



Short Communication

Development and validation of a new wheat (*Triticum aestivum* L.) variety — Raj 4037 to sustain maximum production in peninsular zone of India

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High temperature stress is a significant factor in reducing yield and quality of wheat in India [1]. High temperature stress during the grain filling period is a major constraint to wheat production in the country. An abrupt shoot up in temperature (3-6°C) in the month of March, 2004 in every part of the wheat growing area played a crucial role in adversely affecting the overall production to a great extent. Consequently about 4 million metric tones of wheat production is estimated to have been lost during 2003-04. Fischer and Maurer [2] demonstrated that 1°C rise in temperature above ambient during the period between the end of tillering and the beginning of grain filling, reduces grain yield by 4 per cent. Wiegand and Cuellar [3] found significant yield loss in wheat when average temperatures during the grain filling period were over 15°C.

Hence, by using special varieties for hotter environments having inbuilt resistance to ensure adequate germination under extremely low temperature and for proper grain filling when the temperatures are high, farmers can harvest yield between 30-40 q/ha even from the January sown crop. Thereby, wheat varieties possessing good amount of genetic tolerance for late heat is pre requisite to harvest good grain yield from heat stress environment. Genetic differences for heat tolerance are reported and wild genes are available for developing heat tolerant varieties. Similarly chromosome 2A, 2B and 3B appear to be associated with heat tolerance. Since plant tolerance to temperature stress is heritable, selection and breeding can be used to improve this trait [4]. Hence, breeding for heat stress tolerance assumes significance in India. To achieve this objective meticulous efforts were made which resulted in developing a new heat tolerant wheat (*Triticum aestivum* L.) variety Raj 4037.

The peninsular zone (PZ) accounts for 5.8% of wheat area and 2.4% of production in the country. In this zone during crop season, temperatures above optimum considerably affected even the timely sown wheat and it is a recurring problem. Generally wheat-growing season is very short in PZ. Hence, the wheat varieties, which have early maturity, possessing

adequate heat tolerance along with resistance to rusts are required. Besides, genetic potential to maintain higher yield with high grain weight and desirable quality attributes are most desirable under heat stress environment to sustain maximum production and productivity in wheat crop. In this endeavour, Raj 4037 was developed from two genetically diverse genotypes through single cross (DL 788-2/Raj 3717). The parent Raj 3717 was selected because it had tremendous potential to withstand temperatures higher than 35°C as far as grain yield in main stem is concerned. Hence, this wheat genotype was used as source of high temperature tolerance in breeding program aiming at high yielding varieties for hotter environments. Segregating generations of DL 788-2/Raj 3717 were handled by pedigree selection programme under late sown conditions (50th meteorological week) only. In this breeding method, superior individual plants were selected in successive generations (F₂-F₅) under artificial epiphytotic conditions of rusts. For screening homozygous heat tolerant lines from advance materials (F₆), sowing was done both in normal and late conditions to expose the crop to terminal heat stress. On the basis of various developmental traits for heat tolerance like earliness, high tillering, high number of spikelet per spike, high number of grains per spike, 1000-grain weight, high biomass, grain yield per plant, reaction to important disease and grain quality parameters, the most promising, homozygous line was screened out and named Raj 4077. This variety has foliage colour (boot stage) green and flag leaf, leaf sheath and peduncle are waxy. It has glumes shoulder, medium broad and glumes beak, medium pointed. Glume pubescence was absent. It has medium plant height, medium intermediate pointed erect green leaves; good tillering and waxy ear heads with medium long awn length. It possesses medium long parallel spikes with dense spikelets. Spikes turn dusty white at maturity. It has medium bold, amber, semi-hard and lustrous grains, having sunken cheeks, medium crease width and narrow shape. It is non-lodging and non-shattering variety and suitable for normal sowing conditions under high fertility

irrigated conditions for the PZ of the country and warmer areas of Rajasthan because of its better thermo tolerance mechanism.

Raj 4037 is a wonderful and reliable wheat variety that offers good degree of tolerance to terminal heat under various sowing environments (normal and late) of PZ. The results of breeding trials exhibited that Raj 4037 gave significantly higher grain yield (average grain yield 40.9 q/ha) in comparison to almost all the check varieties during three year testing and it was also qualifying maximum times (17/27) for first non-significant group on pooled basis, indicated that it has its better adaptability and stability for grain yield (Table 1). The results of Agronomic trials (2002-2003) of sowing date experiments revealed that Raj 4037 produced higher grain yield in both normal (38.3 q/ha) and late (35.0 q/ha) sowing conditions over the checks, confirmed its good stability and wider adaptability for grain yield (Table 2). In fertilizer experiments Raj 4037 gave 40.4q/ha grain yield, when it was tested in recommended dose of nitrogen (120 kg/ha). This variety showed better resistance to rusts under natural as well as artificial conditions (Table 3).

Table 1. Grain yield performance of Raj 4037 under normal sowing condition in coordinated trials of PZ of India (2001-03)

	Year of testing	Loca-tions	Raj 4037	Checks				CD
				HD	GW	MACS	GW	
Mean yield (q/ha)	2000-01	5	37.5	29.8*	33.2*	32.0*	-	2.7
	2001-02	11	45.0	38.2*	-	41.0*	43.9	1.4
	2002-03	11	40.2	33.6*	-	-	36.6*	1.1
Zonal mean yield (q/ha)			40.9	33.8	33.2	36.5	40.3	
Frequency in top group			17/27	4/27	2/5	2/1	10/22	

*,**Significant at 5% probability level

Results of plant physiology trials (2003-04) revealed that Raj 4037 consistently showed better performance under high temperature environments. Heat sensitivity index for this genotype was also recorded very low (0.5), which confirmed that this genotype had better thermo tolerance and it can be used as heat tolerant source in future breeding programme. Results of agronomic attributes of Raj 4037 exhibited that it flowered in 57-61 days and attained maturity in 103-106 days. It has average plant height 73-75 cm. It also possesses amber hard and lustrous grains with the average 43-45 g test weight under heat stress environment, which provided extra bonus to wheat growers in the domestic market. Results of quality parameters of this variety revealed that it has average grain appearance score 6.6/10, hectoliter weight 82.5 kg, protein content 11.8% and sedimentation value 43.3 ml.

Raj 4037 has excellent grain weight and quality parameters, which can be helpful to fetch higher premium

Table 2. Grain yield performance of Raj 4037 variety under changed agronomic conditions in Coordinated trials of PZ of India (2002-2003)

Name of experiment	Agronomic condition	Raj 4037	Checks		
			HD	GW	MACS
			2189	322	2496
Sowing date experiments (yield q/ha)	Normal	38.3	30.7	38.0	37.6
	Late	35.0	28.4	33.7	33.4
Fertilizer experiments (yield q/ha)	Recommended dose of nitrogen (120 N)	40.4	33.1	39.2	38.5

Table 3. Resistance of Raj 4037 against various rusts in normal sown condition under natural and artificial conditions at different centres** (2002-2003)

Rust	Raj 4037	Check variety			
		HD	GW	MACS	GW
		2189	190	2496	322
<i>Stem rust</i>					
Natural	5MS	10MR	10MS	5MR	10MS
Artificial	20MS	20MS	20MS	30MS	30MR
	(7.2)*	(9.8)	(6.9)	(9.2)	(5.5)
<i>Brown rust</i>					
Natural	MS	5S	40S	80S	40S
	(0.4)		(15.3)	(6.5)	(10.0)
Artificial	10MS	60S	60S	80S	20S
	(2.6)	(17.5)	(30.2)	(34.9)	(5.9)

*Average coefficient of infection; S-Susceptible; MS-Moderately susceptible, MR-Moderately resistant; **Centres: Delhi, Karnal, Ludhiana, Pantnagar, Durgapura, Hisar, Almora and Ranichauri

in market as compared to existing popular varieties in the PZ for industrial uses. Earliness coupled with higher grain weight under heat stress environment is an unique character of Raj 4037, which could be helpful to alleviate the wheat production under warmer areas of the Peninsular Zone. In February 2004, the Central Sub-committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, released this variety for timely sown, high fertility, irrigated condition of PZ of India (Maharashtra, Karnataka, plains of Tamilnadu and Andhra Pradesh). Recently this variety is also showing very good performance in Rajasthan state particularly in the southern-eastern Rajasthan and gaining popularity among the farmers under timely sown irrigated condition.

References

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