

Pusa Prabhat (HI 8823) a high yielding, drought tolerant and biofortified durum wheat variety for central wheat growing zone of India

Divya Ambati^{1*}, Rahul M Phuke¹, SV Sai Prasad¹, JB Singh¹, TL Prakasha¹, KC Sharma¹, AK Singh¹, DK Verma, AN Mishra¹, GP Singh², JB Sharma³, PK Singh³, Harikrishna³, RK Sharma³, Naresh Kumar³, Rajbir Yadav³, KB Gaikwad³, Shailendra Jha³, Sanjay Kumar³, Prasanth Babu³, H K Raghunandan³, VK Singh³, M Sivasamy⁴, TR Das⁵, Dharam Pal⁶, Vinod³, Anju M Singh³, Neelu Jain³, Manjeet Kumar, Niharika Mallick³, Niranjana M³, P Jayaprakash⁴, VK Vikas⁴, Madhu Patial⁶, RN Yadav⁶ and KVPrabhu⁷

¹ ICAR-IARI, Regional Station, Indore, M.P

² ICAR-Indian Wheat and Barley Research Institute, Karnal

³ ICAR-Indian Agricultural Research Institute, New Delhi

⁴ ICAR-LARI, Regional Station, Wellington, Tamil Nadu

⁵ ICAR-LARI, Regional Station, Shimla

⁶ ICAR-LARI, Regional Station, Karnal

⁷ PPVFRA, Government of India, New Delhi

Article history: Received: 15 Jun., 2023 Revised: 18 Sep., 2023 Accepted: 05 Nov., 2023

Citation: Divya Ambati, Rahul M Phuke, SV Sai Prasad, JB Singh, TL Prakasha, KC Sharma, AK Singh, DK Verma, AN Mishra, GP Singh, JB Sharma, PK Singh, Harikrishna, RK Sharma, Naresh Kumar, Rajbir Yadav, KB Gaikwad, Shailendra Jha, Sanjay Kumar, Prasanth Babu, H K Raghunandan, VK Singh, M Sivasamy, TR Das, Dharam Pal, Vinod, Anju M Singh, Neelu Jain, Manjeet Kumar, Niharika Mallick, Niranjana M, P Jayaprakash, VK Vikas, Madhu Patial, RN Yadav and KVPrabhu. 2023. Pusa Prabhat (HI 8823) a high yielding, drought tolerant and biofortified durum wheat variety for central wheat growing zone of India. *Journal of Cereal Research* **15** (3): 408-412. <http://doi.org/10.25174/2582-2675/2024/133242>

***Corresponding author:** E-mail: divya.ambati@icar.gov.in

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Durum wheat is grown prominently in central and peninsular zones of India with an annual production of 3.5 million tons and acreage of around 1.5 million hectares (Tidiane *et al.*, 2019). Drought and heat stress are some of the barriers for the yield in these zones where wheat is sown early in the month of October to exploit the residual moisture (Sendhil *et al.*, 2020). High temperatures and drought stress during growth period and grain filling period hamper growth and development of wheat crop resulting in lower grain yields (Akter *et al.*, 2017). HI 8627 (Malav Kirti, released in 2007) and DDW 47(released in 2020) are the only two durum wheat varieties suitable for timely sown, restricted irrigation conditions available in the seed chain. At ICAR-Indian Agricultural Research institute, Indore, Madhya Pradesh concrete efforts were

made to breed climate resilient durum wheat varieties having heat and drought tolerance suitable for restricted irrigation conditions.

Development and Notification of HI 8823

HI 8823 (Pusa Prabhat) was developed from an indigenous cross HI 8709/HD 4676 at ICAR-Indian Agricultural Research Institute, Regional Station, Indore through modified pedigree method. HI 8823 was released by Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, Government of India for commercial cultivation under timely sown, restricted irrigation conditions of central Zone of the country vide notification number S.O. 8 (E) dated 03.01.2022 for commercial cultivation.



Yield superiority and adaptability

During *rabi* 2018-19 in NIVT 5B, HI 8823 showed mean yield of 36.3 q/ha and 5.2 % yield advantage over the check HI 8627 (Table 1 & IIWBR, 2019) and was promoted to AVT. Under AVT for two more years, HI 8823 showed mean yield of 38.5 q/ha (weighted mean among 33 locations) and potential yield of 65.6 q/ha in Gwalior location during *rabi* 2019-20 (IIWBR, 2020

& 2021). Pooled analysis of three years co-ordination data showed that HI 8823 has a significant mean yield advantage of 4.9% and 3.5% over the checks HI 8627 and DDW 47 respectively (Table 1). It also showed wider yield stability across the zones as it appeared 11 out of 33 times in first top non-significant group in comparison to check varieties. It yielded > 30.0 q/ha at 12 locations over three years of testing (Table 1).

Table 1: Pooled yield data of HI 8823 in AICW&BIP Trials

Items	Year of testing	No. of trials	HI 8823	Durum wheat Checks		CD
				HI 8627	DDW 47	
Mean yield (q/ha)	NIVT 5B (2018-19)	8	36.3	34.5	-	1.8
	AVT I (2019-20)	13	42.7	40.4	40.1	1.2
	AVT II (2020-21)	12	35.3	34.1	34.1	1.0
	Weighted Mean		38.5	36.7	37.2	
% increase/decrease over the checks & qualifying variety	NIVT 5B (2018-19)			5.2*		
	AVT I (2019-20)			5.7*	6.5*	
	AVT II (2020-21)			3.5*	3.5*	
	Overall Weighted Mean			4.9	3.5	

Adaptability of HI 8823 was studied under three different irrigation levels along with checks HI 8627 and DDW 47 during *rabi* 2020-21. Results indicated that HI 8823 recorded highest grain yield under two irrigation levels with a significant yield increase of 25.6% and 69.8% compared to yield of one irrigation and no irrigation levels respectively. On the basis of mean data, HI 8823 was found suitable for sowing in different irrigation levels

especially under no irrigation and two irrigations, where the grain yield was found to be higher to checks (IIWBR, 2021a & Table 2). Higher yield of HI 8823 was the function of higher number of ear head/sq m and thousand grain weight as compared to both the check varieties to the tune of 11.3 and 3.9% over HI 8627 and 6.3 and 9.1% over DDW 47 respectively.

Table 2: Adaptability of HI 8823 to various irrigation levels

Experiment / Item	Irrigation levels	HI 8823	Durum wheat Checks	
			HI 8627	DDW 47
Yield (q/ha)	I1 (No irrigation)	23.51	22.71	24.35
	I2 (One irrigation)	31.77	31.90	30.74
	I3 (Two irrigations)	39.91	36.85	37.39
	Mean	31.73	30.48	30.83
% Superiority over checks & qualifying variety	I1 (No irrigation)		3.5	-3.5
	I2 (One irrigation)		-0.4	3.4
	I3 (Two irrigations)		8.3*	6.7*
	Over mean		4.1*	2.9*

CD (P=0.05): Irrigation=0.64; Variety = 0.82; Variety within Irrigation = 1.42, Irrigation within Variety =1.42



*Significantly superior

Distinguishing morphological characteristics

HI 8823 has semi erect growth habit, green foliage colour and anthocyanin pigmentation was absent on auricles at boot stage. HI 8823 has erect, green, medium size flag leaf with very strong waxiness on sheath and peduncle along with medium waxiness on leaf blade making it distinguishable from the checks. HI 8823 was found to be medium late variety with 68-75 days to flower and mature within 120-125 days. The average height of HI 8823 was recorded to be 80-85cm. Spikes of HI 8823 were medium in length, dense, white and tapering in shape with long and white awns at maturity. The lower glume has narrow

sloping shoulder with short moderately curved beaks. It possesses amber, lustrous, oblong, medium sized, hard grain with medium germ width.

Resistance to major disease and pests

HI 8823 was screened for disease resistance especially leaf and stem rust at all the stages of yield evaluation *i.e.*, in the preliminary yield trials and national co-ordination trials. HI 8823 recorded a highest score of 15MS and mean ACI score of 2.2 for stem rust; highest score of 10S with mean ACI value of 1.7 for leaf rust under AICRP screening (Table 3). Postulation studies indicated that the resistant genes might be *Sr17+* and *Sr2+*.

Table 3: Field reaction of HI 8823 to stem and leaf rusts under artificial conditions

Disease	Year of testing	Proposed variety HI 8823	Durum Wheat checks	
			HI 8627	DDW 47
Stem Rust	2018-19	10MS (2.0)	40S* (8.0)	-
	2019-20	5MS (1.2)	40MR (2.2)	5MS (1.9)
	2020-21	15MS (3.5)	10MS (3.1)	10S (3.5)
	Mean ACI	2.2	4.4	2.7
Leaf Rust	2018-19	10MS (1.9)	10MR (0.9)	-
	2019-20	10S (2.3)	5MS (1.6)	10MR (1.2)
	2020-21	10MR (0.9)	20S (4.3)	30S (7.7)
	Mean ACI	1.7	2.3	4.5

Seedling resistance tests conducted at ICAR-IIWBR, Regional Station, Shimla showed HI 8823 was showing resistant to moderately resistant reactions to the majority of durum virulent stem rust pathotypes viz., 11, 15-1 &

40 group and prevalent leaf rust races 77 group (IIWBR, 2020a and IIWBR, 2021b). HI 8823 was found resistant to moderately resistant to other important wheat diseases and insects compared to check varieties (Table 4).

Table 4: Incidence of different pests on HI 8823 under multi-location testing

Disease	Proposed variety		Durum wheat checks			
	HI 8823		HI 8627		DDW 47	
	Av	HS	Av	HS	Av	HS
Leaf Blight (dd)	46	89	46	99	41	99
Karnal Bunt (%)	2.8	8.3	2.5	10	3	8
Powdery Mildew(0-9)	4.5	9	2.5	7	3	7
Flag Smut (%)	5.7	11.1	1.5	4.5	1.4	4.3
Fusarium Head Blight (0-5)	-	4.5	-	5	-	4.5
Foot rot (%)	-	30	-	68.7	-	31.8
Loose Smut (%)	0	0	17.8	46.6	7.4	22.2



Quality evaluation of HI 8823

Mean values of quality parameters recorded under three years of AICRP trials indicated that HI 8823 had a good grain appearance score of 7.2, hectoliter weight of 85.3 Kg/hl, protein content of 12.1% and sedimentation value of 36.6 ml. HI 8823 was found to have 7.2 ppm of yellow pigment content, 37.9 ppm of Iron and 40.1 ppm of Zinc content (Table 5 & IIWBR, 2021c). Presence of high

amount micro nutrient content made HI 8823 a naturally biofortified wheat variety and was dedicated to the nation by honorable prime minister of India on 28th September 2021. HI 8823 found to have good pasta cooking quality, taste, flavor, texture and scored an overall acceptability of 5.9 which can be attributed to high protein and gluten contents in the semolina and starch gelatinization properties.

Table 5: Data on Quality Characteristics of HI 8823

Quality Parameters	HI 8823	Check varieties	
		HI 8627	DDW 47
Grain Appearance (Max score 10)	7.2	6.9	6.6
Test weight (kg/hl)	85.3	82.4	81
Sedimentation value (ml)	36.6	32	40
Protein content (%)	12.1	12.7	12
Yellow berry incidence (%)	15.7	13.7	19
Yellow pigment (ppm)	5.8	6.6	7.7
Hardness Index	93.2	93	93.9
Iron Content (ppm)	37.9	38	39.3
Zinc Content (ppm)	40.1	40.4	41
Pasta Cooking quality			
Cooking time (min./sec.)	7.9	8.2	9.2
Water absorption (%)	89.6	86.4	90.1
Water uptake ratio	1.2	1.2	13
Gruel solid loss (%)	7.5	7.5	8.5
Stickiness	MS	MS	MS
Pasta Sensory evaluation			
Colour	6.3	6.4	6.7
Texture	5.5	5.4	5.3
Flavour/ Aroma	5.8	5.2	5.7
Taste	5.9	5.7	6.2
Overall Acceptability	5.9	5.7	6

To conclude, Pusa Prabhat (HI 8823) is a high yielding, disease resistant, biofortified and highly adaptable durum wheat variety released for commercial cultivation for timely sown, restricted irrigation conditions of central wheat growing zone of India in 2022.

Acknowledgement

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 all the cooperators of central zone for their contribution.

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