2*	2*	1	2*	-
Glu-B1	7	17+18	7+8	7+8	-
Glu-1 Score	8	8	8	8	-
Grain Characteristics					
Grain appearance (1-10)	6.9	6.5	6.3	6.6	6.7
Test weight (kg/hl)	81.8	80.7	82.1	82.3	82.7



Grain Hardness index	81.4	70.8	73.8	71.0	69.4
Sedimentation value (ml)	<b>44.8</b>	52.3	43.9	44.2	45.6
Wet Gluten (%)	<b>27.6</b>	30.4	29.2	33.0	
Dry Gluten (%)	<b>8.8</b>	9.6	9.2	10.1	
Gluten Index	<b>70</b>	83	81	56	
<b>End Product evaluation</b>					
Chapati Quality	<b>7.86</b>	7.61	7.53	7.72	-
Bread Loaf Volume (ml)	<b>483</b>	535	491	471	-
Bread Quality (Max. Score – 10)	<b>5.64</b>	6.45	5.36	5.05	-
Biscuit Spread Factor	<b>6.73</b>	6.88	6.60	6.62	-

Based on the three years national Co-ordinated trials by AICRP on wheat and Barley, the genotype was proposed for identification in 2020 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 S.O. 500 E, dated 29.1.2021 for commercial cultivation under irrigated, late 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). In nutshell, the high yield potential variety HI 1634 coupled with stress tolerance to terminal heat and plasticity for sowing time with resistance to major insect pests, stem and leaf rusts makes this variety a suitable choice for the farmers of Central Zone of the country. Pusa Ahilya will help to sustain the livelihood of the farmers and consumer's preferences in addition to increasing its area in the central wheat growing zone to fetch higher price.

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