

“AROOJ-22” a versatile climate resilient high yielding bread wheat variety recommended for irrigated and rainfed areas of Punjab Pakistan

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Contribution	Ahmad, J. provided guidance for execution of research experiments, N. Ahmad & A. Javed evaluated the exotic trials selected the genotype and conducted yield trials along with M. Zulkiffal & M. H. Tanveer while M. M. Javaid analysed the pathology of crop. S. Shamim performed technology experiments, Y. Ramzan conducted agronomic trials. I. Ghafoor helped in data collection and analysis while, Sajid-ur-Rehman performed DNA Fingerprinting of Arooj-22.
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ABSTRACT

Arooj-22 is a bread wheat variety released by Wheat Research Institute (WRI), for irrigated and rainfed areas of Punjab-Pakistan. It was selected during 2016-17 from 24th Semi-Arid Wheat Yield Trial (SAWYT) from CIMMYT, Mexico. It was evaluated for yield stability in regular, provincial and national yield trials with the genotype code; V-17179 from 2017-2021. It delivered superior against the check variety Faisalabad-08, over 28 locations (22 irrigated and 6 rainfed) throughout the province of Punjab and produced 14.7% more grain yield in provincial yield trial. In national yield trial during 2019-20; V-17179 produced 13.4%, 17% and 18% higher yield than check varieties (Ghazi-19, Pak-13, local check) under 20 irrigated locations while produced 11.48%, 15.95% and 17.21% more grain yield than same check varieties under 6 rain-fed locations. Moreover, in national yield trial during 2020-21; V-17179 produced 2.1% and 5.1% more grain yield under 21 irrigated locations as compared to check (Ghazi-19 and Pak-13), while under 6 rain-fed locations V-17179 produced 3.5%, 8.2% and 10% more grain yield than check varieties (Ghazi-19, Pak-13 and local check). Rust resistance index was very good as 8.4 for leaf rust while it was in the acceptable range of 5.67 against yellow rust. The quality parameters were also found worthy regarding protein (12.9%), starch (53.3%), gluten (23%) and test weight (71.1 kg/hl). Arooj-22 delivered best consecutively in two-years (2019-20 and 2020-21) when sown at 1st forth-night during November, with the seed rate of 100 kg/ha along with the dose fertilizer of 120-90-60 N-P-K (kg/ha⁻¹). The DNA fingerprinting report showed that Arooj-22 has diverse genetic background from previously registered genotypes. The variety Arooj-22 was recommended/approved in 2021 for the general cultivation in irrigated and rainfed areas of Punjab.

Keywords: Climate change, thermal stress, plant physiology, genetic diversity, SSR Marker.

INTRODUCTION: The constant availability of quality staple (wheat) to the population of Pakistan, whose boosting population is becoming a big challenge for the country to fulfil the demand of consumers (Ahmad *et al.*, 2020). Wheat contributes about 9% to value addition in agriculture and almost 2.2 to GDP of the country. Wheat production was received 31.4 MT from 9,632 TH cultivated area in Pakistan during 2023-24. In view of current accelerating consumption of wheat, the local farmers demanding new genotypes which contains good yield potential with resistance to biotic and abiotic stresses to replace the present susceptible genotypes who have lost their yield potential (Ahmad *et al.*, 2020). The reduction in cost of crop husbandry with availability of attractive grain yield are the key to elevate the farmers economically (Ahmad *et al.*, 2020). The present unpredictable changing climatic condition of the world considerably affecting the yield potential of wheat crop all over the world. Wheat crop is very much sensitive to abiotic stresses; even increase in only 1% of the mean temperature, especially during the reproductive period of the crop can significantly reduce the grain yield up to 6% (Javed *et al.*, 2022). The higher and stable grain yield during the favourable and unfavourable cropping season can be obtained if the targeted genotype possesses diverse genetic blood which have the ability to express positively in extreme environmental conditions (Kashif *et al.*, 2023).

Wheat Research Institute, (WRI), Faisalabad, Punjab, Pakistan is internationally recognized research institution regarding wheat crop, which continuously executing improved wheat varieties to achieve food self-sufficiency (Ahmad *et al.*, 2021). Out of more than 60 bread wheat varieties; Mexi-Pak, Chenab-70, Pak-81, Inqilab-91, Seher-06, Faisalabad-08 and Galaxy-13 were top rated wheat varieties released by WRI, Faisalabad. However, with the passage of time under the changing climatic conditions of the world, the genetic potential of these mega varieties was deteriorated (Tabassum *et al.*, 2021). A newly approved wheat variety by the Punjab Seed Council, Pakistan, has the great potential to tolerate the biotic or abiotic stresses and can deliver more grains yield than the existing commercial wheat varieties (Ahmad *et al.*, 2023).

OBJECTIVES: The present study was executed to test the newly developed wheat variety for yield stability and rust resistance under the different irrigated and rain-fed environmental conditions.

MATERIALS AND METHODS: This research was executed by WRI under the umbrella of Ayub Agricultural Research Institute (AARI), Faisalabad-Pakistan at several irrigated and rainfed locations of Punjab Pakistan during the year 2016-17 to 2020-21. The

parentage, pedigree and development history of Arooj-22 has been elaborated in figure (1). Breeding material received from International Maize and Wheat Improvement Center (CIMMYT), Mexico in the form of 24-SAWYT-trial was studied in alpha lattice design with two repeats during 2016-17 with check variety Faisalabad-08. It was further studied along with other test entries in regular yield trial (B-trial) following randomized complete block design (RCBD) with three replications under code name V-17179 during 2017-18. Its competitors were broadly adopted check varieties Faisalabad-08, Punjab-11 and Galaxy-13.

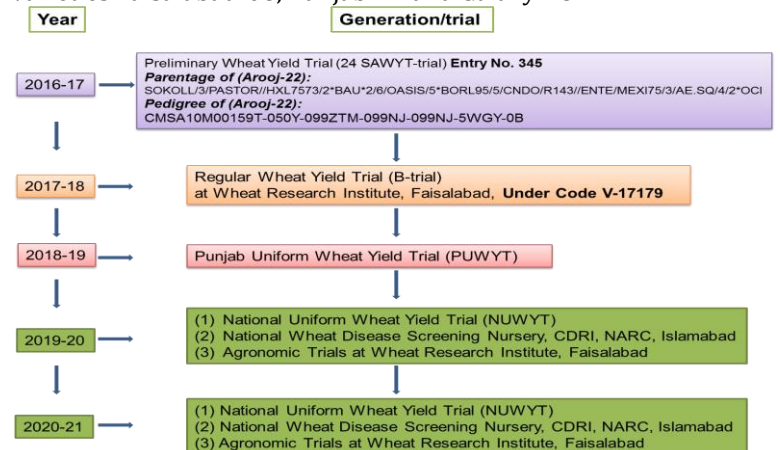


Figure 1: Development history of (V-17179) Arooj-22.

During both the years plot size of 8.1m² was maintained as 6 rows of 5meter length each and 27 cm row-to-row distance. After 2 years testing at Faisalabad location V-17179 was studied in Provincial Uniform Wheat Yield Trial (PUWYT) for confirming its wider adaptability in relation to yield stability under irrigated (n=22) and rainfed (n=6) agro-ecological zones of Punjab Pakistan during 2018-19 over 28 locations. The wider adaptable and high yielding cultivar Faisalabad-08 was kept as control in PUWYT, 2018-19. The said entry was promoted to National Uniform Wheat Yield Trials (NUWYT) for the subsequent two years (2019-20 and 2020-21) testing throughout the Pakistan, a mandatory trial before the variety approval. The NUWYT was executed over 20 irrigated and 6 rainfed sites during 2019-20, while over 21 irrigated and 6 rainfed sites during 2020-21. During NUWYT testing year's Crop Disease Research Institute (CDRI), NARC, Islamabad screened this entry with others local races of leaf and yellow rusts. The agronomic optimization trials (seeding rate, sowing date and fertilizer trials) were executed during 2019-21 at WRI, Faisalabad. The grain quality

testing was performed at Cereal Technology Laboratory (CTL) of WRI, Faisalabad. The procedure for quality testing was followed as demonstrated by American Association of Cereal Chemists and International Association for Cereal Science and Technology. Research work regarding DNA fingerprinting of newly developed wheat variety Arooj-22 was carried out in DNA fingerprinting Lab at Agricultural Biotechnology Research Institute, AARI, Faisalabad-Pakistan. The genotypes were sown at 5 different ports (2 seeds per genotype). Seedlings were established by watering the plants without application of any input and seedlings (n=5) were collected from each genotype at 4-5 leaf stage and were stored at -40°C for DNA extraction purpose. Modified CTAB method was used to obtain purified DNA (Iqbal *et al.*, 2019; Iqbal *et al.*, 2021). The extracted DNA was checked with the help of Nanodrop spectrophotometer (ND 2000, cleaver scientific Pvt. Ltd.). DNA possessing A₂₆₀/A₂₈₀ 1.8-2 was considered of good quality. Further, quality of the DNA was checked by running a proportion of the DNA on 0.8% agarose gel. Working dilutions having 20 ng/μL concentrations were prepared from the stock for PCR assembly (Rahman *et al.*, 2022). Simple sequence repeat (SSR) markers (N=50) of wheat evenly distributed on a, b and d genome were selected on polymorphic information contents (pic) basis (Iqbal *et al.*, 2021; Abbasov *et al.*, 2018; Haque *et al.*, 2021) and got synthesized from Genelink (<https://www.genelink.com/>). Polymerase chain reaction (PCR) were assembled for each marker using already standardized method (Jamil *et al.*, 2020). Binary data was used for estimation of polymorphic information content using power marker (Liu and Muse, 2005), and determination of genetic similarity coefficient using cluster analysis in NTSYSPC program whereas dendrogram was constructed following the method reported by (Sneath and Sokal, 1973).

RESULTS AND DISCUSSION: Preliminary yield trial or A-trial (2016-17): During the year 2016-17, V-17179 (Arooj-22) produced 5180 (kg ha⁻¹) grain yield which was 7.53% more than check variety (4817 kg ha⁻¹). Due to significantly higher yield over check V-17179 was added to regular yield trial for yield stability testing. The wheat material (SAWYT-trial) possesses new advance lines, produced for favourable environmental conditions, having resistance to different biotic and abiotic stresses, evaluated over multi-locations performed through collaboration to ultimately enhance the wheat grain yield (Sharma *et al.*, 2012).

Regular yield trial or B-trial (2017-18): The following year, V-17179 (Arooj-22) produced 11.4%, 16.1% and 9.2% significantly higher grain yield in comparison to check varieties Faisalabad-08, Punjab-11 and Galaxy-13 (table 1).

S. No.	Year	Type of trial	Yield (Kg ha ⁻¹)			
			V-17179	FSD-08	Punjab-11	Galaxy-13
1	2016-17	24 th SAWYT E-345	5180	4817	-	-
		% Increase over Check variety		7.53	-	-
2	2017-18	B- trial	5223	4690	4499	4783
		% Increase over Check varieties		11.36	16.09	9.20

Table 1: Station yield trials of V-17179 (Arooj-22).

S. No	location	Yield Kg ha ⁻¹		During 2018-19			
		V-17179	FSD-08	S. No.	location	V-17179	FSD-08
Irrigated							
1	Govt Seed Farm, Dhakkar Pakpattan	4087	3268	17	ARF Vehari	4750	3858
2	RRS Bahawalnagar	3525	4008	18	Khanpur	4250	3167
3	Jahanian	5917	4084	19	Alipur	4972	4611
4	MMRI Sahiwal	5417	5027	20	AZRI Bhakkar	3903	3875
5	Depalpur	6065	6124	21	Karor	3768	4348
6	PSC Khanewal	4878	3848	22	Kallur Kot	4598	5583
7	ARF Sargodha	3853	3435	Rainfed			
8	Pindibhatian	3413	2513	23	Groundnut Research Sub Station Attock	3613	2608
9	RRI Kala Shah Kaku	4062	3557	24	Fatehjang	7583	4094
10	ARF Gujranwala	3908	3865	25	Chakwal	7189	4567
11	Mandibhaudin	4153	3350	26	WRI Faisalabad	6139	5772
12	ARF Kot Naina	4403	3918	27	RARI Bahawalpur	2584	3000
13	WRI Faisalabad	5170	4531	28	NARC Islamabad	5418	2761
14	ABRI Faisalabad	4042	4292		Average	4666	4065
15	RARI Bahawalpur	4917	5417	% increase over check variety			
16	Multan	4084	4333	14.78			

Table 2: Yield Performance of "V-17179" (Arooj-22) in PUWYT.

Punjab uniform wheat yield trial (2018-19): Afterward two-years on-station (WRI, Faisalabad) testing, V-17179 delivered best against commercial check variety Faisalabad-08 over 28 locations throughout Punjab and produced 14.8% higher grain yield (table 2). Crespo-Herrera *et al.* (2017) also described the adaptability and higher yield, across multi-locations between wheat advance lines.

National uniform wheat yield trial (2019-2021): The ability of a genotype to maintain its economic yield and have wider adaptability over the years across different agro-ecological zones is an ideal behaviour. For, such a desirable plant architecture, a desirable genetic combination which has good expression in field along with the ability to tolerate biotic and abiotic stresses is highly demanded (Ahmad *et al.*, 2020). V-17179 (Arooj-22) proved its potential by showed this kind of desirable behaviour in national uniform wheat yield trials (NUWYT); during 2019-20 (table 3) over 20 irrigated and 6 rainfed locations with a 13.4%, 17% and 18% increase over check varieties (Ghazi-19, PAK-13 and Local Check) under irrigated conditions, and 11.5%, 16% and 17.2% increase over check varieties (Ghazi-19, PAK-13 and Local Check) under rain-fed conditions. On the other hand, during 2020-21, V-17179 showed its adaptability in different agro-ecological zones of Punjab with a 2.2% and 5.2% yield increase over the check varieties (Ghazi-19 and PAK-13) in irrigated conditions, while 3.5%, 8.3% and 10% yield increase over check varieties (Ghazi-19, PAK-13 and Local Check) in rain-fed conditions (table 4).

Agronomic trials: For the optimization of planting time, seeding rate and fertilizers levels (Malhi *et al.*, 2001) to harvest maximum yield, all the agronomic trials were conducted at WRI, Faisalabad Punjab Pakistan. The results of sowing date trials (table 5) during 2019-21 confirmed 1st November as a best sowing time for V-17179. In Sowing date trial during 2019-20; V-17179 (Arooj-22) showed 30.9%, 24.3%, 9.5% and 6.7% yield increase over than check varieties (Faisalabad-08, Ujala-16, Anaj-17 and Akbar-19) while during 2020-21; V-17179 showed 12.1%, 9.3% and 0.5% yield increase over than check varieties (Ujala-16, Anaj-17 and Akbar-19). For the optimization of seeding rate, a trial was executed during 2019-21 (figure 3). The seeding rate of 100 (Kg ha⁻¹) was found best for V-17179 to produce maximum grain yield of 5266 Kg ha⁻¹ and 4390 Kg ha⁻¹ during 2019-20 and 2020-21. The results of fertilizer optimization trial explained (figure 2), the combination of fertilizer-dose 120-90-60 N-P-K (Kg ha⁻¹) was the most returning and productive one in comparison with other combinations, as it delivered highest grain yield of 5233 (Kg ha⁻¹) and 4739 (Kg ha⁻¹) during 2019-20 and 2020-21 respectively.

Disease screening: The major declining factor of the wheat varieties is the rust diseases. Therefore, during the development of new cultivars, it is imperative to screen the candidate lines against rusts at their respective hotspot areas. Brown and yellow rusts are the most prevailing and devastating wheat diseases in Pakistan.

Sr. No.	Punjab Locations (Irrigated)	Yield (kg/ha ⁻¹)			
		V-17179	Ghazi-19	PAK-13	Local Check
1	RARI, Bahawalpur	4111	3278	3833	3612
2	MNS University of Agri. Multan	4945	4112	4167	4062
3	Adaptive Research Farm, R.Y. Khan	4862	5723	4334	4361
4	Alipur	5542	5583	5685	6045
5	Jahanian	6750	5861	4028	4583
6	Khanpur	6203	6147	6217	5388
7	WRI, Faisalabad	5007	4763	4219	4034
8	Govt Seed Farm, Dhakkar, Pakpattan	5866	5626	5135	5178
9	RSS, Bahawalnagar	5229	5114	5289	4373
10	Depalpur	5473	5217	4464	5648
11	MMRI, Yousufwala Sahiwal	4245	4399	3557	3936
12	PSC, Khanewal	5175	5057	4022	4850
13	ARF, Sargodha	4358	3918	3462	3812
14	ARF, Gujranwala	5622	4594	4577	3390
15	Mandi Bahauddin	5258	5110	3207	3540
16	ARF, Kot Naina, Shakargarh	3808	2982	3697	3002
17	RRI, Kala Shah Kaku	4664	3630	4070	3149
18	AZRI Bhakkar	4257	4142	4740	4207
19	GRS, Kallur Kot	5036	4905	4425	4792
20	UAF, Faisalabad	3844	2601	2563	2999
Mean (Pooled data over 20 locations)		5013	4638	4285	4248
% Increase over check varieties			13.48	16.98	18.00

Sr. No.	Punjab Locations (Rainfed)	Yield (kg/ha ⁻¹)			
		V-17179	Ghazi-19	PAK-13	Local Check
1	WRI, Faisalabad	4558	4852	4229	4145
2	AZRI, Bahawalpur	2818	3037	3072	2563
3	BARI, Chakwal	4767	4308	4071	4108
4	GRS, Attock	5508	3844	4597	5183
5	BARS, Fatehjang	5823	5804	5747	5507
6	NARC, Islamabad	5259	3932	3062	3010
Mean (Pooled data over 6 locations)		4789	4296	4130	4086
% Increase over check varieties			11.48	15.95	17.21

Table 3: Performance of "V-17179" in NUWYT Punjab (Irrigated and Rainfed) During 2019-20.

Sr. No.	Punjab Locations (Irrigated)	Yield (kg/ha ⁻¹)			
		V-17179	Ghazi-19	PAK-13	Local Check
1	RARI, Bahawalpur	5111	4728	4789	5334
2	ARS, Khanewal	5542	5192	5833	5545
3	Adaptive Research Farm, R.Y. Khan	4889	4389	4111	4824
4	Alipur	5683	5961	5834	5535
5	Jahanian	5472	5306	4722	5668
6	Mailsi	6056	6000	5723	6078
7	WRI, Faisalabad	4404	4031	4158	4451
8	GASF, Chilla, Mandi Bahauddin	3709	3285	3414	3394
9	RSS, Bahawalnagar	1385	3308	1732	2322
10	Dhakkar Farm, Pakpattan	3385	2920	3710	3925
11	MMRI, Yousufwala Sahiwal	3181	2941	3454	3233
12	ARS, Karor	5084	5060	4550	4780
13	ARF, Sargodha	3229	3224	3214	3475
14	ARF, Gujranwala	2903	2767	2930	3639
15	PSC, Khanewal	4792	4803	3655	4782
16	ARF, Kot Naina, Shakargarh	3609	2373	3332	2788
17	RRI, Kala Shah Kaku	3107	2930	2767	2987
18	AZRI Bhakkar	4814	4740	4525	4550
19	GRS, Kallur Kot	5095	5080	4850	4750
20	ASF, Depalpur	3975	4698	3585	4344
21	MNS, University Multan	3752	3512	3912	4144
Mean (Pooled data over 21 locations)		4246	4155	4038	4312
% Increase over check varieties			2.19	5.15	-

Sr. No.	Punjab Locations (Rainfed)	Yield (Kg ha ⁻¹)			
		V-17179	Ghazi-19	PAK-13	Local Check
1	WRI, Faisalabad	6559	4595	4077	4237
2	AZRI, Bahawalpur	3630	3218	3814	3507
3	BARI, Chakwal	4117	3833	3350	2942
4	GRS, Attock	4162	4047	4339	4599
5	BARS, Fatehjang	4216	5632	4924	4987
6	NARC, Islamabad	5284	5686	5317	5132
Mean (Pooled data over 6 locations)		4661	4502	4304	4234
% Increase over check varieties		-	3.53	8.29	10.08

Table 4: Performance of "V-17179" in NUWYT Punjab (Irrigated and Rainfed) During 2020-21.

The candidate line V-17179 (Arooj-22) showed moderate resisting response to brown and yellow rusts (table 5). Leaf or brown rust is the major challenge to wheat production in Pakistan. Under favourable climatic conditions, it can reduce the yield up to 50% (Iqbal *et al.*, 2022). The candidate line was screened for leaf rust for two years 2019-21. It showed resistant to moderately resistant response for leaf rust during both the years. The maximum leaf rust response in LDSN was recorded as TMR and 10MRMS against the susceptible check variety Morocco that showed 70S for both the years (table 6). Similarly, at national level, it showed maximum reaction of 20MSS and 5MSS at Karachi against the 100S of Morocco

for both the years (table 7). The relative resistance index (RRI) of the candidate line remained 8.4 and 7.94 during 2019-20 and 2020-21 respectively (table 8). Yellow rust is another important disease of wheat. Under severe epidemic conditions, it can cause up to 70% yield loss (Khanfri *et al.*, 2018). The candidate line showed moderate type of resistance against yellow rust during both the years. In the LDSN, it showed maximum response of 5MRMS at Peshawar in the first year while it remained 5RMR at Nowshehra during the second year of screening against Morocco that was 100S (table 8). The RRI reported by CDRI was 5.3 and 5.67 during 2019-20 and 2020-21 respectively (table 9).

Year	Genotype	20-Oct	1-Nov	10-Nov	20-Nov	30-Nov	10-Dec	20-Dec	30-Dec	Average	% increase over check
2019-20	V-17179	4979	5144	5268	4367	4272	3899	3681	3629	4405	
	Fsd.08	3380	4525	3723	3913	2999	2735	2838	2834	3368	30.79
	Ujala-16	4777	4024	3675	3092	3308	3227	3128	3129	3545	24.26
	Anaj.17	5129	4472	4429	4124	3642	3620	3423	3359	4025	9.44
	Akbar-19	5264	4782	4909	3795	3654	3599	3580	3455	4130	6.66
Year	Genotype	20-Oct	1-Nov	10-Nov	20-Nov	30-Nov	10-Dec	20-Dec	30-Dec	Average	% increase over check
2020-21	V-17179	6607	6476	6089	5782	5456	4592	2377	2189	4946	
	Ujala-16	5964	6029	5376	4863	4328	4237	2287	2215	4412	12.1
	Anaj-17	6091	5876	5370	5204	4736	4653	2410	1849	4524	9.33
	Akbar-19	6277	6271	6070	5818	5578	4861	2422	2092	4924	0.45

Table 5: Yield (Kgha-1) response of "V-17179" to different sowing dates

Variety	Year	Faisalabad	Kotnaina	Bahawalpur	Khanewal
V-17179	19-20	TMR	0	0	0
Morocco		60S	70S	60S	50S
V-17179	20-21	10MRMS	TM	5MRMS	0
Morocco		70S	50S	50S	70S

Table 6: Leaf rust data of LDSN at different locations in Punjab

Variety	Year	Karachi	Sakrand	Tandojam	Ghotki	Kunri	Faisalabad	RRI
V-17179	19-20	20MSS	10MSS	TMSS	TMSS	10MSS	0	8.4
Morocco		100S	100S	100S	100S	100S	90S	-
V-17179	20-21	5MSS	5MSS	5MSS	5MSS	5MSS	10S	7.94
Morocco		100S	100S	100S	100S	100S	100S	-

Table 7: Leaf rust data of NWDSN at different locations

Variety	Year	Pirsabaq	Peshawar	Islamabad	Kotnaina	Faisalabad	Bahawalpur
V-17179	19-20	5RMR	5MRMS	0	0	0	TM
Morocco		100S	90S	100S	50S	40S	80S
V-17179	20-21	5RMR	0	0	TM	0	0
Morocco		100S	80S	100S	30S	20S	20S

Table 8: Yellow rust data of LDSN at different Locations in Punjab

Variety	Year	Nowshera	Peshawar	Islamabad	*RRI
V-17179	19-20	60MRMS	50MRMS	60MRMS	5.3
Morocco		100S	100S	100S	-
V-17179	20-21	40MRMS	40MRMS	30MRMS	5.67
Morocco		100S	90S	100S	-

Table 9: Yellow rust data of NWDSN at different locations

*RRI = Relative Resistance Index, Leaf/Yellow Rust = *Desirable RRI* (7); *Acceptable RRI* (5)

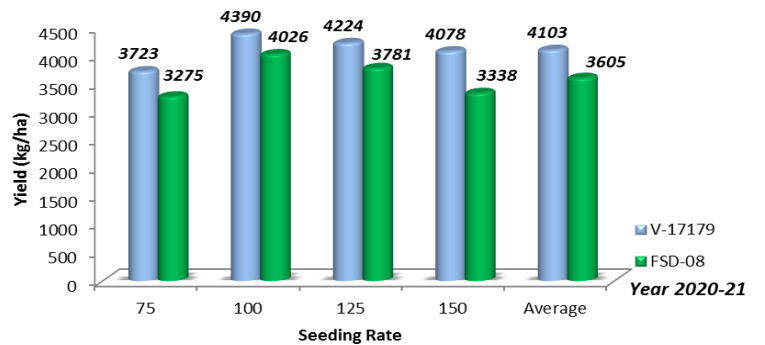
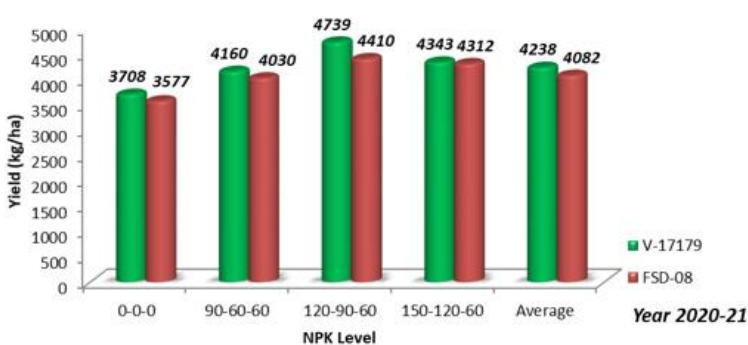
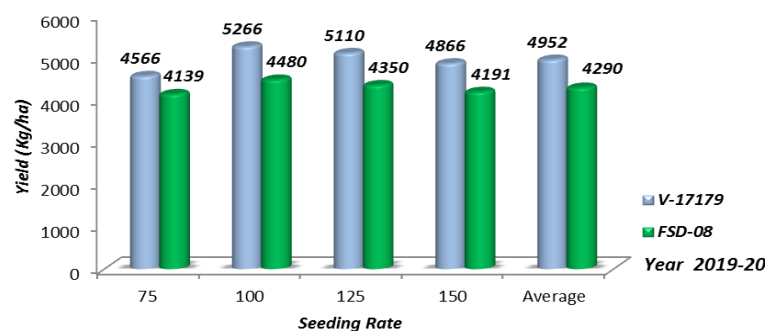
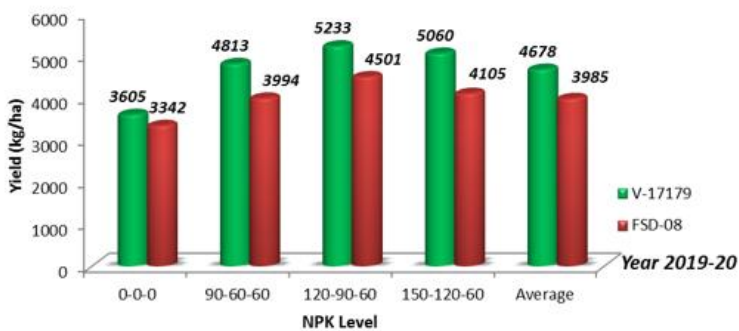


Figure 2: Response of V-17179 to different fertilizers levels.

Figure 3: Response of V-17179 to different seeding rates.

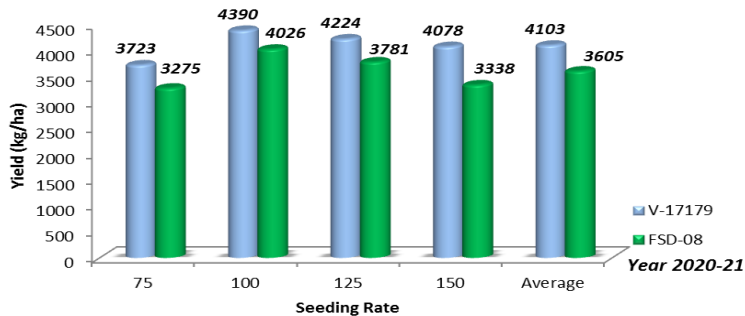
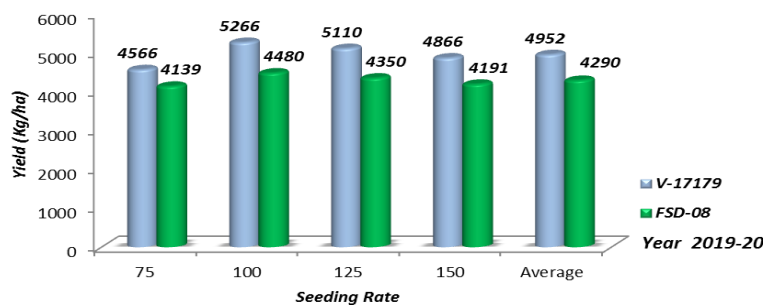


Figure 3: Response of V-17179 to different seeding rates.

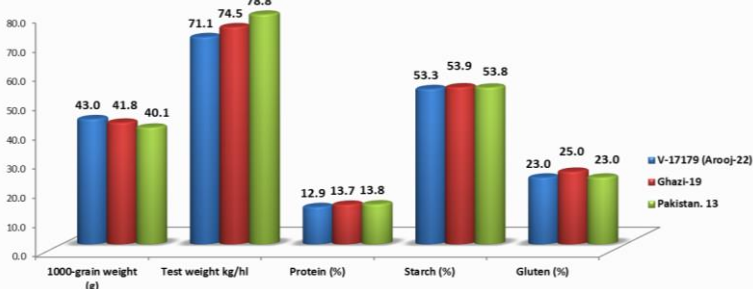


Figure 4: Quality analysis of V-17179.



Figure 5: Pictorial view of Arooj-22 (plant, seed and spike).

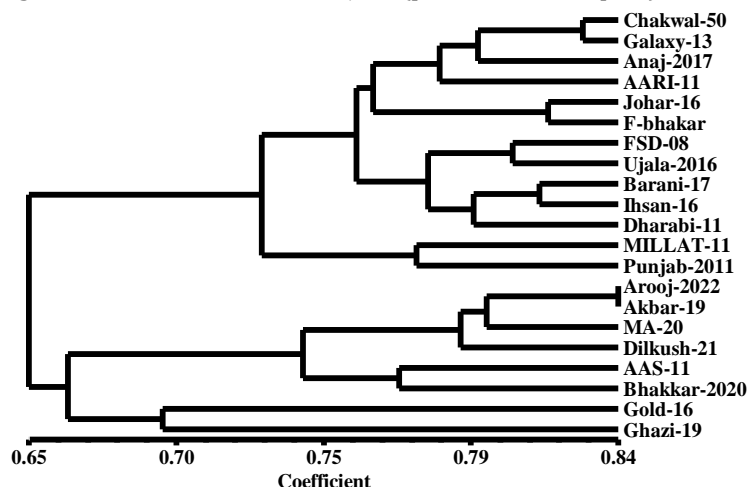


Figure 6: Cluster analysis of 21 wheat genotypes.

Quality analysis: Arooj-22 was found equally desirable for its quality parameters to fulfil the grain quality requirements of bread

wheat stakeholder. Its thousand-grain weight (43g), test weight (71.1 kg/ha), protein content (12.9%), starch content (53.3%) and gluten contents (23 %) were considerably up to the mark of quality criteria for bread wheat grains when compared with the commercial check varieties i.e. Ghazi-19 and Pakistan-13 (figure 4). Similar findings were reported by (Javed *et al.*, 2022).

Botanical attributes of Arooj-22: Arooj-22 is medium tall (110-115 cm) and without seedling anthocyanin. It exhibits semi-erect growth habit at seedling stage while semi-droopy at booting stage with light green color. The stem is 4.5mm in diameter, green in color along with 20cm intermodal length, medium stem waxy bloom and intermediate stiffness to tolerate lodging. It can deliver 480 tillers per m². Flag leaf bears droopy attitude, medium sheath waxiness, no sheath hairs with 25 cm leaf length and 1.5 cm leaf width. Its auricle is hairless and without anthocyanin pigmentation. Its awn is medium in length and yellow in colour. The medium dense ear, without supernumerary spikelets and speltoides, resistant to shattering with tapering shape and has the ability to produce 50 to 55 seeds per ear. The length and width of rachis is 10 mm and 13.79 mm, with hairs on margins and 19 segments. It takes 120 days to complete heading while matures in 145-155 days. The length and width of glume is about 10 mm and 4 mm respectively, and it exhibit strong attachment. Shape of shoulder of glume is elevated with Medium width. Glume beak is straight in shape and medium in length. Glume surface is smooth but without imprints and internal hairs. seed is of amber in colour, ovate in shape, 7-8 mm long and 3-3.5 mm wide. Its thickness is about 2.9 mm. Germ size and shape is medium; with medium brush, intermediate groove and opaque surface. It is good for chapatti and bread making. Because of its resistance ability against the rust, adaptability to different agro-ecological zones of Punjab (irrigated and rainfed) and gigantic yield deliverance confirmed its approval for general cultivation with the name of “Arooj-22” by the Punjab Seed Council, Pakistan, similar findings were reported by Ahmad *et al.*, 2022. The figure 5; showing the pictorial view of Arooj-22 (plant, spike and grains).

The DNA Fingerprinting of Arooj-22: Three alleles were found monomorphic whereas remaining 359 were polymorphic out of 362 alleles after amplification. Maximum number of alleles (n=31) was amplified by SSR marker (WMS-295). On an average 10 alleles were observed per locus which were higher than previous reported results (Al-Ashkar *et al.*, 2020). The PIC of 50 SSR markers ranged from 0.1 to 0.8 which is also higher than previous reported results (Al-Tamimi and Al-Janabi, 2019). The genetic similarity coefficient between 21 genotypes ranged from 0.65 to 0.84 (figure 6). On the basis of cluster analysis, mainly 2 cluster groups were constructed. Cluster-I was including harboring Chakwal-50, Anaj-2017, Galaxy-13, Johar-16, AARI-11, F-Bhakar, Ujala-2016, Ihsan-16, Barani-17, Millat-11, Dharabi-11 and Punjab-11 whereas cluster-II was comprised of Arooj-2022, Akbar-19, MA-20, AAS-11, Gold-16, Ghazi-19 and Dilkash-21. The candidate variety Arooj-2022 showed variable genetic similarity with previously registered genotypes i.e. Chakwal-50 (66%), Galaxy-13 (67%), Aanj-17 (67%), Akbar-19 (84%), Dilkash-21 (78%), MA-20 (81%), AAS-11 (75%), Bhakkar-20 (76%), AARI-11 (61%), FSD-08 (70%), Millat-11 (62%), Punjab-2011 (64%), Ujala-16 (66%), Barani-17 (66%), Dharabi-17 (66%), Ihsan-16 (62%), Johar-16 (66%), F-Bhakar (65%), Gold-16 (67%) and Ghazi-19 (63%) (figure 6). These percentage similarities showed that Arooj-2022 is a novel and distinct variety which have diverse genetic background from previously registered genotypes.

CONCLUSION: Arooj-22 has demonstrated notable adaptability, resilience, and high yield potential in diverse environmental conditions, making it a promising variety for wheat cultivation. This variety offers enhanced disease resistance, particularly against yellow rust and leaf rust, which are significant threats to wheat productivity. Arooj-22 also exhibits improved tolerance to abiotic stresses, including drought and heat, enabling stable performance under variable climatic conditions typical of wheat-growing regions in Pakistan. Yield trials across multiple locations have shown Arooj-22 as a consistent performer over the older varieties, suggesting its potential for widespread adoption among farmers aiming to increase productivity and economic returns. Given these advantages, Arooj-22 is a suitable choice for sustainable wheat production, contributing to food security and resilience in Pakistan’s agricultural sector. Further extension efforts and seed distribution initiatives will be critical for maximizing the impact of this high-potential variety.

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