GROWTH AND YIELD OF WHEAT VARIETIES UNDER THE AGRO-ECOLOGY OF DERA ISMAIL KHAN

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ABSTRACT

Response of thirty different wheat varieties was evaluated at the Agricultural Research Institute, Dera Ismail Khan, Khyber Pakhtunkhwa (KPK), Pakistan, during the year 2009-10. The data showed that the maximum number of tillers (435.0 411.7 and 400.0 m^{-2}) was recorded in variety Pirsabak-2008, Sassuai and Sarsabz, respectively. Variety Marvi-2000 showed the maximum spike length of 15.2cm followed by Sarsabz with 14.2cm long spike. The higher grain weight (42.3g) was noted in Seher-6 and Gomal-8 (41.9g each). Among varieties evaluated, Kiran-95 of Nuclear Institute of Agriculture, Tandojam and Fakhr-e-Sarhad released by Nuclear Institute for Food and Agriculture, Peshawar out yielded all other varieties by producing statistically similar grain yield of 4833 and 4750 kg ha^{-1}.

Keywords: *Wheat, Varieties, Growth, Yield*

INTRODUCTION

Cultivation of low genetic potential varieties is one of the factors which cause yield reduction in wheat (Nasim, Ahmad, Wajid, Hussain, Khaliq, Usman, Hammad, Sultana, Mubeen & Ahmad, 2010). Iqbal, Tabasum, Sayed & Hameed, (2009) noted a significant loss in genetic diversity in bread wheat during the change from traditional landraces (LVs) to modern cultivated varieties. Therefore, screening of varieties across the environments is imperative in measuring crop responses to local conditions, particularly heat tolerance, which is a major setback in wheat production (CIMMYT, 2001; Shah, Sahito, Tonio & Pirzado, 2009). Afiah, Mohamed, Omar & Hassan, (2002) also had the view to find out wheat varieties highly adapted to arid and semi-arid conditions and resistant to drought, salinity as well as rising heat stresses. A variety is considered to be more adaptive if it has high mean yield but low degree of fluctuation in yielding ability when

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grown over diverse environments (Ashraf, Qureshi & Khan, 2001). It has been noted that wheat varieties differ in grain yield and yield contributing factors due to differences in input requirements, varied genetic composition and prevailing local environmental conditions during the crop growth stages (Sharshar and Said, 2000; Ahmad, Niazi, Zaman & Akhtar, 2005; Alam, Nesa, Khan, Hussain & Hoque, 2007; Sugár and Berzsenyi, 2010).

Such comparative studies give growers a wide range of choice to make for high yielding and heat tolerant varieties of wheat in and around the study area (Uddin, Khan, Zubair, Khakwani, Baloch, Khan & Khan, 2005; Falaki, Miko, Mohammed, Abubakar & Valencia, 2009). As far as the cultivation of wheat is concerned, it is a major component of Pakistani diet and grown under both irrigated and rainfed conditions (Siddiqui, 2008). In Khyber Pakhtunkhwa, Saleem-2000, Pirsabak-04, Khyber-87, Bakhtawar-92, Fakhr-e-Sarhad, Uqab, Bhakkar and AS-2002 are reported to be dominant wheat varieties (Anonymous, 2008). Similarly in Southern Punjab, Bhakkar, AS-2002, Manthar are predominant in farmers' fields, however, new varieties like Fareed-06, Sehar-06 and Shafaq-06 are also grown on farmers' fields on small areas. In Central Punjab, Bhakkar and Uqab are the predominant varieties grown on larger area. Three newly released wheat varieties viz. Sehar-06, Shafaq-06 and Fareed-06 are also grown on small area.

In Sindh, wheat varieties viz. TD-1, TJ-83, Kiran, Sarsabz and Bhakkar are the predominant varieties. Other varieties including Bhittai, Marvi, Khirman, Anmol-05, Imdad-05, Sassui, Bhakkar, AS-2002, Abadgar-93 and Moomal are also grown on small area (Anonymous, 2008). These varieties have been developed through the coordinated efforts of the national scientists from all over Pakistan (PARC, 2004) which enhanced the wheat production due to their wider genetic base capable of producing better yield under various agro-climatic zones (Shah, Sahito, Tunio & Pirzado, 2009). Our results suggest that due to the inconsistent relationship of these characters, selection for the improvement of grain yield on the basis of these characters should not be exercised as a routine procedure. The present work was aimed at evaluating the performance of wheat varieties belonging to diverse genetic background under the agro-ecology of Dera Ismail Khan.

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MATERIALS AND METHODS

In order to determine response of wheat varieties on their relative rankings and stability under the local agro-ecology, an experiment was conducted at the Agricultural Research Institute, Dera Ismail Khan. Optimum seed rate of 100 kg ha^{-1} was used by man driven hand drill at spacing of 20cm. The experiment was laid out in a randomized complete block design with three replications using a sub-plot size of 1mx5m with 4 rows, 5 m long and 30 cm apart. Fertilizers were applied @ 150:120:90 kg NPK ha^{-1}. All phosphorous, potash and ½ of the nitrogen were applied at the time of sowing and remaining ½ nitrogen was top dressed with first irrigation. Weedicide Buctril Super was applied @ 750 ml ha^{-1} after first irrigation to control weeds. Textural class of the soil in the experimental site was silty clay, the pH = 7.78 and the organic matter content 0.88 %. Meteorological data during the crop growth stages are given in Table-1. The following thirty wheat varieties including two local checks were evaluated during the year 2009-10.

Varieties	**Source**
1. Dera-98 (Local check)	Agricultural Research Institute (ARI), Dera Ismail Khan
2. Gomal-8 (Local check)	-do-
3. Saleem-2000	Cereal Crops Research Institute (CCRI), Pirsabak
4. Pirsabak-2004	-do-
5. Pirsabak-2008	-do-
6. Khyber-87	-do-
7. Fakhr-e-Sarhad	Nuclear Institute for Food and Agri. (NIFA), Peshawar
8. Bakhtawar-92	-do-
9. Bathoor-2008	-do-
10. Bhakkar-2002	Arid Zone Research Institute, Bhakkar
11. TJ-83	Wheat Research Station, Tandojam
12. Mehran-89	-do-
13. Anmol-91	-do-
14. Abadgar-93	-do-
15. TD-1	-do-
16. Moomal-2002	-do-
17. SKD-1	-do-

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18. Imdad-2005	-do-
19. Jauhar-78	Nuclear Institute of Agriculture (NIA), Tandojam
20. Sindh-81	-do-
21. Sarsabz	-do-
22. Soghat-90	-do-
23. Kiran-95	-do-
24. Khirman	-do-
25. Marvi-2000	-do-
26. Bhittai	-do-
27. Sassuai	-do-
28. AS-2002	University of Agriculture, Faisalabad
29. Meraj-2006	-do-
30. Seher-6	-do-

The data were recorded on days to heading, plant height at maturity (cm), number of tillers (m^{-2}), spike length (cm), 1000-grain weight (g), grain yield (kg ha^{-1}) and analyzed statistically using analysis of variance techniques (Steel, Torrie & Dicky, 1997) and means were separated by least significance difference test using MSTATC software program (MSTATC, 1991).

RESULTS AND DISCUSSION

Days to heading

The data given in Table-2 revealed that variety Jauhar-78, Adgar-93 and Bhittai took 113.7 days each to heading. These varieties were, however, statistically at par with Bakhtawar-92 that took 113.3 days to heading. Pirsabak-2004 and Anmol-91 took 112.3 days to heading. Varieties Bathoor-2008, Sindh-81 and Sassuai took 112.0 days each to heading and were similar statistically. Similarly, Dera-98 took 111.7 days to heading, which was statistically similar to Pirsabak-2008 and Sarsabz with 111.3 days each to heading. The minimum 100.3 and 101.0 days were taken by the varieties Soghat-90 and AS-2002. (Rahman, Chikushi, Yoshida & Karim, (2009) reported that the number of days to heading of wheat varied significantly due to genotypic variations.

Plant height at maturity (cm)

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The data given in Table-2 showed that variety Abadgar-93 and Jauhar-78 produced statistically taller plants of 113.9 and 111.7cm followed by varieties Dera-98 with plant height of 106.1cm. Varieties Soghat-90, Fakhr-e-Sarhad and Khyber-87 produced statistically similar plant height. Similarly, Bathoor-2008, Sindh-81, SKD-1, Imdad-2005, Bhakkar-2002 and Meraj-2006 had similar plant height statistically. Short statured plants were found in varieties AS-2002, Bakhtawar-92, Pirsabak-2008, Saleem-2000 and TD-1, respectively. Out of the thirty varieties evaluated, only nine varieties gained height more than 100 cm. Differences in plant height among varieties might be attributed to their genetic diversity (Shahzad, Bakht, Shah, Shafi & Jabeen, 2002).

Number of tillers (m^{-2})

As mentioned in Table-2, the number of tillers m^{-2} was significantly affected by the varieties. The maximum 435.0, 411.7 and 400.0 tillers m^{-2} were recorded in variety Pirsabak-2008, Sassuai and Sarsabz, respectively. These varieties were followed by Dera-98 with 395.0 tillers m^{-2}. Varieties Khyber-87, Soghat-90, Imdad-2005, TJ-83 and Gomal-8 produced statistically similar 302.0, 297.0, 293.3, 290.3, and 289.3 tillers m^{-2}. Similarly, Moomal-2002, Sindh-81, Khirman and Seher-6 had similar 370.7, 366.0, 365.0 and 363.7 tillers m^{-2}. Saleem-2000, Mehran-89, Kiran-95, Anmol-91 and Bathoor-2008 produced statistically at par number of tillers 343.7, 342.3, 342.0, 336.7 and 334.0 m^{-2}. The minimum 231 tillers m^{-2} were noted in Marvi-2000. Previous findings suggest that the ability to producing tillers of wheat plant and their survival depends on genotype, agronomic and nutritional management practices, and also on environmental factors (Rahman, Chikushi, Yoshida & Karim, 2009).

Spike length (cm)

The data given in Table-3 showed the maximum spike length of 15.2cm in Marvi-2000, followed by Sarsabz with 14.2cm long spikes. These varieties were followed by Sassuai and Bhittai with 13.7 and 13.1cm spike length. Fakhr-e-Sarhad and Jauhar-78 produced spike length of 12.8cm. Similarly, Kiran-95 (12.4cm), Abadgar-93 and Moomal-2002 (12.3cm each) had statistically similar spike length. Most of the varieties had spike length ranging from 10-12cm. Variety Gomal-8 had shorter spike length of 9.8cm.

1000-grain weight (g)

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Wheat varieties had significant effect on grain weight (Table-3). The higher grain weight (42.3g) was noted in Seher-6 and Gomal-8 (41.9g). These varieties were followed by AS-2002 with 41.3g grain weight. Varieties Meraj-2006, Bhakkar-2002, Sassuai, Mehran-89 and Fakhr-e-Sarhad produced statistically similar grain weight of 39.6, 39.4, 39.2, 39.0 and 38.4g, respectively. Similarly, Dera-98 (37.5g), Kiran-95 (37.2g), Moomal-2002 (37.2g), Jauhar-78 (37.1g), TD-1 (37.0g), Khirman (36.8g), Imdad-2005 (36.6g), Khyber-87 (36.3g) and Pirsabak-2008 (36.1g) had statistically similar grain weight, respectively. Anmol-91 and Sindh-81 produced grain weight of 35.6 and 35.5g, respectively. All other varieties produced grain weight less than 35 gram. The lowest grain weight (31.6g) was noted in variety TJ-83. Individual grain weight which is considered as one of the major yield contributor is also significantly influenced by genotypes (Rahman, Chikushi, Yoshida & Karim, 2009).

Grain yield (kg ha^{-1})

The data mentioned in Table-3 indicated that Kiran-95 and Fakhr-e-Sarhad produced statistically similar grain yield of 4833 and 4750 kg ha^{-1}. These varieties were followed by Abadgar-83, Sassuai and Bhakkar-2002 with grain yield of 4717, 4700 and 4667 kg ha^{-1}. Varieties SKD-1 (4167 kg ha^{-1}), Sindh-81 (4100 kg ha^{-1}), Bakhtawar-92 (3933 kg ha^{-1}), Anmol-91 (3917 kg ha^{-1}), Imdad-2005 (3917 kg ha^{-1}), AS-2002 (3900 kg ha^{-1}) and Khyber-87 (3833 kg ha^{-1}) had statistically at par grain yield, respectively. Similarly, Moomal-2002 (4617 kg ha^{-1}), Mehran-89 and Seher-6 (4583 kg ha^{-1} each), Dera-98 (4550 kg ha^{-1}), Pirsabak-2008 (4500 kg ha^{-1}), Saleem-2000 and Sarsabz (4417 kg ha^{-1} each) and Meraj-2006 (4400 kg ha^{-1}) produced statistically similar grain yield. Bathoor-2008 and Soghat-90 had lower grain yield (3317 kg ha^{-1} each) as compared to other varieties tested. The minimum grain yield (3233 kg ha^{-1}) was, however, obtained in Pirsabak-2004. The difference in grain yield was probably due to variation in productivity potential of different wheat varieties (Abera, Tsadik, Feyissa, Yusuf & Kenini, 2005). Jamali, Arain, Naqvi, Soomro, Arain & Ali, (2007) obtained higher grain yield of wheat variety Kiran-95 on account of its early heading and higher number of grains per spike.

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Table 1. Average monthly and seasonal meteorological data during crop growth season.

Month	Temperature (^{0}C)		Relative Humidity		Rainfall (mm)
	Max	Min	0800 Hrs.	1400 Hrs.	
October	33	16	82	57	13
November	25	10	80	55	-
December	22	5	81	63	-
January	16	5	88	76	9.2
February	22	8	76	58	1.1
March	30	15	63	63	22
April	37	19	74	45	-

Table 2. Effect of different varieties on days to heading, plant height (cm) and number of tillers (m^{-2}) of wheat under irrigated conditions.

Varieties	Days to heading	Plant height (cm)	Number of tillers(m^{-2})
Dera-98	111.7 d	106.1 bc	395.0 abc
Gomal-8	107.0 ef	83.3 hi	289.3 d-h
Pirsabak-2004	112.3 bcd	90.5 g	262.3 gh
Pirsabak-2008	111.3 d	78.3 i	435.0 a
Saleem-2000	112.7 abc	78.3 i	343.7 b-g
Khyber-87	107.7 e	92.7 fg	302.0 d-h
Fakhr-e-Sarhad	105.0 ij	93.3 fg	376.7 a-e
Bakhtawar-92	113.3 ab	79.4 i	280.0 fgh
Bathoor-2008	112.0 cd	88.8 gh	334.0 b-g
Bhakkar-2002	105.7 g-j	88.3 gh	349.3 a-g
Jauhar-78	113.7 a	111.7 ab	378.3 a-d
Sindh-81	112.0 cd	88.8 gh	366.0 a-f
Sarsabz	111.3 d	103.3 cd	400.0 ab
Soghat-90	100.3 l	93.3 fg	297.0 d-h
Kiran-95	107.7 e	92.2 g	342.0 b-g
Khirman	105.7 g-j	102.8 cd	365.0 a-f
Marvi-2000	106.7 efg	92.2 g	231.0 h
Bhittai	113.7 a	102.8 cd	237.3 h

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Sassuai	112.0 cd	100.6 cde	411.7 ab
TJ-83	106.3 fg	90.1 g	290.3 d-h
Mehran-89	105.3 hij	104.4 cd	342.3 b-g
Anmol-91	112.3 bcd	99.0 def	336.7 b-g
Abadgar-93	113.7 a	113.9 a	350.7 a-g
TD-1	104.7 j	76.6 i	286.0 e-h
Moomal-2002	107.7 e	102.7 cd	370.7 a-f
SKD-1	107.0 ef	88.8 gh	380.3 a-d
Imdad-2005	106.0 f-i	88.3 gh	293.3 d-h
AS-2002	101.0 l	80.0 i	269.3 gh
Meraj-2006	103.0 k	87.7 gh	306.0 c-h
Seher-6	106.3 fgh	94.1 efg	363.7 a-f
$LSD_{0.05}$	**1.299**	**6.699**	**91.26**

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

Table 3. Effect of different varieties on spike length (cm), 1000-grain weight (g) and grain yield (kg ha^{-1}) of wheat under irrigated conditions.

Varieties	Spike length (cm)	1000-grain weight (g)	Grain yield (kg ha^{-1})
Dera-98	11.1 g-m	37.5 a-f	4550 a-e
Gomal-8	9.8 o	41.9 ab	3767 b-g
Pirsabak-2004	10.5 l-o	34.7 def	3233 g
Pirsabak-2008	10.3 l-o	36.1 a-f	4500 a-e
Saleem-2000	10.4 l-o	33.5 def	4417 a-e
Khyber-87	9.9 no	36.3 a-f	3833 a-g
Fakhr-e-Sarhad	12.8 cde	38.4 a-e	4750 ab
Bakhtawar-92	10.5 l-o	34.8 def	3933 a-g
Bathoor-2008	10.5 l-o	34.6 def	3317 fg
Bhakkar-2002	11.8 e-i	39.4 a-e	4667 a-d
Jauhar-78	12.8 cde	37.1 a-f	3717 c-g
Sindh-81	10.4 l-o	35.5 b-f	4100 a-g
Sarsabz	14.2 b	35.2 c-f	4417 a-e
Soghat-90	11.1 g-m	35.2 ef	3317 fg
Kiran-95	12.4 def	37.2 a-f	4833 a
Khirman	10.8 i-n	36.8 a-f	4317 a-f

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Marvi-2000	15.2 a	33.5 def	3633 efg
Bhittai	13.1 cd	33.8 def	3750 b-g
Sassuai	13.7 bc	39.2 a-e	4700 abc
TJ-83	10.6 k-o	31.6 f	3667 d-g
Mehran-89	12.1 d-h	39.0 a-e	4583 a-e
Anmol-91	11.7 f-j	35.6 b-f	3917 a-g
Abadgar-93	12.3 def	39.8 a-d	4717 abc
TD-1	11.1 h-m	37.0 a-f	3750 b-g
Moomal-2002	12.3 def	37.2 a-f	4617 a-e
SKD-1	11.2 g-l	33.4 def	4167 a-g
Imdad-2005	12.1 d-h	36.6 a-f	3917 a-g
AS-2002	10.2 mno	41.3 abc	3900 a-g
Meraj-2006	11.1 g-m	39.6 a-e	4400 a-e
Seher-6	10.7 j-o	42.3 a	4583 a-e
$LSD_{0.05}$	**1.006**	**6.523**	**1010**

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