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Development of a High Yielding Wheat Variety "Bahawalpur-97" for Southern Punjab, Pakistan

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Abstract. Studies were conducted to develop and release new improved wheat (*Triticum aestivum* L) varieties that can yield better and resist the diseases. On the basis of performance under field conditions, a line, MLT'S' (Metaltail)= ORE F1 158/FDI/Kl/BB/3/Nac, was selected from the Bread Wheat Observation Nursery MRA (1985-86), received through the courtesy of CIMMYT (Mexico) and given the No. V-7222. This line was tested/evaluated in 36 yield trials at different locations in Preliminary and Advanced Yield Trials (1986-89), Micro Wheat Yield Trials (1989-90) and National Uniform Wheat Yield Trials (1990-91 and 1991-92). On the average of 36 yield trials, Bahawalpur-97 gave 2.14, 5.94 and 1.22% higher yield than Inq-91, Pwz-94 and Pb-96, respectively. Its production technology was also developed. Its best sowing time was November to December. It gave maximum yield when NPK @ 125-100-50 kg/ha was applied. It was resistant to all foliar diseases. Its yield potential was 7200 kg/ha. This variety was approved and released by the Punjab Seed Council, Lahore, as a general-purpose variety for Southern Punjab in the name of "Bahawalpur-97" during 1998.

Keywords: wheat variety, disease resistance, Southern Punjab

Introduction

Wheat is the staple food in most countries of the world.The ever growing population pressure keeps the wheat breeders busy to develop sustainable new and better wheat varieties. Among the most widely cultivated crops in the Punjab, in terms of area and production, wheat ranks the highest covering more than 15 million acres. Inspite of the biggest cereal crop, yield per acre is low, only slightly more than one ton per hectare. Consequently, a huge amount of foreign exchange is being spent on its import every year. Research efforts have resulted in increasing the yield per hectare from 849 kg (APCOM, 1987) to 2300 kg in 1997. Dwarf gene has resulted in the green revolution in the world. Genetic yield improvement is almost non-significant. On the other hand, the removal of agronomic plant constraints, better response to fertilizer and resistance against foliar diseases has resulted in a jump in the yield.

Southern Punjab of Pakistan, although cotton zone, contributes about 44% to the total wheat production of the province. Cotton, being the major crop of the region, has a long stay in the field. So, about 80% of the wheat crop is being planted under late conditions. This cropping pattern demands wheat varieties that are of medium duration and can be successfully grown after the harvest of cotton. At present, wheat variety Inqlab-91 is covering maximum area under normal and late sowing. There is a need therefore for a high yielding, widely adapted, disease resistant variety, which can fetch more area under wheat cultivation and increase genetic diversity in the wheat fields.

The new wheat strain V-7222 developed at the Regional Agricultural Research Institute, Bahawalpur has a potential to share the only adapted wheat variety Inqlab-91(Inq-9) for sowing after cotton harvest in Southern Punjab. Furthermore, the strain carries blood of the world famous cross "Metaltail", which will be a new addition to the existing wheat genetic make up in the country. The cross "Metaltail" is famous for its high yield potential and resistance to foliar diseases. Therefore, the new variety V-7222 has the high yield potential and resistance to foliar diseases. It has more tillers compared to Inq-91. The food products prepared from this variety have better dietary qualities. Its 'bhoosa' (chopped wheat shaft) is cream-white in colour and is liked by the animals as fodder.

Materials and Methods

On the basis of performance under filed conditions, a line, MLT'S' (Metaltail) = ORE F1 158/FDI//Kl/BB/3/Nac was selected from the Bread Wheat Observation Nursery MRA (1985-86), received through the courtesy of CIMMYT (Mexico) and given the No. V-7222 (Bahawalpur-97; Bwp-97). This line, having desirable traits, was evaluated in Preliminary Yield Trials (1986-87), Advanced Yield Trials

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(1987-1989), Micro Wheat Yield Trials (1989-90) and National Uniform Wheat Yield Trials (1990-92). Sowing date and fertilizer trials were also conducted to ascertain its production technology during 1993-94 to 1996-97. The line V-7222 was also tested against diseases, such as rusts, loose smut and karnal bunt at the Regional Agricultural Research Institute, Bahawalpur; Wheat Research Institute, Faisalabad; and Crop Disease Research Institute, NARC, Islamabad during 1990-1997 in comparison with the then existing standards. The Coordinator Wheat, NARC, Islamabad also studied the quality characteristics of the line during 1990-1992. The Federal Seed Certification and Registration Department, Islamabad studied its plant characteristics. The yield data were subjected to analysis of variance by computer using MSTAT statistical programmes and means were compared using Duncan's multiple range test (Steel and Torrie, 1980).

Results and Discussion

Yield performance. ***Station yield trials.*** The variety was tested in preliminary and advance yield trials at the Regional Agricultural Research Institute, Bahawalpur during 1986-87 and 1988-89 in normal planting, and in late planting during 1991-92 and 1992-93 in comparison with the national checks, i.e., Pak-81, Pb-85 and Inqlab-91. The performance of the variety Bahawalpur-97 is given in Table 1and 2. On the basis of average for 3 years, the variety Bahawalpur-97 gave 6.59% and 10.34% higher yield than Pak-81 and Pb-85 in normal trial, and 14.5% and 6.90% higher yield than Pak-81 and Inqlab-91, respectively, in short trials.

Microwheat yield trial. The Director, Wheat Research Institute, Faisalabad also evaluated the performance of Bahawalpur-97 during 1989-90 at various locations throughout Punjab in replicated yield trials under coded numbers. The results given in Table 3 show that 5.20% and 6.18% higher yield was obtained from Bahawalpur-97 as compared to Pak-81 and Pb-85, respectively, on the basis of average of 10 locations.

Table 1. Normal station trials

Trial year	Yield (kg/ha)		
	V-7222	Pak-81	Pb-85
1986-87 (A8)	3079a	2628a	2950a
1987-88 (B3)	3750a	3917a	
1988-89 (C2)	4520a	4103a	3937b
Average-I	*3783	3549	
Average-II	3800		3444
Increase (%)		6.59	10.34

a, b: values with different alphabets significantly different from each other at p = 0.05 (Duncan's multiple range test)

Table 2. Late station trials

Trial year	Yield (kg/ha)		
	V-7222	Pak-81	Inq-91
1991-92 (B3)	3521a	2146b	
1992-93 (C7)	3875a	3438a	3625a
Average	3198	2792	
Increase (%)		14.5	6.90

a, b: values with different alphabets significantly different from each other at p = 0.05 (Duncan's multiple range test)

Table 3. Microwheat yield trial (normal) 1989-90

Locations	Yield (kg/ha)		
	V-7222	Pak-81	Pb-85
Wheat Res. Inst., Faisalabad	4025a	4247a	3740b
Govt. Agric. Farm, Jhang	3426a	2592b	2778b
Agric. Res. Farm, Sheikhupura	4120a	4028a	3935a
Kot Mubarak, Gujranwala	5048a	4630b	4491c
Shamki Bhattian, District Lahore	5554a	5556a	5926a
Potato Seed Centre, Khanewal	5185a	4722a	4490b
Regnl. Agric. Res. Inst., Bahawalpur	5594a	4372c	4583b
Agric. Res. Station, Rahimyar Khan	3824a	4144a	3958a
Mr. Hanif Gujar, Farmer, Muzaffargarh	3704a	3704a	3935a
Ch. Liaqat Ali, Farmer, Bahawalpur	3833a	4120a	3889a
Average	4431	4214	4173
Increase (%)		5.20	6.18

a, b, c: values with different alphabets significantly different from each other at p = 0.05 (Duncan's multiple range test)

National uniform wheat yield trial. Coordinator Wheat, Islamabad, also evaluated the variety Bahawalpur-97 in a replicated trial called NUWYT under normal and short conditions throughout Pakistan during 1990-91 and 1991-92. The performance of Bahawalpur-97 in this trial is given in Table 4 and 5, which reveals that Bahawalpur-97 gave 8.91% and 10.54% higher yield than Pak-81 and Pb-85, respectively, on the national level on the basis of 10 locations of cultivation during 1990-91, while it was 9.66% and 2.87% higher than the above said checks during 1991-92.

Varietal characteristics. Various varietal characteristics recorded by the Federal Seed Certification and Registration Department, Islamabad, in comparison with Inqlab-91, are given in Table 6.

Table 4. National uniform wheat yield trial (normal), 1990-91

Locations	Yield (kg/ha)		
	V-7222	Pak-81	Pb-85
Wheat Res. Inst., Faisalabad	5359a	4861b	3414c
Govt. Agric. Farm, Jhang	4552a	4479a	4511a
Potato Seed Centre, Khanewal	4906a	4511b	4188c
Govt. Agric. Farm, Sahiwal	5177a	5229a	4969b
Wahan Adam, Kasur	3958a	3479b	4063a
Rice Res. Inst., Kala Shah Kaku	3729a	3729a	3896a
Univ. Agric., Faisalabad	3496a	2841b	
Chak No.249/G.B,Toba Tek Singh	2885a	2251b	
Regnl. Agric. Res. Inst., Bahawalpur	4313a	4125a	
Khanpur, Rahimyar Khan	2938a	2429a	
Average-I	4131	3793	
Average-II	4614		4174
Increase (%)		8.91	10.54

a, b, c: values with different alphabets significantly different from each other at p = 0.05 (Duncan's multiple range test)
Source: Mustafa *et al*. (1991)

Table 5. National uniform wheat yield trial (normal), 1991-92

Locations	Yield (kg/ha)		
	V-7222	Pak-81	Pb85
Food Res. Inst., Sargodha	5531a	5042b	5083b
Chak No.195/G.B., Faisalabad	3735a	3594a	
Wheat Res. Inst., Faisalabad	5121a	5352a	5315a
Renala Khurd, Dist., Okara	4656a	4313b	4625a
Wahan Adam, Dist., Kasur	6000a	5031b	5813a
Agric. Res. Farm, Sheikhupura	4771a	4563a	4313b
Hafizabad, Gujranwala	3613a	3417b	3758a
Regnl. Agric. Res. Inst., Bahawalpur	3771a	3177b	
Chak No.75/4-R, Haroonabad	3292a	2521b	
Layyah Agric. Res. Farm, Karore	5042a	4115b	4719a
Potato Seed Centre, Khanewal	5167a	5104a	5167a
Average-I	4609	4203	
Average-II	4988		4849
Increase (%)		9.66	2.87

a, b: values with different alphabets significantly different from each other at p = 0.05 (Duncan's multiple range test)
Source: Mustafa *et al*. (1992)

Agronomic studies. Six trials were conducted at the Regional Agricultural Research Institute, Bahawalpur during 1991-1995 to ascertain its package of production technology. The final findings are given as under:

•sowing time: November to December;
•seeding rate: 125 kg/ha;
•fertilizer requirements: 125-100-50 NPK (kg/ha); and
• irrigation: 5-6 times.

Pathological studies. The response of the variety Bahawalpur-97 to various foliar diseases studied at Crop Diseases Research Institute, NARC, Islamabad; Wheat Research Institute, Faisalabad; and Regional Agricultural Research Institute, Bahawalpur are given in Table 7-11. The perusal of the data shows that the variety is resistant/tolerant to yellow rust, leaf rust, loose smut, *Fusarium,* and karnal bunt.

Table 6. Varietal characteristics

Characteristic	Bwp-97 (V-7222)	Inq-91 (Check)
Days to heading	118 days	114 days
Days to maturity	145-158 days	135 days
Plant height	92-102 cm	98 cm
Lodging resistance	resistant	resistant
Tillers per meter row	155	132
Thousand kernel weight	40-42 g	44 g
Protein percentage	13.07%	10.51%
Disease reaction	resistant	resistant
Grain shape	long-rounded	round-elongated
Maturity status	long-duration	medium-duration
Growth habit	semi-erect	drooping
Yield potential	7200 kg/ha	6900 kg/ha

Table 7. Disease reaction at Regional Agricultural Research Institute, Bahawalpur

Year	Leaf rust		Yellow rust		
	V-7222	Pak-81	Pb-96	V-7222	Pb-96
1992-93	20MR	10S		0	
1993-94	0	20MS		0	
1994-95	20MR, MS	50S		0	
1995-96	10R	50MS		0	
1996-97	10MR	90S	10MS	0	10S

MR: moderately resistant; MS: moderately susceptible; S: susceptible

Table 8. Disease reaction report of Crops Diseases Research Institute, National Agricultural Research Centre, Islamabad

Research station	Trial year 1990-91				Trial year 1991-92			
	V-7222		Pak-81		V-7222		Pak-81	
	LR	YR	LR	YR	LR	YR	LR	YR
Wheat Res. Inst., Faisalabad	T, MR, MS		5MS		30MR, MS		50S	
Cereal Res. Inst., Pirsbak				T, MS				
Agric. Res. Station, Gujrat					T, MS			
National Agric. Res. Cent., Islamabad								T
Agric. Res. Station, Mardan					15MS			

LR: leaf rust; YR: yellow rust; MR: moderately resistant; MS: moderately susceptible; S: susceptible; T: traces
No disease was detected on trials at Gov. Agric. Farm, Jhang; Wheat Res. Station, Rawalpindi; Univ. Agric. Faisalabad; Agric. Res. Farm, Sheikhupura

Table 9. *Fusarium* disease reaction in national uniform wheat yield trial during 1991-92

	Site	*Fusarium* infection
V-7222	Mardan	0
PR-38	Mardan	6

Source: Mustafa *et al*. (1992)

Table 10. Loose smut data in national uniform wheat yield trial during 1990-91

Variety	Baha-walpur	Khane-wal	Jhang	Faisal-abad	Univ. Agic. Faisal-abad	Chakwal
V-7222			TS			
86038		TS		TS	TS	TS

T: traces; S: susceptible
Source: Mustafa *et al*. (1991)

Table 11. Disease reaction at Wheat Research Institute, Faisalabad

Diseases	V-7222	Pak-81 (Check)	WL 711 (Check)
Yellow rust	0	40S	80S
Leaf rust	TMS	100S	100S

T: traces; S: susceptive; MS: moderately susceptible
Source: WRIF (1999)

Quality studies. The quality characters recorded by National Agricultural Research Centre, Islamabad, are given in Table 12, which reveal that the new variety is comparable if not better than the existing checks.

Conclusion

The variety Bahawalpur-97 (V-7222) is not only a high yielder and tolerant/resistant to all diseases, but is also best suited in wheat-cotton-wheat rotation. Due to its better adaptability, it has the potential to replace the previously approved wheat varieties, especially in Southern Punjab. This variety was accordingly approved and released by Punjab Seed Council, Lahore for general cultivation.

Table 12. Quality characteristics of V-7222 versus checks

Year	Variety	Test weight	Flour yield (kg/hl)*	Flour ash (% d b)**	Protein (% d b)**	1000 kernel	Gluten (%)	Chapati quality
1990-91								
	V-7222	78.0	65.5	0.59	13.07	45.7	8.9	good
	Inq-91	78.1	65.5	0.57	10.51	42.0	9.6	good
1991-92								
	V-7222	76.6	65.1	0.53	8.71	40.9	6.85	good
	Pak-81	76.1	67.0	0.58	8.00	41.7	6.56	good

*hl: hectolitre; **d b: on dry wt basis
Source: Mustafa *et al*. (1991; 1992)

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