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GOMAL-8, A HIGH YIELDING, DISEASE TOLERANT WHEAT VARIETY FOR IRRIGATED AREAS

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ABSTRACT

Wheat variety Gomal-8, having parentage/pedigree "ATTILA" CM85836-4Y-0M-0Y-14M-0Y-5M-0Y-1SJ-0Y-0AP, was first tested at the Agricultural Research Institute (ARI), Dera Ismail Khan, during the year 1999-2000 in Regional Bread Wheat Yield Trial (RBWYT) received from Centro International de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico. Out of 24 lines tested, high yielding and disease resistant line (DN-38) was selected which was then tested in various Preliminary Yield Trials (A-Test, B-Test, Micro Plot Trial) under irrigated condition at ARI, Dera Ismail Khan, during 2000-01. DN-38 was then included in Advanced Yield Trial (AYT) during 2001-02 and National Uniform Wheat Yield Trials (NUWYT) for two consecutive years from 2005-07. In NUWYT, DN-38 showed its dominance in high yield and resistance to yellow and leaf rusts. On the basis of its overall performance, DN-38 (Gomal-8) was approved by the Provincial Seed Council (PSC) as new wheat variety for general cultivation in irrigated areas of Khyber Pakhtunkhwa (KPK). The optimum sowing time for Gomal-8 is from 25th October to 25th November in KPK.

Key words: Wheat, *Triticum aestivum* L., variety, yield, disease resistance.

INTRODUCTION

Wheat (*Triticum aestivum* L.) yield is low in Pakistan as compare to other leading wheat producing countries like USA and China (Anonymous, 2009-10). It is staple food for the people of Pakistan occupying 70% of Rabi and 37% of the total cropped area of the country. In KPK, wheat is grown on 40% of the total cropped area (Khan, 2011). Wheat is annually cultivated on about 0.90 million hectares with a total production of 2.38 million tons in Pakistan (Anonymous, 2009-10). The current average yield (1.84 t ha^{-1}) is very low, leading to overall low wheat productivity in the province. The major wheat yield limiting factor, especially in irrigated areas, is the leaf and yellow rusts, which can reduce grain yield up to 50% depending upon the severity and its time of incidence. In central upper Punjab and in KPK, yellow rust was observed 10MSS to 60S (Afzal, 2009). Stripe rust expressed its severity during 2004-05 in the upper Punjab and KPK which caused serious reduction in wheat production. Such outbreaks has emphasized to avoid monoculture of a single wheat variety and to identify yellow rust resistant wheat varieties and their cultivation according to different ecological zones. Development and adoption of high yielding wheat varieties with narrow genetic base has led to cultivating fewer varieties over a large area that has created genetic vulnerability to stress (Afzal, 2009).

Rusts are the most destructive and widely recognized diseases of wheat crop (Qamar and Niks, 2007). Rusts cause significant reduction in yield and pose a constant threat to sustainable production in all wheat growing countries including Pakistan (Sing and Julio, 2006). To overcome this problem, the cultivation of rust resistant varieties is a viable solution (Anonymous, 2005; (Bakhsh *et al*., 2005).

The development of wheat germplasm resistant to prevailing diseases is pivotal to cater for the need of increasing population of the country. Moreover, the availability of germplasm with diverse genetic makeup provides an opportunity to breeders to select material conducive to local environment (Dixen *et al*., 2009). The continuous development of high yielding and disease resistant varieties such as Zam-04 (Uddin *et al*., 2005) Hashim-8 (Khan *et al*., 2011), Pirsabak-2008 (Shah *et al*., 2010) and Fareed-06 (Hussain *et al*., 2010) is a step forward towards higher wheat productivity in the country. In addition to yield and resistance to disease and draught, acceptability of wheat variety also depends upon nutritional statures that affect *Chapati* quality as well as suitability of wheat to various breakfast and confectionaries products. Wheat has been reported to provide 73% of the calorie and protein requirements of the daily diet (Arif *et al*., 2010)

Current wheat variety Gomal-8 has shown its superiority in yield and resistance to biotic and abiotic stresses in all trials including A and B tests, micro plot trial (MPT), advanced yield trial and finally in NUWYT during 2005 to 2007. This variety, having parentage/ pedigree as ATTILA CM85836-4Y-0M-0Y-14M-0Y-5M-0Y-1SJ-0Y-0AP, was developed after years of

untiring efforts of wheat scientists at the Agricultural Research Institute (ARI), Dera Ismail Khan. The research team, consists of highly qualified staff members, has developed several other high yielding wheat varieties in the past which include Dera-98, Daman-98, Naseer-2000, Raj, Zam-04 and Hashim-8. These varieties have been under cultivation in different parts of KPK (Uddin *et al.*, 2000, 2005; Khan and Khan, 2010).

Gomal-8 is high yielding, input responsive and has wider adoptability. Therefore, this variety is recommended for general cultivation in irrigated areas of Dera Ismail Khan and other parts of KPK.

MATERIALS AND METHODS

Wheat variety Gomal-8 (ATTILA CM85836-4Y-0M-0Y-14M-0Y-5M-0Y-1SJ-0Y-0AP) was received from CIMMYT, Mexico through National Agricultural Research Center **(**NARC), Islamabad and from 1999-2000 to 2006-07, for a period of seven years, the variety passed through various trials and finally approved for general cultivation. At the outset, the variety was put into the trial called Regional Breed Wheat Yield Trial (RBWYT) in 1999-2000. The trial was planted at ARI, Dera Ismail Khan in a randomized complete block design with three replications during the year 1999-2000. Land preparation, irrigation, fertilization and all other agronomic practices were adopted as recommended for the area. Standard checks (Dera-98 and Zam-04) were also included for comparison.

This line was again tested in Micro Plot Trial (MPT) in a randomized complete block design with four replications during 2000-2001. Each plot consisted of 6 rows, 30 cm apart and 5 m long. Based on good performance in grain yield and resistance to diseases, this line was included in Advanced Yield Trial (AYT) during 2001-02. Recommended doses of fertilizers @ 150-120-90 NPK kg ha^{-1} were applied in all trials throughout the testing period. It was finally sent to NARC, Islamabad for inclusion in National Uniform Wheat Yield Trial (NUWYT) in 2005-06 under irrigated conditions. Its performance was tested across the country in 2005-06. DN-38 was retested in NUWYT during the year 2006-07. For yield determination, four central rows were harvested in all trials. Rust infection scoring was done according to the methods as described by Stakman *et al*. (1962) and the protocols followed by Crop Disease Research Institute (CDRI), Islamabad (Anonymous, 2000a). Wheat quality parameters were evaluated according to methods set by AOAC (Helrich, 1990) and AACC methods (2000b). Data on seed yield and yield related traits were recorded and statistically analyzed (Steel *et al*., 1997) using MSTATC computer program (MSTATC, 1991). Means were compared using Fisher's protected least significant difference (LSD) procedure.

RESULTS AND DISCUSSION

Performance of Gomal-8 in Preliminary Nursery: The variety Gomal-8 (DN-38) was received from RBWYT during the year 1999-2000. Out of 24 lines tested, entry No. 4 in the said trial produced 23% higher grain yield (4342 kg ha^{-1}) than check variety Dera-98 (3340 kg ha^{-1}) at ARI, Dera Ismail Khan and was selected for further testing (Table-1).

Performance of Gomal-8 in Preliminary and Advanced Yield Trials: The variety was evaluated for yield, disease resistance and other agronomic traits in various replicated trials. This variety produced grain yield of 3883 and 4009 kg ha^{-1}, which was higher than that produced by check varieties Dera-98 (3841 kg ha^{-1}) in PYT during 2000-01 and Zam-04 (2986 kg ha^{-1}) in AYT during 2001-02 (Tables 1-3).

Performance of Gomal-8 in National Uniform Wheat Yield Trials (NUWYT): In NUWYT testing, Gomal-8 produced 4% higher grain yield than the local checks in 6 sites of KPK and 39 sites of Pakistan including Azad Jammu and Kashmir (Table-4) during the year 2005-06. Similarly, this variety produced 4.5% higher grain yield in 5 sites of KPK and 1.4% more grain yield as compared to local checks in 36 sites of Pakistan including Azad Jammu and Kashmir during the second year NUWYT testing (Table-5).

Disease reaction: According to NUWYT data (2005-06 and 2006-07), Gomal-8 was one of the four candidate lines, which was found completely resistant to leaf and yellow rusts at all locations across the country. During 2005-06, the candidate line was evaluated in NUWYT for yellow and leaf rusts along with terminal reaction, average coefficient of infection (ACI), country average relative percentage attack (CARPA) and relative resistance index (RRI). Gomal-8 showed a desirable relative resistance index (RRI) of 8.0 for yellow rust (YR) and 6.0 for leaf rust (LR) during 2005-06 and 9.0 for yellow rust and 8.0 for leaf rust during 2006-07 (Table-6).

General characteristics of Gomal-8: It has erect growth habit with 90-100cm plant height and 5-6cm stem diameter. It has stiff stem thickness and completely resistant to shattering and lodging. Gomal-8 produces 135-150 tillers (m^{-2}). Flag leaf is erect with 25 and 2cm length and width, respectively. Ear emergence takes place after 75-85 days after sowing (DAS) while crop matures after 140-150 DAS. Ear is medium having 10-12cm length. Its grains are bold with attractive amber color. Seed is oval shaped having 7, 4 and 3mm length, width and thickness, respectively.

Quality characteristics: DN-38 was evaluated for quality parameters including kernel weight (g), test

Table-1. Grain yield (kg ha^{-1}) of Gomal-8 (DN-38) in comparison to the checks in various yield tests conducted from 1999-2000 to 2006-07.

Test	Year	DN-38	Local Check	% Increase
RBWYT (E # 4)	1999-2000	4342	3340 (Dera-98)	23 %
MPT-2 (IR)	2000-2001	3883	3841 (Dera-98)	2 %
AYT	2001-02	4009	2986 (Zam-04)	26 %
NUWYT (NWFP)	2005-06	3933	3786 (Local Check)	4 %
NUWYT (NWFP)	2006-07	3000	2864 (Local Check)	4.5 %
NUWYT (N)	2005-06	3662	3506 (Local Check)	4 %
NUWYT (N)	2006-07	3583	3530 (Local Check)	1.4 %

RBWYT (Regional Bread Wheat Yield Trial)
MPT (Micro Plot Trial) AYT (Advanced Yield Trial)
NUWYT (National Uniform Wheat Yield Trial)

Table-2. Grain yield (kg ha^{-1}) of Gomal-8 (DN-38) in PYT (Normal) at ARI, D.I.Khan during 2000-01.

Entry No.	Grain yield (kg ha^{-1})
1	4175 ab
2	4008 abc
3	3298 cde
4 (DN-38)	3883 a-d
5	3897 a-d
6	4133 ab
7	3966 abc
8	4258 a
9	3424 b-e
10	3006 e
11	3131 de
Local Check (Dera-98)	3841 a-d

Means followed by different letter(s) in a column are significant at 5% level of probability.

Table-3. Grain yield (kg ha^{-1}) of Gomal-8 (DN-38) in AYT at ARI, D.I.Khan during 2001-02.

Entries	Grain yield (kg ha^{-1})
DN – 22	3344 cd
DN – 26	3069 d
DN – 27	3316 cd
DN – 35	2524 e
DN – 36	3000 de
DN – 37	3613 bc
DN – 38	4009 b
DN – 39	3019 de
DN – 47	5192 a
Local Check (Zam-04)	2986 de
$LSD_{0.05}$	531.4

Means followed by different letter(s) in a column are significant at 5% level of probability.

Table-4:Pooled yield (kg ha^{-1}) analysis of wheat varieties included in NUWYT (Irrigated) during 2005-06.

NUWYT No.	Line/ Variety (Source)	NWFP (5 sites)	Pakistan including AJK (42 sites)
1.	V-03158 AARI-FSD	3783	3570
2.	V-022668 AARI-BPUR	3714	3418
3.	2KC050 BARI-CHAKWAL	4229	3678
4.	DN-38 ARI-DIK	3948	3652
5.	CT-99022 NIFA-PESH	4069	3711
6.	V-9316 UAF	3388	3203
7.	V-00BT034 BIOTECH-AARI	3887	3608
8.	V-01078 AARI-FSD	4124	3834
9.	V-15-10 NIA-T.JAM	3084	3080
10.	NR-270 NARC	3701	3352
11.	V-03079 AARI-FSD	4233	3744
12.	PR-88 CCRI-PIRSABAK	4003	3535
13.	V-002495-A AARI-BPUR	3481	3428
14.	Q.S-1 QAARI-LARKANA	2871	2869
15.	V-02192 AARI-FSD	4044	3625
16.	PR-84 CCRI-PIRSABAK	3882	3484
17.	MARIA ARS-SWAT	3115	2893
18.	INQILAB-91 CHECK	3596	3674
19.	MALIR WRI-SAKRAND	3683	3654
20.	Local Check	3931	3524
	$LSD_{0.05}$	241.8	58.4

Table-5: Pooled yield (kg ha^{-1}) analysis of wheat varieties included in NUWYT (Irrigated) during 2006-07.

NUWYT No.	Line/ Variety (Source)	NWFP (4 sites)	Pakistan including AJK (42 sites)
1.	PR-89 CCRI-Pirsabak	2829	3445
2.	AUP-4606 Ag.Un.Peshawar	2755	3520
3.	MPT-7 WRI-Sakrand	2608	3187
4.	TW0107 AZRI-Bhakkar	2855	3368
5.	V-03079 AARI-Faisalabad	3206	3859
6.	CT-99022 NIFA-Peshawar	2918	3640
7.	V-04188 AARI-Faisalabad	2983	3582
8.	2KC050 BARI-Chakwal	2945	3733
9.	PR-88 CCRI-Pirsabak	2918	3449
10.	V-033010 RARI-Bahawalpur	2981	3639
11.	V-04189 AARI-Faisalabad	3117	3879
12.	V-9244 U. Agri. Faisalabad	2709	3456
13.	Seher-2006 Check	3151	3858
14.	NR-285 NARC-Islamabad	2880	3668
15.	V-03138 AARI-Faisalabad	2964	3629
16.	DN-38 ARI-D.I.Khan	3000	3583
17.	V-032862 RARI-Bahawalpur	3075	3764
18.	MALIR WRI-Sakrand	2859	3542
19.	MSH-14 NIA-Tandojam	2770	3539
20.	Local Check	2864	3530
	$LSD_{0.05}$	198	51

weight (kg ha^{-1}), PSI, grain ASH (%), grain protein (%), gluten consistency, wet gluten (%), dry gluten (%), SDS

value (cc) as shown in Table-5. Gomal-8 was found at par with other approved wheat varieties regarding physio-chemical qualities. The quality evaluation report revealed that DN-38 possesses all desirable attributes including 31.34% wet gluten, 1.55% ash and 13.65% protein (Table-7). DN-38 (Goml-8) is well adapted in the irrigated areas of KPK which can be sown from 25th October to 25th November. Gomal-8 was approved by the Provincial Seed Council, KPK, for general cultivation in 2008. The addition of this variety will help in increasing per unit wheat yield in KPK.

Table-6. Disease reaction data of candidate lines found resistant to both rusts in NUWYT 2005-06 and 2006-07.

Name	Category	2005-06		2006-07	
		Lr	Yr	Lr	Yr
99FJ03	Rainfed	5.0	9.0	9.0	7.1
NR-268	Rainfed	8.0	9.0	9.0	8.0
DN-38	Seeding date	6.0	8.0	7.2	7.5
2KC050	Seeding date	7.0	8.0	8.6	8.3

Source: NUWYT 2005-06, 2006-07

Table-7. Quality evaluation of NUWYT entries during 2005-06.
A – NUWYT (Seeding date trial)

NUWYT No.	Line	1000-Kernel Wt. (g)	Test Weight (kg/ha)	PSI	Grain Ash (%)	Grain Protein (% d.b)	Gluten Consis-tancy	Wet Gluten (%)	Dry Gluten (%)	SDS Value (cc)
1	V-03158	33.2	75.1	39	1.596	12.30	S	29.15	9.54	30
2	V-022668	34	71.95	61	2.112	15.43	MS	37.59	11.99	38
3	2KC050	37.5	71.9	43	1.643	12.49	S	21.45	7.23	23
4	DN-38	39.6	74.2	40	1.55	13.65	W	31.34	9.19	24
5	CT-99022	36.3	73.15	58	1.374	13.55	S	21.34	7.43	22
6	V-9316	37.4	69.3	40	1.533	13.00	S	28.63	9.62	39
7	V-00BT034	40.6	75.4	40	1.547	12.16	S	32	10.02	30.5
8	V-1078	44.9	78.1	40	1.457	14.79	MS	34.55	10.58	34
9	V-15-10	26.4	71.7	39	2.07	15.81	S	40.04	12.34	32.5
10	NR-270	-	-	-	-	-	-	-	-	-
11	V-03079	36.3	75.8	40	1.493	14.84	MS	35.46	11.42	38
12	PR-88	38.9	74.8	44	1.334	14.16	S	19.58	6.82	22
13	V002495A	33.4	73	62	1.931	15.21	MS	35.35	10.89	33.5
14	Q.5-1	39.2	72.5	56	2.1	12.25	S	26.49	8.61	20.05
15	V-02192	31.8	76.1	60	1.33	11.46	S	21.44	7.48	22
16	PR-84	39.9	74.6	44	1.378	11.44	MS	27.83	8.91	22
17	Maria	27.3	67.15	42	1.362	11.65	MS	27.01	9.26	35
18	Inqilab-91	38.5	78.6	40	1.423	13.11	S	30.94	10.36	39
19	Malir	33.7	77.6	44	1.742	12.45	S	29.69	9.17	30
20	Local Check	-	-	-	-	-	-	-	-	-

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