



Full Length Article

Hashim-8: a Short Duration, High Yielding and Disease Resistant Wheat Variety for Rain-fed Areas of Pakistan

MUHAMMAD HASHIM KHAN, NASIR-UD-DIN, ABDUL AZIZ KHAKWANI, MOHAMMAD SAFDAR BALOCH, MUHAMMAD ZUBAIR[†], SAIFULLAH KHAN[‡] AND ABDUL WAHAB KHAN[¶]

Agricultural Research Institute, Dera Ismail Khan, Pakistan

[†]*Department of Forestry, Wildlife and Range Management, Bahauddin Zakariya University, Multan, Pakistan*

[‡]*Arid Zone Research Institute, Quetta, Pakistan*

[¶]*Rice Program, National Agricultural Research Center, Park Road, Islamabad, Pakistan*

[†]Corresponding author's e-mail: dikhan2000@hotmail.com

ABSTRACT

To boost the yield per unit area, continuous release of high yielding and widely adapted wheat varieties resistant to both biotic and abiotic stresses is the key factor. With this in view, a new wheat variety "Hshim-8" was developed at the Agricultural Research institute, Dera Ismail Khan in 2008. This variety was selected from wheat observation nursery (WON) received from ICARDA during the year 1997-1998 and was evaluated under the name of DN-44. Hashim-8 was released after 10 years of vigorous research and experiments at different research stations and farmer's fields coordinated by National Agricultural Research Center (NARC) Islamabad. Preliminary and advance yield trials showed outstanding performance of DN-44 (Hashim-8) across domains containing a number of international entries and local approved varieties grown as check. This variety out yielded in national uniform wheat yield trials (NUWYT) for two successive years in Pakistan. It ranked 3rd during 2004-2005 and 1st during 2005-2006 across the country including Azad Jammu and Kashmir. It is early maturing, high yielding, disease resistant, heat and drought tolerant wheat variety best suited under the agro-ecology of Dera Ismail Khan. It falls under acceptable Relative Resistance Index (RRI) for yellow rust (YR) at various locations. The Provincial Seed Council (PSC), KPK approved this variety in 2009 for general cultivation in rainfed areas. © 2011 Friends Science Publishers

Key Words: *Triticum aestivum*; Germplasm screening; Variety development; Dry areas

INTRODUCTION

Wheat covers 70% of rabi and 37% of the total cropped area of the country. It is the staple food and therefore grown in almost every part of Pakistan (Akhtar *et al.*, 2010). It plays fundamental role in the food security of the country. In Khyber Pakhtunkhwa (KPK), more than half of the cultivated area lying under rainfed conditions, barely supports vegetation especially food grains, which are insufficient to meet demand for the local population (Khan, 2011). The situation is further aggravated by the erratic distribution of the rainfall. Often rain occurs in patches and sometimes at times whereby most of the wheat sowing is over, thereby shortening crop-growing season.

The current wheat yield is low in Pakistan due to a number of constraints, however, lack of high yielding wheat varieties being the major one (Muhammad *et al.*, 2010). Ahmad *et al.* (2005) and Bakhsh *et al.* (2005) also reported that the yield may be increased substantially through the evolution of high yielding genotypes. Moreover, about 80% wheat is being planted under late conditions due to long stay of cotton in the field. Therefore, the development of medium to late maturing wheat varieties is necessary that

can successfully be grown after the harvest of cotton (Ahmad *et al.*, 2005; Hussain *et al.*, 2010).

Most of the cultivated varieties become susceptible to diseases, for example, wheat varieties Inqlab-91 and Bhakkar-2002 have been found susceptible to rust diseases in most parts of the country (Anonymous, 2005). To overcome this problem, the cultivation of rust resistant varieties is a viable solution (Anonymous, 2005). Thus, there is always need to develop wheat varieties, which are ecologically suitable, environmental friendly and economically viable in order to sustain farmers' income and improve their livelihoods.

Hashim-8 has edge over most of the cultivated wheat varieties due to its early maturity and rapid grain filling capacity under diverse climatic and soil conditions. This variety possesses improved genetic potential and has performed exceptionally well in yield trials and therefore best suited to available growing period in most parts of the country.

MATERIALS AND METHODS

Hasim-8, with pedigree
JUP/ALD'S'//KLT'S'/3/VEE'S'/6/BEZ//TOB/8156/4/ON/

3/6*TH/KF//6*LEE/KF/5ICW91-0321-2AP-0TS-1AP-2AP-0L-0AP, was selected from wheat observation nursery (WON) received from ICARDA during the year 1997-1998. The entry No. 52 in the said nursery performed well and therefore selected for further evaluation under rainfed conditions. The genotype was evaluated for three years in various replicated trials including preliminary yield trial (PYT), B-Test and advance yield trial (AYT) at the Agricultural Research Institute, Dera Ismail Khan during the year 1998-2003. All these trials were laid out in a randomized complete block design with three replications. Standard checks (Rawal-87, Daman-98 & Zam-04) were also included in every experiment for comparison.

DN-44 was then evaluated for yield, disease and drought resistance and other agronomic traits in NUWYT (Rainfed) across the country on 17 experimental sites during 2004-2005 and 2005-2006, respectively. All the agronomic and cultural practices were followed as per standard recommendations for the localities. After obtaining the highest grain yield at local and national level, the candidate line DN-44 was approved by the Provincial Seed Council (PSC), KPK in 2009 for general cultivation in rainfed areas and given the name of Hashim-8 (in recognition of long-term services of wheat breeder Muhammad Hashim Khan). The data recorded on grain yield (kg ha^{-1}) were analyzed statistically using analysis of variance techniques (Steel *et al.*, 1997) and means were separated by least significance difference test using MSTATC software program (MSTATC, 1991).

RESULTS AND DISCUSSION

Performance of DN-44 in preliminary nursery: DN-44 was selected from wheat observation nursery received from ICARDA during the year 1997-1998. Out of 182 lines, DN-44 produced grain yield of $4002 \text{ (kg ha}^{-1}\text{)}$, which was 26% higher than the local check (Rawal-87), which produced grain yield of 3001 kg ha^{-1} (Table I).

Performance of DN-44 in preliminary yield trial (PYT): Fourteen lines including Daman-98 (check variety) were evaluated in preliminary yield trial during the year 1998-1999. DN-44 produced grain yield of $3311 \text{ (kg ha}^{-1}\text{)}$ as compared to check variety Daman-98 which produced grain yield of $3257 \text{ (kg ha}^{-1}\text{)}$. This yield was 2% higher than the check variety (Table I & II).

Performance of DN-44 in advance yield trial (AYT): Ten promising lines including DN-44 were tested for yield comparison in advance yield trial during the year 2003-2004 (Table III). Wheat variety Zam-04 was used as standard check. DN-44 produced 36% higher grain yield (4653 kg ha^{-1}) than Zam-04, which produced grain yield of $2986 \text{ (kg ha}^{-1}\text{)}$. This yield was 2% higher than the check variety (Table I & II).

Performance of DN-44 in national uniform wheat yield trial (NUWYT): NUWYT (RF) data recorded during the year 2004-2005 and 2005-2006 (two years testing) revealed the incomparable performance of DN-44 across the country.

In NUWYT (2004-2005), DN-44 ranked 1st in KPK (8 sites) by producing the highest grain yield of $4376 \text{ (kg ha}^{-1}\text{)}$ among other candidate varieties from all over Pakistan. Whilst comparison of sites at Pakistan level (17 sites), it ranked 3rd showing grain yield of $3538 \text{ (kg ha}^{-1}\text{)}$, however by taking into account the LSD values, this yield is at par with the other two high yielding varieties, depicting its position same as the top ranked variety performing during 2004-2005 (Table IV). Similarly, as shown in Table V, it was ranked 1st in Pakistan (including Azad Jammu & Kashmir) by producing the maximum grain yield of $3534 \text{ (kg ha}^{-1}\text{)}$ during the second year trial (2005-2006). The attainment of 1st position in Pakistan is therefore, a marvel of the suitability of this variety under diverse climatic conditions as well.

Disease reaction: Regarding disease reaction (terminal reaction) reported in NUWYT results 2004-2005 and 2005-2006 (Table VI & VII), DN-44 falls under acceptable relative resistance index (RRI) pertaining to yellow rust (YR) showing resistance of this variety against diseases at various locations. Regarding yellow rust, DN-44 was given a value of $\text{RRI} = 9$, which is highly desirable in conjunction with Crop Diseases Research Program (CDRP) evaluations that any variety obtained RRI of 7 and above is resistant to YR. During the year 2005-2006, leaf rust reaction $\text{RRI} = 1$ showed its susceptibility, however leaf rust is not a serious problem of wheat in KPK and other cooler regions of Pakistan. Leaf rust did not appear in epidemic form in the country since 1976; therefore, it is not a serious threat to wheat crop at present. In addition, it is worthy to mention that the rainfall in the Southern regions remains below 10 mm, which comes under dry climate, wherein rust problem is least likely to occur/appear. Secondly, it is a short duration variety and therefore escapes the development of rust by early maturity. Similarly, DN-44 showed a desirable index of 6 regarding LR even though it is not prevalent and severe indicator of problem in KPK. The NUWYT data obtained during 2005-2006 revealed that DN-44 was the only rainfed line, which was found resistant to yellow rust across the country during both the years (2004-2005 & 2005-2006).

General characteristics of DN-44: DN-44 has erect growth. The plant shows green colour at boot stage. On average, it produces 170 tillers (m^{-2}). Plant height ranges from 80-90 cm with stem diameter 4-5 cm. Flag leaf is semi-erect with 29 and 10.6 cm length and width, respectively. Ear emergence takes place in 55-65 days after sowing, while the crop matures in 95-120 days. Ear size is medium with 8-11 cm length. Seed colour is whitish amber, opaque surface, oval shaped. It is lodging and disease resistant.

DISCUSSION

The development of a variety having the higher yield potential and better adaptability is a dire need of the day, because low seed yield is also attributed to non-availability

Table I: Grain yield (kg ha⁻¹) of "DN-44" in comparison to standard checks in various yield tests conducted during 1997-1998 to 2005-2006

S #	Test	Year	DN-44	Local check	% increase
1.	WON (E # 52)	1997-98	4002	3001 (Rawal-87)	26 %
2.	PYT-3 (RF)	1998-99	3311	3257 (Daman-98)	2 %
3.	AYT	2003-04	4653	2986 (Zam-04)	36 %
4.	NUWYT (KPK)	2004-05	4376	3468 (Local check)	21 %
5.	NUWYT (KPK)	2005-06	4032	3870 (Local check)	4 %
6.	NUWYT (RF)	2004-05	3538	3186 (Local check)	11 %
7.	NUWYT (RF)	2005-06	3534	3236 (Local check)	9 %

Table II: Grain yield (kg ha⁻¹) of DN-44 in PYT (Rain fed) at ARI, D.I. Khan during 1998-1999

Entry No.	Grain yield (kg ha ⁻¹)
1	2443 b
2 (DN-44)	3311 a
3	3111 ab
4	2777 ab
5	3048 ab
6	2922 ab
7	2964 ab
8	3195 ab
9	3153 ab
10	3236 ab
11	2463 b
12	2944 ab
13	3048 ab
14 (check)	3257 ab

Table III: Grain yield (kg ha⁻¹) of DN-44 in AYT (Rain fed) at ARI, D.I. Khan during 2003-2004

Entries	Grain yield (kg ha ⁻¹)
DN-35	2524 e
DN-36	3000 d
DN-39	3019 d
DN-40	3910 b
DN-42	2928 d
DN-43	1538 f
DN-44	4653 a
DN-45	3663 b
DN-46	3316 c
Zam-04 (check)	2986 d
LSD _{0.05}	267.9

Means followed by different letter(s) are significant at 5% level of probability

of pure seed of improved varieties (Sarwar & Ahmad, 2003). Wheat yield per unit area may be increased substantially through the evolution of high yielding genotypes (Bakhsh *et al.*, 2005). About 30-50% improvement in wheat yield could be achieved by the introduction of new high yielding variety (Mirza *et al.*, 2003). In Pakistan, a handful of short duration varieties were developed that performed well over the years namely Sonalika, Khyber-87 etc. But this was thing of the past and since last two decades, there is no such development to utilize the potential of short duration wheat varieties for the benefit of the community. Under these circumstances, wheat variety Hashim-8 is a blessing, which heads even in 55-60 days under rainfed conditions. It has a number of distinguishing features that stand it high over other approved

Table IV: Pooled yield (kg ha⁻¹) analysis of wheat varieties included in NUWYT (Rain fed) during 2004-2005

NUWYT No.	Line/variety (source)	Punjab (9 sites)	KPK (8 sites)	Pak + A.JK (17 sites)
1.	PR-87 (CCRI, Pirsabak)	3503	4004	3606
2.	NR-241 (NARC, Islamabad)	3413	3896	3533
3.	SN-128 (ARS, Serai Naurang)	3206	4165	3524
4.	V-00BT004 (Biotech, AARI-Faisalabad)	3001	3543	3169
5.	V-00055 (AARI, Faisalabad)	3238	3593	3353
6.	V-5 (ARI-Sariab, Quetta)	3388	3791	3475
7.	NRL-2017 (NIFA-Peshawar)	3518	3945	3620
8.	NR-234 (NARC-Islamabad)	3045	4223	3486
9.	V-002467 (RARI-Bahawalpur)	2939	3827	3304
10.	DN-44 (ARI, D.I.Khan)	2981	4376	3538
11.	PR-83 (CCRI, Pirsabak)	3003	4372	3531
12.	Local check	3050	3468	3186
	LSD _{0.05}	177	290	156

Table V: Pooled yield (kg ha⁻¹) analysis of wheat varieties included in NUWYT (Rain fed) during 2005-2006

NUWYT No.	Line/variety (source)	Punjab (9 sites)	KPK (8 sites)	Pak + A.JK (17 sites)
1.	NR-268 (NARC, Islamabad)	3227	3795	3494
2.	00FJ03 (BARS, Fatehjang)	2767	3677	3195
3.	V-002467 (RARI, Bahawalpur)	2967	4070	3486
4.	PR-87 (CCRI, Pirsabak)	3081	3991	3509
5.	V-03007 (AARI, Faisalabad)	2730	4071	3361
6.	93T347 (AZRI, Bhakkar)	2583	3794	3153
7.	DN-44 (ARI, D.I.Khan)	3091	4032	3534
8.	NRL-2017 (NIFA, Peshawar)	2941	4077	3475
9.	NR-267 (NARC, Islamabad)	2785	4002	3358
10.	PR-83 (CCRI, Islamabad)	2727	3804	3234
11.	99FJ03 (BARS, Fatehjang)	2821	3572	3175
12.	Local check	2656	3870	3226
	LSD _{0.05}	179	290	166

varieties suitable for the rainfed areas of Pakistan. Like Pak-81, Hashim-8 earned the privilege of being at the top in yield through out Pakistan after a lapse of more than two decades in the field of wheat breeding. Seed quality is an important parameter that determines its acceptability among the consumers (Hussain *et al.*, 2010). It is the most effective input for improving productivity (Akhtar *et al.*, 2010). The quality evaluation report revealed that Hashim-8 possess all desirable qualitative attributes including 1.59% grain ash, 15.82% grain protein, 23.58% wet gluten and 7.47% dry gluten (Table VIII). It has good *chapati* making quality.

Table VI: Disease reaction data of wheat varieties included in NUWYT (RF) during 2004-2005

S #	Line/variety (source)	Terminal Reaction			
		RRI Yr	Desirable/acceptable RRI (CDRP*)	RRI Lr	Desirable/acceptable RRI (CDRP*)
1.	PR-87 (CCRI, Pirsabak)	5	7/5	8	7/6 or 5
2.	NR-241 (NARC, Islamabad)	8	7/5	3	7/6 or 5
3.	SN-128 (ARS- Serai Naurang)	7	7/5	3	7/6 or 5
4.	V-00BT004 (Biotech, AARI-Fsd.)	0	7/5	0	7/6 or 5
5.	V-00055 (AARI, Faisalabad)	1	7/5	4	7/6 or 5
6.	V-5 (ARI-Sariab, Quetta)	6	7/5	2	7/6 or 5
7.	NRL-2017 (NIFA-Peshawar)	3	7/5	6	7/6 or 5
8.	NR-234 (NARC-Islamabad)	4	7/5	3	7/6 or 5
9.	V-002467 (RARI-Bahawalpur)	7	7/5	8	7/6 or 5
10.	DN-44 (ARI, D.I.Khan)	9	7/5	6	7/6 or 5
11.	PR-83 (CCRI, Pirsabak)	9	7/5	8	7/6 or 5
12.	Local check	-	-	-	-

Crop Disease Research Program, Pakistan Agricultural Research Council, Islamabad

Table VII: Disease reaction data of wheat varieties included in NUWYT (RF) during 2005-2006

S #	Line/Variety (Source)	Terminal Reaction			
		RRI Yr	Desirable/ Acceptable RRI (CDRP*)	RRI Lr	Desirable/ Acceptable RRI (CDRP*)
1.	PR-87 (CCRI, Pirsabak)	4	7/5	5	7/6 or 5
2.	NR-241 (NARC, Islamabad)	-	7/5	-	7/6 or 5
3.	SN-128 (ARS- Serai Naurang)	-	7/5	-	7/6 or 5
4.	V-00BT004 (Biotech, AARI-Fsd.)	-	7/5	-	7/6 or 5
5.	V-00055 (AARI, Faisalabad)	-	7/5	-	7/6 or 5
6.	V-5 (ARI-Sariab, Quetta)	-	7/5	-	7/6 or 5
7.	NRL-2017 (NIFA-Peshawar)	0	7/5	3	7/6 or 5
8.	NR-234 (NARC-Islamabad)	-	7/5	-	7/6 or 5
9.	V-002467 (RARI-Bahawalpur)	3	7/5	5	7/6 or 5
10.	DN-44 (ARI, D.I.Khan)	7	7/5	1	7/6 or 5
11.	PR-83 (CCRI, Pirsabak)	9	7/5	8	7/6 or 5
12.	Local check	-	-	-	-

Crop Disease Research Program, Pakistan Agricultural Research Council, Islamabad

Table VIII: Quality evaluation of NUWYT (RF) candidate lines during 2005-2006

NUWYT E. No.	Line	1000-kernel weight (g)	Test weight (kg/ha)	PSI	Grain ash (%)	Grain protein (%)	Gluten consistency	Wet gluten (%)	Dry gluten (%)	SDS value (cc)
1	NR-268	41.2	75.8	40	1.392	12.28	MS	25.61	9.12	36
2	V-00FJ03	39.9	77.2	46	1.327	9.37	MS	20.60	6.76	23
3	V-002467	40.9	75	42	1.822	14.51	MS	36.69	11.43	36
4	PR-87	46.9	74.40	51	1.435	11.28	MS	21.69	6.97	22
5	V-03007	39.9	73.5	46	1.383	11.76	W	28.74	9.12	31
6	V-93T347	38.9	71.40	44	1.549	12.29	S	17.16	6.32	20
7	DN-44	43	74.85	42	1.593	15.82	MS	23.58	7.47	19.5
8	NR-2017	38.9	76.5	45	1.575	11.32	S	21.42	7.11	26
9	NR-267	43.3	77.75	39	1.343	12.63	S	26.16	9.34	36
10	PR-83	46.5	76.30	40	1.511	12.72	MS	24.04	8.83	28
11	99FJ03	40.6	77.2	44	1.200	10.76	S	23.01	7.47	23.5
12	Local check	-	-	-	-	-	-	-	-	-

CONCLUSION

The development of Hashim-8 is the pinnacle of achievements in the field of variety evaluation. Nothing is comparable with respect to early maturing and yield of this variety under rainfed conditions particularly in warmer areas of KPK, Punjab and Pakistan. Even it can also thrive well in cooler stressed conditions of Azad Jammu and Kashmir areas. Furthermore, resistance to yellow and leaf rust make it highly suitable for growing under rainfed conditions in KPK and Pakistan. This will not only diversify the genetic base of the area regarding wheat varieties consistent with

WTO regulations, but also improve the livelihood status of the farmers of the area by having a short duration high yielding variety, best tolerant to high temperature, moisture stressed conditions as well as under cooler climatic conditions.

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