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RELEASE OF HIGH YIELDING WHEAT VARIETY *AaS-2011* REISTANT TO STEM RUST (UG-99) IN PAKISTAN

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ABSTRACT

"AaS-2011" is a high yielding and rust resistant variety of bread wheat with erect growth habit. It was released in the year 2011 for irrigated areas of Punjab. *AaS-2011* originated from a cross [PRL/PASTOR//2236(V.6550/Sutlej-86)] attempted at Regional Agricultural Research Institute (RARI), Bahawalpur during 1997-1998. F_1 to F_5 progenies of this cross were advanced by pedigree method. Resistance against lodging, karnal bunt, stem rust (UG-99 a local race), spot blotch, rusts (Leaf rust = 10R to 30RMR and Yellow rust = 10R to 20MRMS, RRI value of 7.2-9.0 and 7.5-9.0 for leaf and yellow rusts, respectively) and high yield potential (6678 kg ha^{-1}) are the major attributes of *AaS-2011* that make it a superior variety for its target regions. *AaS-2011* is tolerant to wheat aphid and responsive to fertilizer compared to the check varieties. The 1000-seed weight of this variety is 40-45 gm. Seed is amber in colour and contains 13.02% protein and 29% gluten. Its flour yield is 68.4%. It has good *chapati* making quality. Plant type *of AaS-2011* is erect with plant height 95-105 cm with droopy flag leaf. Auricle colour is white. Ear shape is tapering and colour is red. Its straw is soft. It completes heading in 85-90 days and matures in 134-140 days. *AaS-2011* performs better in irrigated areas of Punjab when planted from 1st November to 15 December, keeping 125 kg ha^{-1} seed rate and fertilizer dose as 150-120-60 kg NPK ha^{-1}. It can be concluded that *AaS-2011* is not only a high-yielder, possesses better quality traits, tolerance/resistance to regional prevailing diseases and insect pests, but is also best suited for wheat-cotton-wheat rotation system.

Key words: *Triticum aestivum*, variety, rust resistance, quality, grain yield.

INTRODUCTION

Bread wheat is the most widely grown crop in the world. Being most important crop, wheat was cultivated on an area of 8.805 million hectares during 2010-11 with a production of 24.2 million tones in the country with 3.9 percent increase over the last year's crop of 23.3 million tones (Anonymous, 2011). It contributes 13.1 percent to the value added in agriculture and 2.7 percent to GDP (Anonymous, 2011). Southern Punjab contributes about 39.9% of the total wheat production of the province (Crop Reporting Services, Punjab, 2011-12). Due to long stay of cotton crop in the field about 80% wheat in this region is being planted late. This situation necessitates the development of medium to late maturing wheat varieties like *AaS-2011* that can be successfully grown after the harvest of cotton (Ahmad *et al.,* 2005).

Wheat variety Sehar-06 covers maximum area under wheat in Pakistan. Leaf rust of wheat *(Puccinia recondita* f. sp. *tritici)* is a serious production hazard all over the world (McIntosh *et al.,* 1997). During favorable years, it spreads fast and can significantly reduce yields but this reduction depends upon disease intensity and time of infection (Anonymous, 1993). Leaf rust epidemic can cause upto 50% losses in grain yield (Yaqoob, 1991) and sometimes result in total failure of the crop. Chemical control of rut diseases is not economical; therefore, cultivation of rust resistant varieties is of paramount importance (Anonymous, 2005). Successive release of rust resistant varieties in Pakistan has reduced losses caused by rust (Khan, 1987). With the introduction of rust resistant varieties, new rust races also develop due to mutation, therefore, the plant breeders and plant pathologists have to be vigilant of its dynamics. Therefore, wheat variety having the higher yield potential, disease and insect resistance and better adaptability is a dire need.

AaS-2011 is a result of devoted and untiring efforts of the researchers' team consisting of plant breeders, agronomists, plant pathologists, entomologists and agricultural chemists working at Regional Agricultural Research Institute, Bahawalpur. It is suitable for late planting in irrigated areas of Punjab and will help to achieve the self-sufficiency in wheat production due to its commendable traits. This variety possesses improved genetic potential and thus, has performed better in yield trials. Development and evolution of the new wheat variety *AaS-2011* is described herein.

MATERIALS AND METHODS

AaS-2011 was developed from a cross [PRL/PASTOR//2236(V.6550/Sutlej-86)] attempted at Regional Agricultural Research Institute (RARI), Bahawalpur. The hybridization was carried out during 1997-98

as described by Alam (1994) and pedigree method of breeding was used to develop this variety. The hybrid population was evaluated for target traits and advanced to F_5 generation. A single row of 4 m length was planted with F_0 hybrid seed. The seeds were sown by single row drill at RARI, Bahawalpur under irrigated conditions. The F_1 seeds were harvested at the end of April 1998. Planting was done in 30 cm wide rows. This bulk planting was continued upto F_5 generation with negative selection of undesirable diseased plants under natural infection conditions. The seed from selected plants were bulk harvested. A high yielding and rust resistant line was selected during 2002-03 in F_5 generation and was given the number 032862. This line was tested in replicated yield trials for grain yield evaluation and disease reaction. These trials were conducted at Regional Agricultural Research Institute (RARI), Bahawalpur. Planting of on-station trials was done in the first week of November of each year. The testing was done in Micro, Regional and National Uniform Yield Trials. All the yield trials were laid out in RCBD with 4 replications. The row to row spacing was maintained at 30 cm. Planting was done with single row drill in 4 row plots of 5 m length. One to two (1-2) standard checks were included in every experiment for comparison. A series of replicated yield trials were conducted for three years (2006-2009) at RARI, Bahawalpur for its response to different sowing dates and various NPK combinations in comparison with the check variety Sehar-06 to ascertain its production technology. Disease reaction was separately recorded under artificial inoculation every year. Test entries were planted in a single 2-meter long, 30 cm apart row. Two rows of *Morocco and Local White*, which are universally susceptible to rusts, were planted around the test entries. In addition, a row of susceptible check (*Morocco*) was also planted after every 10 entries. Artificial inoculations with a mixture of field collection/national bulk inoculums of known prevalent races/virulences of the rusts were carried out during the month of March. Initially inoculations of spreaders, 3-5 tillers in a row, were carried out by hypodermic syringe method using aqueous uredospore suspension to which 1-2 drops of Tween-20 were added to break the surface tension. Subsequently all the material was sprayed 2-3 times by turbo-air sprayer using aqueous spore suspension with fortnightly intervals to obtain heavy rust development. The data were recorded on leaf and yellow rusts as percent infection on the plants according the modified Cobb's Scale (Peterson *et al*., 1948) during the first week of April. Relative Resistance Index (RRI) was calculated according the formula of Hussain *et al*. (1999). The desirable RRI value for leaf and yellow rusts is 7 (Aslam, 1982; Mustafa *et al*., 2007) and acceptable value is 5 or 6 (Mustafa *et al*., 2007). *AaS-2011* was also evaluated for two years (2009-2011) in replicated yield trials at RARI, Bahawalpur for its response to wheat aphid in comparison with the check varieties Fareed-06, Sehar-06 and Mairaj-08. Finally, the selected line was evaluated in national uniform yield trials. This trial was conducted by the National Coordinator Wheat, National Agricultural Research Centre, Islamabad at 23 locations in 2006-07 and at 19 locations in 2007-08 throughout Pakistan. At all the locations, the experiment was planted in RCBD with 4 replications. Six rows 30 cm apart per plot were planted with each entry. The sowing time and crop husbandry practices were different at all the locations. The replicated data of individual locations were averaged and converted to kg ha^{-1} for comparison (Mustafa *et al*., 2007 and 2008). The Physico-chemical properties were studied at Bio Chemistry Lab. at AARI, Faisalabad (Mustafa *et al*., 2007). The yield data were subjected to ANOVA by computer using MSTATC statistical package and the means were compared using LSD (Steel *et al*., 1997). Various steps involved in the development of *AaS-2011* are given in Table 1.

Table 1. Various steps involved in development of wheat variety *AaS-2011*

Years	Trials	Remarks
1997-98	Cross attempted	PRL/PASTOR//2236(V.6550/Sutlej-86)
1998-03	Filial generations	Filial generations from F_1 to F_5 were raised
2003-05	A. B. Trials	These trials were conducted at RARI, Bahawalpur
2005-06	Micro Wheat Yield Trial	These trials were conducted at various locations in Punjab under coded numbers by Director, Wheat Research Institute, Faisalabad
2003-11	Rust resistance studies	These studies were conducted at RARI and NARC, Islamabad.
2006-09	Agronomic Trials	Agronomic Trials at RARI & ARS, Bahawalpur
2006-08	National Uniform Wheat Yield Trials (NUWYT)	These trials were conducted throughout Pakistan by National Coordinator Wheat, NARC, Islamabad
2008-11	Regional Wheat Yield Trial	These trials were conducted at various locations in Punjab under coded numbers by Director, RARI, Bahawalpur
2009-11	Entomological Trials	These studies were conducted at RARI, Bahawalpur
2010-11	Physico-chemical characters and chemical composition of seed of ***AaS-2011***	The quality traits were studied in Biochemistry Laboratory at Ayub Agricultural Research Institute, Faisalabad
2011	On the basis of its better performance, it was released for general cultivation in the name of ***AaS-2011*** by the Punjab Seed Council, Lahore during 2011	

RESULTS AND DISCUSSION

AaS-2011 was evaluated for grain yield in preliminary (A) and regular (B) yield trials during 2003-2005. The data on grain yield recorded in these trials are presented in Table 2 which shows that grain yield of *AaS*-2011 ranged from 2989 to 4855 kg ha^{-1} as compared to Inqlab-91 for which yield ranged from 2900-4678 kg ha^{-1}. The new variety gave 7% higher yield than Inqlab-91 (Table 2). The differences were significant in A1 trial while non-significant in other three trials. Earlier released varieties although possessed relatively high yield potential but those appeared to be susceptible to rusts as revealed in the results reported by Anonymous (2004, 2005). Consequently, these are being banned by the government for general cultivation to avoid epidemic of rust. Since the major emphasis was placed on incorporation of rust resistance in the target variety aimed for release in irrigated areas of Punjab, *AaS*-2011 appeared to be a promising line with respect to this major trait wanted for wheat cultivation in rust prone areas.

AaS-2011 was tested in Micro Wheat Yield Trials which were conducted by Director, Wheat Research Institute, Faisalabad during 2005-06 at 17 locations (normal and late sets) in whole of the Punjab province, under coded numbers. On the basis of 17 locations average, *AaS-2011* gave 9% higher yield as compared to Inqlab-91 (Table 3).

AaS-2011 was tested in national testing system through National Uniform Yield Trial (NUYT) consecutively for two years (2006-07 and 2007-08) across the country. The location wise comparison of *AaS-2011* with check varieties for grain yield is given in Tables 4-5. The results revealed that *AaS-2011* gave 5% higher yield than check variety Sehar-06 on the basis of 23 locations average during 2006-07 (Table 4). *AaS-2011* gave 12% higher than Sehar-06 and Fareed-06 during 2007-08 on the basis of average of 19 locations (Table 5). The two years evaluation of *AaS-2011* over multiple locations confirmed the results of preliminary trials where it was concluded that *AaS-2011* having better grain yield compared to already released varieties possesses high tolerance against rust diseases. It was also observed that with overall good performance, the new variety is well adapted to various climatic conditions of Punjab and Pakistan.

The new variety was also tested in Regional Wheat Yield Trials at 7 locations throughout southern Punjab by the Director, Regional Agricultural Research Institute, Bahawalpur for three years (2008-09 to 2010-11) under late and normal sown conditions. The results presented in Tables 6 revealed that the new variety gave 6 to 13% higher yield than the check varieties like Sehar-06 and Fareed-06 at all locations.

Several earlier researchers like Khan and Din (1999), Saleem *et al*. (2002), Ahmad *et al*. (2002a,b), Tariq *et al*. (2003), Siddiqi *et al*. (2001), Ahmad *et al*. (2005), Sarwar and Ahmad (2003), Bakhsh *et al*. (2005) and Hussain *et al.* (2010a,b,c) reported higher yield in new sesame, mungbean, chickpea, guar, wheat and cotton varieties than the checks.

Six trials were conducted at Regional Agricultural Research Institute, Bahawalpur during the years, 2006-07, 2007-08 and 2008-09 to ascertain its package of production technology. The results are summarized in Table 7 which shows that *AaS-2011* performed better under irrigated conditions when planted from 1st November to 15 December, keeping 125 kg ha^{-1} seed rate, fertilizer @ 150-120-60 kg NPK ha^{-1} and 5-6 irrigations are applied. Similar results were reported by Ahmad *et al*. (2002a, b) and Hussain *et al.* (2010a, b, and c).

The response of the variety *AaS-2011* to various foliar diseases was studied at Crop Diseases Research Programme, NARC, Islamabad and Regional Agricultural Research Institute, Bahawalpur. The disease score *of AaS-2011* and the check varieties recorded from 2003-04 to 2010-11 is presented in Table 8. The comparison *of AaS-2011* with released varieties showed that the rust score of *AaS-2011* varied from 10R to 30RMR for leaf rust and 10R to 20MRMS for yellow rust as compared to 20S to 90S for leaf rust and 10S to 90S for yellow rust of the check variety i.e. Morocco under Bahawalpur agro-climatic conditions. In National Disease Screening Nursery planted throughout Pakistan, *AaS-2011* proved to be resistant to leaf and yellow rust as against Morocco. *AaS*-2011 had RRI value of 7.2-9.0 and 7.5-9.0 for leaf and yellow rust, respectively, which is above desirable limit. *AaS-2011* was also tested against stem rust and it showed resistance against the check variety Local White (Table 9). *AaS*-2011 was also found to be resistant against Karnal bunt, UG-99 and spot blotch. Resistance against leaf and yellow rust makes *AaS-2011* a better option for rust prone areas. Leaf and yellow rusts of wheat, beside yield reduction, damages the quality of grain as well. Therefore, the grains obtained from susceptible varieties grown under diseased conditions are of inferior quality, whereas, the resistant varieties produces better yield and grains of better quality. This phenomenon was recorded in the case of *AaS-2011* as well when grown in disease condition. Ahmad *et al*. (2002 a, b and 2005) and Hussain *et al.* (2010a, b, c) reported new varieties of wheat to be more resistant to rust diseases compared to checks.

The response of the variety *AaS-2011* to wheat aphid was studied at Regional Agricultural Research Institute, Bahawalpur during 2009-11. The perusal of the data presented in Table 9 shows that the *AaS-2011* had less attack of wheat aphid as compared to the check varieties Fareed-06, Sehar-06 and Mairaj-08. Ahmad *et al*. (2002a, b and 2005), Siddiqi *et al*. (2001) and Hussain *et al.* (2010a, b, c) reported similar results for new wheat varieties.

Table 2. Grain yield performance of *AaS-2011* in preliminary (A) and regular (B) trials at RARI, Bahawalpur during 2003-05

Name of Trial	Years	Yield (kg ha^{-1})		LSD (0.05)
		AaS-2011	Inqlab-91 (check)	
A1-trial	2003-04	4855	4500	282
A2-trial	2003-04	2989	2900	NS
B1-trial	2004-05	4815	4678	NS
B2-trial	2004-05	3488	3037	NS
Average		**4037**	**3779**	-
%age increase in AaS-2011 over check		**+7**		

Table 3 Grain yield performance of *AaS-2011* in Micro Wheat Yield Trials during 2005-06.

S. No	Locations	Yield (kg ha^{-1})		LSD (0.05)
		AaS-2011	Inqlab-91 (check)	
A-	**November Planting (Nov-10 to Nov-30)**			
1	ARF, R. Y. Khan	5844	5556	NS
2	ORS, Khanpur	3333	2833	435
3	ARS, Bahawalpur	4355	4241	NS
4	RARI, Bahawalpur	3833	3417	234
5	CRS, Haroonabad	3750	3472	NS
6	Tareen Farm, Lodhran	3926	3250	365
7	Tareen Farm, Mian Channu	3870	3833	NS
8	ARF, Karor	5222	4852	144
	Average	**4267**	**3932**	
	% increase in *Aas-2011* over check	**+8**		
B-	**December Planting (Dec.1 to Dec-15)**			
9	ARF, R. Y. Khan	3333	2833	337
10	ORS, Khanpur	5000	3889	756
11	ARS, Bahawalpur	3789	3500	371
12	RARI, Bahawalpur	5444	5056	526
13	PSC, Khanewal	3985	4167	341
14	CRS, Haroonabad	3741	3662	340
15	Tareen Farm, Lodhran	3648	3676	313
16	Tareen Farm, Mian Channu	4981	4287	420
17	ARF, Karor	3259	2852	432
	Average	**4131**	**3769**	
	Overall average	**4195**	**3846**	
	% increase in *Aas-2011* over check	**+9**		

Table 4. Grain yield performance of *AaS-2011* in National Uniform Wheat Yield Trial during 2006-07

Sr. No	Locations	Yield (kg ha^{-1})		
		AaS-2011	National check (Sehar-06)	LSD
A-	**November Planting (Nov-10 to Nov-30)**			
1	Cotton Research Station, R. Y. Khan	6556	6194	NS
2	Ch. Arif, Chak No. 8/P, Khanpur	5882	4938	514
3	RARI, Bahawalpur	5641	5354	NS
4	Tareen Rice Mills Tariq Abad, Chishtian, B/Nagar,	5583	5576	NS
5	Multan, 384/WB Pul Dawa	3821	3683	NS
6	Luddan, Vehari Ahmad Abad Model Farm	4708	4854	NS
7	Punjab Seed Corporation, Perowal Khanewal	4725	4875	NS

8	Tareen Farm, Mian Channu	5163	4875	NS
9	AR Farm, Karor Layyah	5000	4292	611
10	Sher Mand, Choti Zareen, D.G. Khan	4444	4049	NS
11	Khanpur Buga Sheer, Muzaffar Garh,	4313	4243	NS
	Average	**5076**	**4812**	
B-	**December Planting (Dec.1 to Dec-15)**			
12	Cotton Research Station, R. Y. Khan	5153	4994	NS
13	Ch. Arif, Chak No. 8/P, Khanpur	5069	5069	NS
14	RARI, Bahawalpur	4240	3953	NS
15	Tareen Rice Mills Tariq Abad Chishtian B/Nagar,	4167	4075	NS
16	II-MPR, Gaelaywal Lodhran	3383	3108	NS
17	384/WB Pul Dawa Multan	4229	3604	349
18	Ahmad Abad Model Farm, Luddan, Vehari	3267	3125	NS
19	Punjab Seed Corporation, Perowal Khanewal	3875	3917	NS
20	Tareen Farm, Mian Channu	4271	4221	NS
21	AR Farm Karor Layyah	3625	3454	NS
22	Sher Mand, Choti Zareen, D.G. Khan	3847	3549	NS
23	Khanpur Buga Sheer, Muzaffar Garh,	3924	3771	NS
	Average	**4102**	**3903**	
	Overall average	**4567**	**4337**	
	% increase in *AaS-2011* over check		**+5**	

Table 5. Grain yield performance of *AaS-2011* in National Uniform Wheat Yield Trial during 2007-08 under Late Sown Conditions

Sr. No	Locations	Yield (kg ha^{-1})		
		AaS-2011	**Local Check**	**LSD**
A-	**November Planting (Nov-10 to Nov-30)**			
1	Zaher Peer Road Khanpur	4725	4229 (Fareed-06)	482
2	R.Y.K ATI	5450	4521 -do-	597
3	RARI, Bahawalpur	5833	5563 -do-	NS
4	Arifwala, B/Nagar	5000	4979 (Sehar-06)	NS
5	Chishtian B/Nagar,	5833	4104 (Fareed-06)	636
6	Pak German Chak 5 Faiz Multan	4347	4314(sehar-06)	NS
7	Luddan, Vehari	4280	4196 -do-	NS
8	Punjab Seed Corporation, Perowal Khanewal	4184	4399 -do-	NS
9	DG Khan, Mouza Aliwala	4908	4333 (Fareed-06)	399
10	Muzffar Garh, Khanpur Buga Sheer	4950	3329 -do-	562
	Average	**4951**	**4397**	
B-	**December Planting (Dec.1 to Dec-15)**			
11	Zaher Peer Road Khanpur	4042	2796 (Fareed-06)	471
12	ATI, R.Y.Khan	3292	3396 -do-	NS
13	RARI, Bahawalpur	4417	3917 -do-	NS
14	Chishtian B/Nagar,	4817	4369 (Fareed-06)	407
15	Pak german Chak-5 Faiz Multan	3641	3043 (Sehar-06)	286
16	Punjab Seed Corporation, Perowal Khanewal	2845	2955 -do-	NS
17	AR Farm, Karor Layyah	3050	2914 -do-	NS
18	Aliwala D.G. Khan,	4071	3854 (Fareed-06)	NS
19	Khanpur Buga Sheer Muffed garh,	3458	3058 -do-	NS
	Average	**3858**	**3362**	
	Overall average	**4376**	**3909**	
	% increase in *AaS-2011* over check		**+12**	

Table 6. Grain yield performance of *AaS-2011* in Regional Wheat Yield Trials during 2008-11.

Varieties	2008-09				Av. (kg ha^{-1})	% increase in *Aas-2011* over check
	Yield (kg ha^{-1})					
	RARI, Bwp	P.S.C Khanewal	O.R.S. Khan Pur	Ali Wala D.G.Khan		
AaS-2011	6678	5928	4875	4700	5545	
Sehar-06 **(check)**	6129	5600	4625	4620	5243	+5
Fareed-06 **(check)**	5833	5500	4520	4500	5088	+8
LSD	671	522	NS	NS		

	2009-10								
	RARI Bwp	A.R.S Layyah	A.R.F RYK	B. Nagar	O.R.SKhan pur	D.G. Khan	M. Garh		
AaS-2011	5278	5282	5656	6128	5093	4722	4839	**5282**	
Sehar-06 **(check)**	5063	5004	5139	4167	4907	4297	4500	4725	+11
Fareed-06 **(check)**	4815	4444	5419	5061	4370	3741	4800	4664	+12
LSD	456	392	502	630	477	721	NS	NS	

	2010-11								
	Rari Bwp (1 Nov)	Rari Bwp (2 Dec)	B. Nagar	Karor Layyah	Khan Pur	M. Garh	D.G. Khan		
AaS-2011	4690	3678	4380	6400	3850	4679	3600	4468	
Sehar-06 **(check)**	4435	2972	4270	5533	3650	4312	3288	4066	**+9**
Fareed-06 **(check)**	4270	3289	4326	6500	3494	4027	3360	4181	**+7**
LSD	518	382	NS	722	NS	489	NS		

Table 7. Grain yield performance of *AaS-2011* in sowing date, fertilizer and seed rate trials at RARI, Bahawalpur during 2006-07 and 2007-08.

	Sowing Date Trial						
Variety	**Nov 1st**	**Nov 15th**	**Dec. 1st**	**Dec. 15th**	**Jan. 1st**	**Av.**	**% increase over check**
AaS-2011	5685	6000	4733	4197	3277	4778	-
Sehar-06 **(check)**	5704	5933	4200	3826	2733	4479	+7
LSD	**NS**	**NS**	**402**	**NS**	**367**		

Fertilizer Trials for AaS-2011 (2006-07)				
Tr. No.	**Nutrient (kg ha^{-1})**			**Yield (kg ha^{-1})**
	N	**P_2O_5**	**K_2O**	
1	0	0	0	2219 d
2	0	120	60	2387 d
3	75	120	60	3799 b
4	**150**	**120**	**60**	**4404 a**
5	225	120	60	4411 a
6	150	0	60	3344 c
7	150	60	60	4014 b
8	150	180	60	4209 a
9	150	120	0	3631 c
			LSD	**322**
2007-08				
1	0	0	0	2203 d
2	0	120	60	3132 d
3	75	120	60	3884 c
4	**150**	**120**	**60**	**4225 a**

5	225	120	60	4140 a
6	150	0	60	3869 c
7	150	60	60	4006 c
8	150	180	60	4140 a
9	150	120	0	4089 b
10	150	120	30	4217 a
11	150	120	90	4225 a
			LSD	**129**

Seed Rate Trial (2008-09)

Seed Rate (kg ha^{-1})	Yield (kg ha^{-1})	LSD
90	4275 b	430
125	4850 a	
150	5280 a	
172	5110 a	

Table 8. Disease Reaction of *AaS-2011* under inoculated condition

Year	Regional Agricultural Research Institute, Bahawalpur			
	AAS-2011		**Morocco (Check)**	
	Lr.	**Yr.**	**Lr.**	**Yr.**
2003-04	0	0	20S	10S
2004-05	10R	0	70S	20S
2005-06	30RMR	20MRMS	80S	50S
2006-07	10R	0	40S	10S
2007-08	0	10R	50S	40S
2008-09	10R	0	70S	10S
2009-10	0	0	30S	40S
2010-11	0	5R	90S	90S

throughout Pakistan (NWDSN)

Year	***AaS-2011***		**Morocco (Check)**	
	Lr.	**Yr.**	**Lr**	**Yr.**
2005-06	0	10R	40S	80S
2006-07	0	10S	50S	90S
2007-08	0	0	20S	20S
2008-09	0	0	50S	10S
2009-10	TS	0	30S	90S

throughout Pakistan (NWDSN)

Year	***AAS-2011***		
	Lr.	**Yr.**	**Powdery Mildew**
2006-07	9.0	7.5	6
2007-08	9.0	9.0	-
2009-10	7.2	9.0	-

Note: 6 and above Relative Resistance Index (RRI) is considered as desirable.
Lr: Leaf rust, Yr: Yellow rust, R: Resistant, MR: Moderately resistant, RMR: Resistant and moderately resistant, S: Susceptible, MRMS: Moderately resistant and moderately susceptible

Seed quality is an important parameter that determines the acceptability of a commodity among the consumers (Bhatty, 1988). The comparison of quality parameters showed that seed of *AaS-2011* contains 13.02% protein and 29% gluten. It has good chapati making quality. The quality traits recorded reveal that the new variety is better than the existing checks. Gluten consistency of the variety is strong to medium strong, while gluten %age of the variety is also acceptable. Mustafa *et al*. (2004 and 2005) and Hussain *et al.* (2010a, b, c) reported similar results for new wheat varieties.

Plant Characteristics of *AaS-2011*: The plant of *AaS-2011* is erect. At boot stage the plant colour is dark green. It has 143 productive tillers at maturity. Plant height is 95-105 cm. Stem colour is off white. Flag leaf width and length are 1.2 to 1.6 and 32-37 cm, respectively. Auricle hairiness is sparse with week anthocyanin. Its straw is soft. It completes heading in 85-90 days and matures in

134-140 days. It is lodging and disease (rusts) resistant. The ear emerges 75-85 days after sowing. Ear colour is white. Its size is medium and shape is tapering. It is dense and shattering resistant. *AaS-2011* is awned variety. Awn's length is 6-8 cm and colour is off white. Awn habit is horizontal. Anther colour is green. *AaS-2011* has elongated seed with a width and length of 3 mm and 5-7 mm, respectively and with amber coloured. Seed thickness is 1.5mm. Seed germ size is longer with intermediate seed groove. Seed is hard with rough surface. Number of seeds per spike varies from 65 to 70. Its 1000-seed weight is 40-45 grams (Table 10).

Quality Traits of *AaS-2011*: Its seed contains 13.02% protein and 29% gluten. Its flour yield is 68.4%. It has good *chapati* making quality (Table 11)**.**

Table 9. Disease Reaction of *AaS-2011* to Karnal Bunt, stem rust, spot blotch and wheat aphid at RARI, Bahawalpur during 2008-09.

Condition	**Karnal Bunt**		
	***AaS-2011* (% Inf.)**	**Bhakkar-02 (% Inf.)**	
Under inoculated conditions	2.5	8.0	
Under natural conditions	0	2	
	Stem rust (local race i.e. RRTTF)		
Locations	***AaS-2011*(% incidence)**	**Local white (check) (%)**	
RARI, Bahawalpur	10R	40S	
Sindh	0	10MS	
Varieties	**Stem rust (UG-99) TTKSK**		
AaS-2011	15 MS		
Fareed-06 **(check)**	70 S		
	Spot Blotch (% incidence)		
Varieties	**2008-09**	**2009-10**	**2010-11**
AaS-2011	2	1	2
Bhakkar-02 **(check)**	9	8	9
	Reaction of *AaS-2011* against wheat aphid during 2009-10 and 2010-11		
Varieties	**Number of Aphid Tiller^{-1}**		
	2009-10	**2010-11**	
AaS-2011	8	15	
Fareed-06 **(check)**	6	18	
Sehar-06 **(check)**	12	19	
Mairaj-08 **(check)**	9	14	

Table 10. Botanical description of *AaS-2011*

Plant Traits	**Value**
Plant color	Light green
Waxiness	Waxy stem sheath
Leaf behavior	Erect
Flag leaf behavior	Drooping
Flag leaf width	1.2-1.6 cm
Flag leaf length	32-37 cm
Plant height	95-105 cm
Productive tillers per meter row	134
Awn's colour	White
Ear shape	Tapering
Ear color	White
Straw	Soft
Stem colour at maturity	Off white
Heading	85-90 days
Maturity	134-140 days
Grain color	Amber
1000 grain weight	40-44 gm
Grain size	Long
Auricle color	White

Table 11. Quality traits of *AaS-2011*

Variety	1000-grain weight	Protein (%)	Gluten (%)	Test weight	Flour (%)	Chapati Quality
AaS-2011	42 gm	13.02	29	78	68.4%	Good
Fareed-06	39 gm	13.44	29	76	67.8%	Good

Source: Biochemistry Laboratory, Wheat Research Institute, Faisalabad

Conclusion: *AaS-2011* is not only a high-yielder, possesses better quality traits and tolerant/resistant to all diseases and insect pests, but is also best suited in wheat-cotton-wheat rotation. It is resistant to UG-99 (RRTTF) which is a newly emerging and future threat to wheat crop. Due to its better adaptability, it has the potential to replace the previously approved wheat-varieties. This variety was unanimously approved and released by Punjab Seed Council, Lahore, during its 41st meeting held on 26th July 2011 in Agriculture House under the Chairmanship of Minister for Agriculture, Government of the Punjab, for general cultivation in hot and drought areas of Punjab under the name of "*AaS-2011*".

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