NRL 2017: A HIGH YIELDING DROUGHT TOLERANT WHEAT STRAIN FOR RAINFED AREAS OF NWFP

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ABSTRACT

The wheat breeding research efforts conducted at Nuclear Institute for Food and Agriculture (NIFA) Peshawar resulted in the development of potential wheat genotypes, suitable for the moisture stressed rainfed areas in NWFP. One such strain, namely "NRL 2017" was selected from the exotic germplasm introduced from ICARDA. It was initially selected from wheat observation nursery for dry land (WON-D) during 1998-99. The line was then evaluated for grain yield and other agronomic traits in statistically well designed experiments over a period of five years. It was tested in preliminary barani trial (PBT) during 1999-2000 and in advance barani trials (ABT) during 2000-01 giving grain yield of 5556 kg ha^{-1} and 3181 kg ha^{-1} respectively. The line was then evaluated in the multi-locational micro-plot tests during 2001-02 and 2002-03 in the province. In these tests it surpassed the check variety and showed no symptoms of any disease. On the basis of high yield potential, disease resistance, drought tolerance and other agronomic attributes the line was included in the National Uniform Wheat Yield Trials (NUWYT-Rainfed) during 2004-05 and 2005-06. Again it proved its potential for high yield and moisture stress tolerance. The line ranked first throughout Pakistan in the first year and topped the tested candidate lines in NWFP during the second year mandatory testing in National uniform wheat yield trial- Rainfed.

Keywords: High Yielding, NRL 2017, *Triticum aestivum* L., Wheat

INTRODUCTION

In Pakistan wheat is one of the major commodities essential to food security, supplying 72 % of the calories and protein in the average diet. It is cultivated on 8.5 million hectares, both in irrigated and rainfed areas. About 20% of the total wheat acreage in the country and 60% in NWFP are planted under rainfed conditions. The pattern and distribution of rainfall is always erratic and the wheat crop, in addition to other factors, is badly handicapped by water stress. The rainfed crop production thus depends strongly on both the amount and distribution of rain. Currently, breeding for sustained yields under drought stress is totally dependent on the use of yield as selection index.

The North West Frontier Province has the most heterogeneous environment and the highly varied and greatly diversified climatic conditions have a profound effect on crop yields. In addition, the broad genetic makeup of exotic wheat germplasm had made it possible for researchers to select lines adapted to different environmental conditions. Penjamo-62, Lermarojo-64 and Mexipak-65 were introduced from CIMMYT for general cultivation in NWFP (Norman, 1965). Similarly WL-711 and Sonalika proved superior cultivars in NWFP (Anonymous, 1979). Faisalabad-83, Kohinoor-83 and Barani-83 are other cultivars that were introduced and adapted to local environment (Anonymous, 1984). In the early nineties numerous wheat cultivars were developed both for irrigated and rainfed areas of which Pak-81 (Khan *et al.* 1990), Pirsabak-85 (Khan *et al.* 1992 a), Khyber-87 (Khan *et al.* 1992 b), and Pirsabak-91 were grown in NWFP. Due to out break of yellow rust epidemic as a result of the development of new race (134 E 150) of the disease in NWFP during 2004-05 and exposure to moisture stresses affected the wheat production in the province (Khan et al. 2006).

The release of new variety "Tatara" by NIFA (Khan *et al.* 2006) effectively filled up the gap and it not only expressed disease resistance but also played an important role in boosting the financial status of farming community through increased per acre yield.

On account of avoiding monoculture and disease epidemics, there is always a great need for the development of improved genotypes. Therefore, the rainfed wheat-breeding group of NIFA is running a continuous campaign with the objective to develop high yielding, drought tolerant, disease resistant and good bread (chapatti) making wheat cultivars for the rainfed areas of NWFP. These research efforts have resulted in the development of an improved strain "NRL 2017'' which will surely play a key role in further boosting of the farm productivity.

MATERIALS AND METHODS

NRL 2017, a cross of AMSEL/TUI was initially field evaluated during 1998-99 in the non-replicated wheat observation nursery for dry land (WON-D) at Nuclear Institute for Food and Agriculture (NIFA). Each entry in the nursery was planted in a plot size of 2 rows 30 cm apart and 2 m long. Based on better field performance it was tested in preliminary barani trials conducted in 1999-2000 and in advanced barani trials during 2000-01 at NIFA. Randomized Complete Block Design (RCBD) was used with four replications. Each plot had six rows 30 cm apart and 5 m long. Wheat varieties "Tatara and Takbeer " were used as a standard checks in all the trials. It was selected on the basis of drought tolerance, plant type,

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number of tillers per plant, spike length, number of grains per spike and resistant type reaction to fungal infestations, i.e., YR and LR. The line was then promoted to microplot tests for further multilocational evaluation in NWFP during 2001-02 and 2002-03 using the same design (RCBD) with 4 replications. In 2004-05 the same potential wheat line was evaluated in the National Uniform Wheat Yield Trials (NUWYT-Rainfed) at 19 sites across the country. Its second year mandatory testing was carried out in the National trials in 2005-06 at 17 sites to confirm its performance for high yield, disease resistance and drought tolerance.

RESULTS AND DISCUSSION

Significant grain yield potential was observed for NRL 2017 in comparison to the check (Tatara), as well as, other selected entries of WANA bread wheat observation nursery (Dryland Areas) at NIFA during 1998-99. Under field evaluation in preliminary barani trial during 1999-2000 the line produced 5666 kg ha^{-1} grain yield. After selection from preliminary barani trial it was tested for grain yield and related agronomic traits in well-designed advanced barani trial where it gave maximum grain yield of 3181 kg ha^{-1} grain yield as compared to the commercial check Tatara (3145 kg ha^{-1}) during 2000-01 (Table I).

Yield data of micro-plot test 2001-02, again confirmed the yield advantage of NRL 2017 against the check variety Tatara at three distinct regions of NWFP. The increase in yield over check was 1, 51 and 6 % was recorded for NRL 2017 at Peshawar, Nowshera and Bannu, respectively (Table II). The line was evaluated for second year in micro-plot test conducted during 2002-03 at nine different locations under rainfed conditions. Tatara and Takbeer were used as commercial checks. Overall, 34% higher yield than Takbeer (commercial check) was recorded for the said line at Kohat and 12 % more grain yield was produced at CCRI, Pirsabak than Tatara (Table III).

Due to high yield potential, disease resistance and other agronomic attributes the line was included in the National Uniform Wheat Yield Trials coordinated by National Agriculture Research Centre, Islamabad on 19 sites during 2004-05 and on 17 sites during 2005-06, in Pakistan and Azad Jammu Kashmir. During the first year mandatory testing NRL 2017 was on top at nine sites in Punjab by producing 3518 kg ha^{-1} and on overall Pakistan basis where it gave 3620 kg ha^{-1} grain yield (Table IV). It also showed excellent performance during second year mandatory evaluation and ranked first in NWFP by producing grain yield of 4077 kg ha^{-1} as compared to 3870 kg $ha^{-1}$of composite check (Table V).

CONCLUSION AND RECOMMENDATIONS

Considering the high yielding potential, drought tolerance and stable grain yield performance over the years and locations, the release of NRL 2017 as a commercial variety for the rainfed areas will definitely help in enhancing and stabilizing the wheat production in the province. It would be the best option for the farmers of North West Frontier Province to grow this line after its release as a commercial variety for harvesting high yields compared to growing old and susceptible varieties.

Table-I: ***Summary of development history***

Year	Type of trial	Remarks
1998-99	WANA bread wheat observation nursery	High yielding, disease resistant and drought tolerant entry at S. No 02 was selected (mean yield 4000 kg ha^{-1})
1999-2000	Preliminary Barani Trial	Produced 5556 kg ha^{-1}
2000-01	Advanced Barani Trial	The line gave top mean grain yield
2001-02	Micro-Plot Test	Produced the highest yield
2002-03	Micro-Plot Test	Produced 2nd highest grain yield
2004-05	NUWT (Rainfed)	NRL 2017 ranked 1st throughout the country including Azad Jammu Kashmir
2005-06	NUWT (Rainfed)	Performed well and ranked 1st in NWFP

Table-II: ***Yield performance of NRL 2017 in Micro-Plot test at 03 locations in NWFP during 2001-02***

	Grain yield kg ha^{-1}		
Location	**NRL 2017**	**Tatara**	**%± over check**
Peshawar	2765	2755	1
Nowsehra	2650	1750	51
Bannu	1510	1426	6

Table-III: ***Yield performance of NRL 2017 in Micro-Plot test at 09 locations during 2002-03***

Location	Yield (kg ha^{-1})				
	NRL 2017	Takbeer	**%± over check**	Tatara	**%± over check**
NIFA	4667	4292	9	4250	10
Mansehra	4667	5417	-14	4833	-3
Kohat	3555	2645	34	3278	8
Bannu	2961	2479	19	3258	-9
Chakwal	5382	5035	7	5000	8
Tandojam	1083	1083	0	1063	2
NWFP AUP	3861	4444	-13	3694	5
CCRI, Pirsabak	3583	3167	13	3208	12
D.I. Khan	1885	1695	11	1807	4

Table-IV: ***Grain yield (kg ha^{-1}) performance of NRL 2017 in NUWYT-Rainfed conducted by wheat coordinator during 2004-05***

LINE	NUWYT No	Punjab (9 sites)	NWFP (8-sites)	Pakistan + AJK (19-sites)
PR-87	1	3503	4004	3606
NR-241	2	3413	3896	3533
SN-128	3	3206	4165	3524
V-00BT004	4	3001	3543	3169
V-00055	5	3238	3593	3553
V-5	6	3388	3791	3475
NRL-2017	7	3518 (I)	3945 (VI)	3620 (I)
NR-234	8	3045	4223	3486
V-002467	9	2939	3827	3304
DN-44	10	2981	4376	3538
PR—83	11	3003	4372	3531
Local check	12	3050	3468	3186
Grand Mean:		3190	3934	3444
C.V (%):		11.9	15.0	14.2
LSD (0.05):				
Location		269	476	390
Variety		177	290	156
L x V		**	820	**

Table-V: ***Grain yield (kg ha^{-1}) performance of NRL 2017 in NUWYT-Rainfed conducted by wheat coordinator during 2005-06***

LINE	NUWYT No	Punjab (9 sites)	NWFP (8-sites)	Pakistan + AJK (17-sites)
NR 268	1	3227	3795	3494
OOFJ03	2	2767	3677	3195
V002467	3	2967	4070	3486
PR 87	4	3081	3991	3509
V03007	5	2730	4071	3361
93T347	6	2583	3794	3153
DN-44	7	3091	4032	3534
NRL 2017	8	2941(V)	4077 (I)	3475 (V)
BR 267	9	2785	4002	3358
PR 83	10	2727	3804	3234
99FJ03	11	2821	3572	3175
Local Check	12	2656	3870	3226
Grand Mean:		2864	3896	3350
C.V (%)	15.1	17.0	16.5	
LSD (0.05):				
Location	173.9	265.8	222.0	
Variety		200.5	325.5	186.5
L x V		**	920.7	**

REFERENCES

Anonymous. 1979. CIMMYT Report on wheat improvement. Int'l Maize and Wheat Improvement Center, Mexico.

Anonymous. 1984. CIMMYT Report on wheat improvement. Int'l Maize and Wheat Improvement Center, Mexico.

Norman, D. B. 1965. Wheat breeding and its impact on world food supply. Proc. 3rd Wheat Genetics Symp. Canberra.

Khan, M., A.A. Abidi and K. Gul. 1990. Pak. 81. A promising wheat cultivar for NWFP. Sarhad J. Agric. 6(3): 265-269.

Khan, M., A.A. Abidi, H. Ali, K. Gul and S. Fazli. 1992a. Khyber-87. A short duration variety to replace Sonalika under later sowing situation. Sarhad J. Agric. 8(3): 301-309.

Khan, M., A.A. Abidi, H. Ali, K. Gul and K. Hasham. 1992b. Pirsabak-85. An outstanding cultivar for NWFP. Sarhad J. Agric. 8(3): 311-319.

Khan, A.J., T. Mohammad, F. Azam, A. Ali and M. Tariq. 2006. Tatara: a high yielding drought tolerant wheat variety for rainfed areas of NWFP. Sarhad J. Agric. 22(1): 13-15.