

Pusa Mangal (HI 8713)

A durum wheat variety boosting economy and nutritional security of central zone wheat farmers

Divya Ambati*, S V Sai Prasad, Jang B Singh, Rahul M Phuke, A K Singh, K C Sharma and S Upendra

ICAR-Indian Agricultural Research Institute, Regional Station, Indore, Madhya Pradesh 452 001

Pusa Mangal (HI 8713), a high yielding durum wheat variety was released in 2013 by CVRC for high fertility, irrigated, timely sown conditions of Central Zone, which is the largest durum wheat producing zone in India. HI 8713 recorded a mean yield of 52.3 q/ha and showed good levels of field resistance to stem and leaf rusts over 3 years of testing in national trials. Farmers cultivating HI 8713 in Madhya Pradesh and Uttar Pradesh got bumper yields, i.e. 80-90% increase compared to the check varieties. Pusa Mangal showed consistent higher yield in national wheat trials as check variety and had higher breeder seed indent in the recent past. It indicates the potential of Indian durum wheat for export, and providing economic and nutritional security to the wheat farmers of central zone. High yield potential and quality make HI 8713 (Pusa Mangal) the best choice for inclusion in the nutritifarm scheme and an excellent raw material for the upcoming semolina-based pasta industries, generating additional employment opportunities, boosting farm economy and nutritional security in the country.

Keywords: Durum wheat, High yield, Quality pasta

AMONG the cultivated wheat species, durum/macaroni wheat (*Triticum durum* L.) is the second most important species locally known as *Kathia* wheat/Pasta wheat. In India, every year more than 2.5 million tonnes of durum wheat is produced from nearly 10-11% of the total wheat area. Durum is the hardest of all wheat varieties and is more adapted to hot and dry wheat growing zones of India i.e. peninsular and central zones. Durum kernels are amber coloured with yellow endosperm, which gives its end products a golden hue. Premium pasta products are produced from durum wheat because of its yellow endosperm along with high gluten strength and protein content. In India, durum wheat is preferred over bread wheat in making a number of traditional recipes like *daliya*, *bati*, *bafla*, *laddu*, *churma*, *sevaiyan*, *suji-halwa*, *suji-upma*, etc.

The demand for durum wheat is increasing because of its suitability to make unique food products and increasing consumption of these food products with rapid urbanization. Durum wheat cultivation has several advantages to offer like saving irrigation water due to its high water-use efficiency, minimizing the risk of rust epidemics because of its diverse rust resistance, providing naturally biofortified health food due to its high protein and micronutrient content.

HI 8498 (Malav Shakthi) which was released in 1999, was the only popular durum wheat variety under irrigated, timely sown conditions in central zone. To enhance and diversify the durum wheat cultivation, there was an urgent need for new durum wheat varieties with high yield, disease resistance and quality. ICAR-Indian Agricultural Research Institute, Regional Station,

Indore developed a durum wheat variety HI 8713 (Pusa Mangal) from an indigenous cross HD 4672/PDW 233. HI 8713 was evaluated for 3 years under All India Co-ordinated Wheat and Barley trials (AICW&BIP) from 2009-2012 for yield, quality and adaptability among 37 locations of central wheat growing zone of the country (Madhya Pradesh, Chhattisgarh, Gujarat, Kota and Udaipur divisions of Rajasthan and Jhansi division of Uttar Pradesh). Significantly higher yield, disease resistance, quality, adaptability and plasticity of HI 8713 to sowing conditions led to the release of Pusa Mangal by Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops (CVRC), Government of India for commercial cultivation under timely sown, irrigation conditions of central zone in 2013.



HI 8713 (Pusa Mangal) growing in field

Performance of HI 8713 in AICW&BIP trials

HI 8713 was tested for 3 years during *rabi* 2009-12 in 37 locations of central zone along with checks. HI 8713 recorded mean yield of 52.3 q/ha and showed superiority over checks by giving 4.8-5.7% higher yield over durum wheat checks: HI 8498 and MPO 1215; and 1.5-19.3% yield superiority over bread wheat checks: Lok-1, GW 322 and PBW 343 (Table 1). In agronomic trials conducted during *rabi* 2011-12, HI 8713 showed significantly superior performance over checks: MPO 1215, HI 1544, HI 8498, GW 322 and plasticity to variations in sowing conditions. HI 8713 recorded more ear heads/sqm

and number of grains/ear head compared to checks, which provided wide adaptability to this genotype.

HI 8713 is showing consistent performance in AICW&BIP trials as national check in NIVT 4 and as zonal check for central zone in advance varietal trials (AVT) from *rabi* 2017-18 till now (Table 2). It is considered as zonal check in a timely sown AVT trial along with HI 8737, GW 322 and HI 1544. HI 8713 had shown consistent higher yield (57.9 q/ha) compared to other checks HI 8737 (56.4q/ha), GW 322 (54.0q/ha) and HI 1544 (52.9 q/ha).

Disease resistance and quality traits of HI 8713

HI 8713 recorded high degree of

resistance against important diseases like stem and leaf rust, flag smut and leaf blight in comparison to checks during AICW&BIP trials. It showed resistance to durum virulent pathotypes of the leaf rust and stem rust indicating that the resistance spectrum is different from that of the checks. It showed high level of resistance to the African stem rust race 'Ug99' and its variants during screening in Kenya. The recent rust disease data from central zone AICW&BIP trials show HI 8713 is still resistant to major diseases, indicating its durable resistance.

HI 8713 has high yellow pigment content (7.16 ppm), less gruel solid loss and high overall acceptability compared to the durum checks (Table 3). It showed parity with the check varieties in other desired quality traits like grain appearance, protein content, test weight, etc. indicating its suitability for pasta making. HI 8713 has high protein content (12%) along with essential micronutrients, viz. iron content (36 ppm), zinc content (34 ppm) and copper content (6 ppm) which makes it the best choice for inclusion in 'Nutrifarm scheme' of Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India which includes 25 districts in Madhya Pradesh. It can serve as a dual quality durum suitable both for excellent pasta preparations as well as

Table 1. Mean yield (q/ha) of HI 8713 in coordinated trials

Year of Testing	No. of trials	HI 8713	Durum checks			Bread wheat checks			CD
			HI 8498	MPO 1215	Lok-1	GW 322	HI 1544	PBW 343	
2009-10	5	50.7	45.1	-	-	-	-	42.5	3.7
2010-11	17	51.5	48.9	50	47	50.9	51.3	-	1.5
2011-12	15	53.8	51.6	49.5	-	52.8	53.5	-	1.6

Table 2. Performance of HI 8713 as check in AICW&BIP trials

Variety	2017-18		2018-19	2019-20	2020-21		Mean yield
	NIVT	AVT	NIVT	NIVT	NIVT	AVT	
HI 8713	48.5	50.7	66.6	60.7	67.6	53.4	57.9
HI 8737	48.8	50.1	62.7	58.2	62.0	-	56.4
HI 1544	53.0	52.6	47.6	58.1	53.3	52.8	52.9
GW 322	55.2	52.6	44.5	58.8	59.5	53.4	54.0

Table 3. Important quality parameters of HI 8713

Character	HI 8713	Durum checks	
		HI 8498	MPO 1215
Grain appearance	6.2	6.9	7.1
Protein content (%)	11.7	12.5	12.4
Yellow pigment (ppm)	7.16	4.99	5.29
Sedimentation value (ml)	29	33	29
Yellow berry incidence (%)	9	6.2	10.6
Test weight (kg/l)	82.9	83.4	83.3
Hardness index	70	86	78
Iron (ppm)	35.5	28.9	32
Zinc (ppm)	33.6	27.9	30.7
Copper (ppm)	6.02	5.55	5.63
Manganese (ppm)	32.9	26.5	30.6
Cooking time (min)	10.5	10.4	10.35
Gruel solid loss	1.37	2.38	2.45
Overall acceptability	8.3	5.7	5.7

for chapati making or blending purposes.

Success stories of farmers cultivating HI 8713 and demand for seed

HI 8713 was demonstrated in farmers' field during *rabi* 2012-13 to 2014-15 along with popular bread wheat variety Lok-1 in Indore, Ujjain and Dewas districts of Madhya Pradesh by ICAR-IARI, Regional Station, Indore. HI 8713 showed about 80-95% average increase in yield compared to Lok-1 during these years (Table 4). It yielded more than 70 q/ha in *rabi* 2013-14 in all the field demonstrations. Farmers had expressed complete satisfaction about this variety in terms of grain production and productivity compared to their local popular bread wheat variety Lok-1. The farmers had conveyed that HI 8713 had fetched a higher price than Lok-1 in the grain mandis, which in turn increased their profitability in terms of economic returns.



HI 8713 (Pusa Mangal) Grain

Ten FLDs were conducted by KVK, Sehore each year during *rabi* 2015-16 to 2018-19 where HI 8713 was sown in 4 ha area under the thrust area Soil Health Management, Crop management practices. Pusa Mangal yielded in the range of 52-60 q/ha compared to the old variety which yielded 44-50 q/ha (Table 5). Increase in yield was recorded in the range of 7.3-12.0% which led to cost:benefit ratio of 3.62.

A progressive farmer Shri Govind Meena from village Kothara Pipalya,

Nasrullaganj, Sehore district had sown it in 0.4 ha during 2018-19. Under the supervision of ICAR-ATARI, Zone-IX, Jabalpur (MP) and CRDE-Krishi Vigyan Kendra, Sewania, District- Sehore (MP) HI 8713 was harvested and yield was recorded as 64.58 q/ha compared to local check (53.18 q/ha). The net income with HI 8713 cultivation was calculated as ₹ 97,253/ha and cost:benefit ratio was 3.74 compared to farmers practice (2.86).

Progressive farmer Shri Prabhu Dayal, resident of Village Khiriya, Lalitpur District of Bundelkhand Region of Uttar Pradesh had sown HI 8713, seed procured from Krishi Vigyan Kendra, Lalitpur during *rabi* season 2018-19. He had sown HI 8713 and local durum wheat variety in one acre area each, and HI 8713 yielded 20.8 q/acre. The grain HI 8713 fetched a higher price of ₹ 2,500/q and could earn a net benefit of ₹ 40,800/acre. During last 3 years i.e. from 2018-19 to 2020-21, he sowed HI 8713 in 20 acres leading to an enhancement in production from 20 q to 500 q and gross income from 0.5 lakh to 12.5 lakh. Now, Shri Prabhu Dayal intends to grow *Kathia* wheat on a larger scale. He is also planning to encourage other farmers to take up cultivation.

Demand for HI 8713 seed among the farmers is growing since its release. The DAC indented release of Pusa Mangal has never been less than 200 q from 2016-17 and it was in the top 10 DAC indented wheat varieties during *rabi* 2018-19. The indent of HI 8713 during 2016-17 (248.8 q), 2017-18 (288 q), 2018-19 (462.2 q), 2019-20 (202 q) and 2020-21 (270 q) indicates the demand for the seed of Pusa Mangal among farmers.

Table 4. FLD Demonstrations of HI 8713 in comparison to Lok-1

Farmer	Area (ha)		Yield (q/ha)		Yield Increase	
	HI 8713	LOK-1	HI 8713	LOK-1	q/ha	%
<i>Rabi 2012-13</i>						
Deepak Wakhla	0.4	0.4	53	30	23	76.7
Banne Singh Chouhan	0.4	0.4	64	30	34	113.3
					Average	95.0
<i>Rabi 2013-14</i>						
Durgalal Sisodiya	0.4	0.4	74	38	36	94.7
Surajmal Dhangaya	0.4	0.4	74	40	34	85.0
Ajit Singh patel	0.4	0.4	71	40	31	77.5
Babulal Patel	0.4	0.4	73	40	33	82.5
Jiwan Patel	0.4	0.4	72	42	30	71.4
					Average	82.2
<i>Rabi 2014-15</i>						
Salim patel	0.6	0.5	58	32	26	81.3
Nasir patel	1.4	1.0	62	34	28	82.4
					Average	82.0

Table 5. FLD Demonstrations of HI 8713 conducted by KVK Sehore

Year	Area (ha)	Yield (q/ha)		Yield Increase		Net revenue		Cost:Benefit Ratio	
		HI 8713	Old variety	q/ha	%	HI 8713	Old variety	HI 8713	Old Variety
2015-16	4	55.65	43.58	12.0	27.7	40361	58238	2.62	3.31
2016-17	4	51.6	44.1	7.5	17.0	40511	52523	2.58	3.11
2017-18	4	52.33	45.05	7.3	16.2	79134	64837	2.57	3.11
2018-19	4	59.81	49.35	10.5	21.2	93573	73241	2.88	3.62

*Source: Annual reports of KVK, Sehore, MP

Export potential of Indian Durum wheat

Durum wheat has a special niche in the Indian wheat economy. Indian durum wheat is typically purchased by the private trade at a premium price, mainly for processing high

value products and generating additional employment through durum based pasta industry. There is also a huge potential of earning foreign exchange through the export of quality grain and value-added products. The grain and nutritional quality of durum wheat varieties: HI 8663, HI 8713, HI 8737, HI 8759 and HI 8777, viz. grain protein content (>13%), high iron (>45 ppm), high zinc (>40 ppm), yellow pigment (>6 ppm) content is in comparison with Canadian and Australian durums, which makes Indian durum wheat highly potent for export. However, the availability of exportable durum is limited and due to the lack of gradation system for durum wheat, it gets mixed with bread wheat in local markets. Special grading system and strict policies by

the government in the procurement of durum wheat and preparation of pasta products from durum wheat only can boost the Indian pasta manufacturing industries and durum wheat growers.

SUMMARY

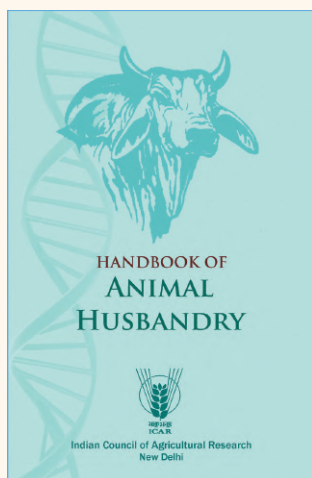
Durum wheat cultivation is found to be highly profitable in central India due to varieties having high yield potential, rust resistance and high tolerance to drought and heat, which ensure more production with less irrigation. Around 13% of increase in durum wheat area was found in Madhya Pradesh compared to the durum wheat area in the last 5 years. With the rising demand from milling industries in and around Madhya Pradesh, farmers are increasingly taking up the cultivation

of durum wheat. HI 8713 is a durum wheat variety with high yield, wider adaptability, high yellow pigment (7.16 ppm), good levels of essential micronutrients, and excellent dual quality grain with high levels of resistance to stem and leaf rust. Quality traits, viz. high hectolitre weight, less gruel solid loss and good grain appearance make Pusa Mangal, a best choice for good quality pasta. The success stories of farmers growing HI 8713 in terms of net revenue, cost benefit ratio and demand for the seed ensure Pusa Mangal can offer economic and nutritional security for wheat farmers of Central zone.

*Corresponding author's e-mail:
divya.ambati@icar.gov.in

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TECHNICAL SPECIFICATIONS

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