

DROUGHT TOLERANT WHEAT CULTIVAR (RAJ) FOR RAINFED AREAS OF KPK, PAKISTAN

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The wheat cultivar Raj 2002 having the parentage 1771, 5RK- 9RK-10RK during 1995-96 was first tested at Agriculture research institute D.I. Khan in the 16th Elite Screening Wheat Yield Trial (ESWYT) with local check variety BK-92. The line was selected on the basis of high yield (2839 kg ha⁻¹) as compare to check BK-92, (2421 kg ha⁻¹). Selected entries were promoted to B-2 test and MPT-4 (advanced yield trial) 1997-98 due to their high yield potential, disease and drought resistant and accepted stature as compared to Daman-98 and BK-92. Best performing entry Raj was promoted to Micro Plot Yield Trial in 1997-1998 and 1998-1999. Raj produced maximum yield of 3215 Kg ha⁻¹ vs. 2756 Kg ha⁻¹ of Rawal-87 during 1997-98. This selection was further evaluated for yield, disease and drought resistant and other agronomical traits in NUWYT conducted by National Agricultural Research Center, Islamabad at different sites in Pakistan (1854 to 3452 kg ha⁻¹) Table 6. Based on higher grain yield, disease and drought resistance and better grain quality, this entry was named as Raj and was approved by the Provincial Seed Council of Khyber Pukhtunkhaw (KPK) and released for cultivation in the rainfed areas during 2001.

Keywords: wheat, Raj, rainfed areas, grain yield, quality

INTRODUCTION

Wheat crop plays an important role in the agricultural system of Pakistan. Grain yield in Pakistan is much less as compared to other wheat producing countries of the world. Various factors are considered responsible for better crop harvest. Among which high potential varieties offer a tremendous scope. Different varieties of cereal respond differently through agro climatic conditions of a particular area due to difference in their genetic makeup and physical life process (Behera, 1994). Selection of improved and high yielding genotypes of different cereal having a wide range of adaptation to agro climatic condition is essential to increase the yield per hectare. Breeders are making continuous efforts to improve wheat yield and production in Pakistan. However, still there is big gap in the yield per acre of wheat as compared to some other developing countries. This can be achieved by the agronomic, cultural and the genetic improvement. The improvement to 30-50% in wheat yield has been achieved by the introduction of newly high yielding cultivar in the country (Mirza *et al.*, 2003). In general breeding for tolerance to drought involves combining good yield potential in the absence of the stress and the selection of traits that provide drought stress tolerance (Blum, 1988). In defining a strategy for wheat breeding under drought stress, Rajaram *et al.* (1996) suggested simultaneous evaluation of the germplasm both under near optimum conditions (to

utilize high heritability and identify genotypes with high yield potential) and stress conditions (to preserve alleles for drought tolerance). In the case of wheat, yield in extremely dry years are reduced as much as 81% (Dragovic, 1999).

Wheat program at ARI, D.I. Khan developed strategy for drought tolerant wheat. For the said purpose Wheat Program screened wheat material from International and local germplasm with particular emphasis on drought tolerance and disease resistant. Many varieties like Pirsabak-85, Daman-98, have been developed in the past which got extra ordinary popularity not only in Pakistan but in the neighboring countries like Iran and Afghanistan. As wheat varieties run out mostly due to diseases, continuous efforts are needed to produce new varieties to replace the old ones. The main objective of the present study was to screen and evaluate the ESWYT germ plasma received from CIMMYT in the agro ecological zones of Khyber Pakhtunkhaw (KPK), Pakistan for high yield and disease resistance.

MATERIALS AND METHODS

Forty entries were received from CIMMYT in the 16th Elite Screening Wheat Yield Trial (ESWYT) and tested under the agro climatic conditions of D.I. Khan during 1995-96. The trial was planted at ARI, D.I. Khan in Randomized complete block design (Gomez and Gomez, 1983) with four replications during 1995-96 for

yield and disease resistance. Each plot consisted of six rows 25 cm apart and five meter long. The line 1771, 5RK-9RK-10RK (Entry 5, Raj) was selected on the basis of high yielding, drought and disease resistance. This variety was selected for its good plant height, maturity, disease resistance, grain yield and harvest Index. Data on grain yield, disease reaction, plant height, days to heading, and total dry matter was recorded. On the basis of high yielding performance and disease resistance, the line (1771) was advanced to B-2 test with 10 genotypes having Daman-98 as check and Micro Plot Yield Trial-4 (Advanced screening trial) 997-98 with twelve genotypes including check (Rawal 87) and was planted in RCBD with four replications. The genotype Raj (1771) was reevaluated in Micro plot yield trial -2 on the basis of good grain yield and disease resistance during 1998-99 to confirm its yield stability. Each entry was sown in plot having six rows five meter long and 25 cm apart. Fertilizer was applied at the rate of 60:30 NP kg/ha in all the trial throughout the testing of the line from 1995-96 to 1998-99. On the basis of its good performance genotype Raj (1771) was selected to be tested in National Uniform Wheat yield Trial under the rainfed conditions by National Agriculture Research Centre Islamabad (coordinated wheat program) during 1999-2000 as DN-10. NUWYT was planted at nineteen (19) locations with six rows 5 meter long with row to row distance of 30 cm. Check varieties were different at each location. For yield determination centre four rows of five meter long from NUWYT were harvested in all tests conducted for the selection of Raj (DN-10). Data were analyzed by ANOVA at 5% probability using the statistical package MStatC. Disease data was collected by CDRI, Islamabad. RRI (Relative disease Indices) was recorded by the formula

$$RRI = \frac{(100 - CARPA)}{100}$$

where CARPA is Country/Zonal relative (%) to highest attack which is calculated for each entry over locations.

RESULTS AND DISCUSSION

The history and yield performance of Raj in B-2 from 1995-2000 is reported in Table 2 & 5. After selection from the 16th ESWYT 1995-96 (Entry 5), the variety was tested in B-2 where it gives maximum grain yield of 3716 Kg ha⁻¹ as compared to check 3298 kg ha⁻¹ (Table 3). The variety was tested in MPT-4 Rainfed in 1997-98 and yielded 3215 Kg ha⁻¹ as compared to other variety or check variety (Table 4). The yield data of Micro Plot Yield Trial (Rainfed) in 1998-99 again confirmed the yield advantage of Raj against the check variety Daman-98. Raj produced the highest yield of 3465 Kg ha⁻¹ against the yield of 3257 Kg ha⁻¹ of Daman-98 the check variety (Table 2 & 5).

Table 1. Percent Increase of Raj (DN-10) over local Check in 16 ESWYT, 1995-96

Entry	Grain Yield kg ha ⁻¹	% Increase over Check
Entry 5. Raj (DN-10)	2839	17
Entry 1. (Check)	2421	

Raj was evaluated for grain yield, disease and drought resistance and other agronomic traits in National Uniform Wheat Yield Trials conducted by National Agricultural Research Center, Islamabad on 19 sites during 1999-2000. The trial consisted of 12 entries with different check varieties at different locations. The variety produced high grain yield as compared to the

Table 2. History of Development of RAJ

S.No.	Type of Trial	Year	No. of Entries Tested	Remarks
1	16 th ESWYT	1995-96	40	Entry No. 5 (Raj) was selected on the basis of best performance.
2	B2 Test (Rainfed)	1997-98	12	Raj (S. No. 10) out yielded all the entries included the trials.
3	MPT4 (Rainfed)	1997-98	12	Raj (Entry No. 7) produced the high yield than the check variety (Rawal-87).
4	MPT2 (Rainfed)	1998-99	10	Raj (S. No.9) produced the maximum yield as compared the check variety (Daman-98).
5	NUWYT	1999-2000	12	Raj (Entry 11) produced Avg. yield of 2344 kg ha ⁻¹ and was higher than checks at different location. Stood 7 th in NUWYT.

Table 3. Grain Yield of Raj (DN-10) in B-2 Trial (1997-98)

Entry	Grain Yield kg ha ⁻¹
1	2630 bc
2	3382 ab
3	3090 ab
4	3465 ab
5	2046 c
6	2756 bc
7	3215 ab
8 (Daman-98) Check	3298 ab
9	2672 bc
10 Raj (DN-10)	3716 a

Probability at 5% (Data followed by same latter are non- significant)

Table 4. Grain Yield of Raj (DN-10) in MPT-4 Trial (1997-98)

Entry	Grain Yield kg ha ⁻¹
1	2756 b
2	2004 g
3	2380 d
4	3215 a
5	2004 g
6	2171 f
7 Raj (DN-10)	3215 a
8	1921 h
9	2171 f
10	2547 c
11	2255 c
12 (Rawal-87) Check	2756 b

(P_≥ 0.05) (Data followed by same latter are non- significant)

Table 5. Zonal grain yield (Kg/ha) of Raj in comparison to local checks in various yield tests conducted from 1995-96 to 1999-2000

S. No.	Nursery/Test	Year	Raj Yield (Kg ha ⁻¹)	Yield (Kg ha ⁻¹) Local Check
1	ESWYT	1995-97	2839	2421 (BK-92), Entry No. 5 Table 13.13 Annual Report.
2	B-2 test (Rainfed)	1997-98	3716	3298 (DAMAN-98), Entry No. 10, Table 13.36, Ann. Report.
3	MPT-4 (Rainfed)	1997-98	3215	2756 (Rawal 87), Ent. No. 7, Table 13.12, Ann. Report.
4	MPT-2 (Rainfed)	1998-99	3465	3257 (DAMAN-98), Ent. No. 9, Table 13.10, Ann. Report.
5	NUWYT, D. I. Khan	1999-2000	2792	2167 (DAMAN-98), Ent. No. 7, Table 84, Result of NUWYT, PARC, 1999-2000.

Table 6. National Comparison of Grain Yield of Raj and Local checks during 1998-1999

S. No	Nursery Test	Raj Kg/ha	Local check yield Kg ha ⁻¹	LSD
1	Bhakar, AZRI	1854	1833 (Chakwal-86)	200
2	Chakwal Jatli	3275	3204 (Chakwal-97)	338
3	Islamabad, NARC	3452	3600 (Kohistan-97)	NS
4	BARS, Kohat	2208	1775 (Suleman-96)	NS

Table 7. Comparison of grain yield of Raj and local check as (NUWYT) during 1999-2000

S. No	Locations	Raj Kg ha ⁻¹	Local Check Yield Kg ha ⁻¹	Rank
1	ARI, Sariab, Quetta	458	292 (Sariab-9)	6
2	AZRC, Quetta	594	634 (AZRI-96)	14
3	Layyah KARORE, ARF	2313	2311 (Chakwal 86)	3
4	Narowal Shakar Garh	3150	2800 (Local Check)	7
5	Gujrat Tobacco Research Station, Kunjah	1563	1313 (Chakwal -97)	5
6	BARI, Chakwal	1696	1863 (Chakwal-97)	11
7	Chakwal JATLI, Village Babra	2138	1842 (Chakwal-97)	1
8	WRS, Rawalpindi	2563	3375 (Chakwal-97)	11
9	NARC, Islamabad	3950	3550 (Chakwal-97)	4
10	Barani Agri. Res. Station, Fatehjang, Attock	3750	3867 (Chakwal-97)	3
11	Agri. Res. Station, Attock	3875	4125 (Chakwal-97)	10
12	ARI, D. I. Khan	2792	2167 (Daman-98)	4
13	AZRI, D. I. Khan	1746	1970 (Local Check)	13
14	ARS, Sarai Naurang, Lakki Marwat	725	1121 Suleman-96)	4
15	BARS Kohat	1700	1556 (Suleman-96)	4
16	NIFA, Taranb Peshawar	3667	4917 (Tatara)	11
17	CCRI, Pirsabak, Nowshera	3625	3550 (Sulaman-96)	5
18	ARS, Dhodial, Mansehra	2500	2550 (Suleman-96)	12
19	Garhi Dupatta Res. Farm, Muzaffarabad	1743	1160 (Local Check)	4

Table 8. Disease reaction of 12 wheat (Rainfed) lines/varieties and one local check variety

NUWY T No	Line/Variety	Source	Terminal Reaction			Cooperators Data		
			LR	RRI	YR	RRI	LR	YR
1	94R30	WRS Rawalpindi	10 RMR (AARI)	6	20MS	7	0	10MR(NIFA)
2	95C001	BARI-Chakwal	60RMR (NIFA)	2	10S(AARI)	6	0	10MRMS(NIFA)
3	V-95022	AARI- Faisalabad	20MRMS(NARC)	4	40S(AARI)	0	0	0/50MS(CCRI)
4	PR-69	CCRI- Pirsabak	TS(AARI)	0	10MRMS (RWP)	6	TR(NIFA)	20MR(NIFA)
5	NR-142	NARC Islamabad	5MSS(AUP)	2	20S(AARI)	4	0	5MSS(CCRI)
6	V-4	ARI- Quetta	10S(BARI)	4	10MRMS (NARC)	8	TS(RWP)	TR(NIFA)
7	BWL-949549	NIFA-Peshawar	30MRMS (RARI)	0	30MRMS (NARC)	7	0	10MRMS(NIFA)
8	V-94195	AARI- Faisalabad	20MRMS (AUP)	3	20MRMS (NARC)	7	TMR(BARI)	5MR(NIFA)
9	95C022	BARI-Chakwal	10 MRMS (NIFA)	4	60S (NARC)	1	TR(NIFA)	30MS(NIFA)
10	NR-138	NARC Islamabad	TMS (BARI)	5	5MR (AARI)	9	5MRMS (BARI)	10MRMS(BARI)
11	DN-10	ARI. D.I. Khan	0	9	10MRMS (BARI)	8	0	5MR(NIFA)
12	L-check	-	-	-	-	-	0	5S(RWP)

RRI = Relative Resistance Indices

		Desirable RRI	Acceptable RRI
Leaf Rust	=	7	6 or 5
Yellow Rust	=	7	5

local check (Table 6 & 7). At last after several years of hectic efforts the wheat section at ARI, D.I. Khan succeeded in a variety which is not only high yielding, resistant to diseases and drought tolerant but also have good chapatti quality. This variety (Raj) showed good plant height with higher grain yield and harvest Index in drought years under rainfed conditions of D.I. Khan as compared to local check (Daman-98 and Rawal 87) (Petrovic *et al.*, 2001). Raj showed resistance against stripe rust (yellow rust) with 10 MRMS having relative resistance indices of 8.

The disease reaction of Raj to Leaf Rust (LR) and Yellow Rust (YR) are reported in Table 6. Raj (DN-10) posses complete resistance against Strip and leaf rust reported by Crop Diseases Research Program, NARC, Islamabad showing Relative Resistance Index (RRI) for LR and YR in 1999-2000 i.e., 5 (acceptable index) for LR and 9 (desirable index) for YR, respectively.

Table 9. Quality Characteristics of Raj

Characters	Result
1000 Grain wt (g)	41.31
Test weight kg ha ⁻¹	77.60
Grain Ash %	1.63
Grain protein %	11.20
Dry Gluten Content %	8.98

Source: National Uniform Yield Trial Report (1999-2000)

As of its comparative advantage over checks the line was evaluated in National Uniform Wheat Yield Trials during 1999-2000. Raj has earned 7th position in NUWYT trials (1999-2000, RF) on national level. Raj (DN-10) has excellent grain weight (1000 grain) with

11.20 % protein and 8.98 % dry gluten (Table 9). I have excellent chapatti quality.

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