Research Article
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Evaluation of wheat lines for yield and yield components under rain-fed conditions

Abstract

Field experiment entitled "Evaluation of wheat lines for yield and yield components under rain-fed conditions" was conducted in winter season 2015-2016 at Agriculture Research Farm of University of Haripur. Twenty wheat genotypes viz., advance line #1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and two check varieties viz., Pirsabak 2015, Aas-2011were evaluated in the field under rain-fed conditions under randomized complete block design using three replications. The data regarding number of productive tillers, plant height, days to 50% heading, spike length, number of grains spike-1, 1000 grain weight, biological yield and grain yield was recorded. The analysis of data revealed non-significant differences among the investigated wheat genotypes for plant height days to 50% heading. However, significant differences were found among the tested wheat genotypes for number of productive tillers, biological yield and grain yield. Over all line # 3, 7, 9 and 17 out yielded the local checks with regard to number of productive tillers, biological yield and grain yield. Therefore, potential exists among the investigated advance lines for their further evaluation in the field under rain-fed conditions for using them as breeding material for development of wheat cultivars for rain-fed areas of Pakistan.

Keywords: wheat genotypes, line, yield and yielding components

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Introduction

About 70% of the world's wheat is cultivated under rain-fed conditions[1] and cause significant reduction in yield.[2] The yield loss may reach up to 70% in different parts of the world. In Pakistan, wheat under rain-fed conditions is cultivated on more than 20% of the total wheat area mainly concentrated in Pothwar plateau where average farmer yield is about 1.5 t ha^{-1} which is 50% less than national average wheat yield. Wheat is the major staple food of Pakistan as well as of the world. The grain is directly or in directly used as human diet and its straw is used as an animal feed. In Pakistan, wheat was grown on 7m ha in irrigated areas with an average yield of 2566 kg ha^{-1} (MINFAL, 2004-05). Optimum temperature range for better wheat growth falls between 15° and 25°C. Low wheat yield under tropical rain-fed conditions is generally associated with low soil moisture at planting and high temperature stress at reproductive growth stages of the crop. Wheat is grown all over the world for its high nutritious value. It is ranked among the top three most produced cereal crops in the world, along with corn and rice. Wheat grain is consumed in several ways in a number of industrial and commercial products. It is also a cheaper source of feed for livestock and poultry.[3] About 93% of the food to feed the people of the world comes from plants, two-third of which is contributed by the cereals (wheat, maize, barley, sorghum, and millet). These cereals are the major source of calories and protein for the most of the world. About 80 % of the global cereal production comes from wheat, maize, and rice. Among the cereals, wheat is the largest. Of the two principal types of wheat, 90% of the world's wheat is bread wheat, which accounts for 94% of the production.

Wheat is a major cereal grown in Pakistan. The technical name of wheat is "*Triticum aestivum* L" it is a self pollinated (95%), long day plant belonging to the family "poaceae" having genus "triticum". It is a source of energy and proteins, 95% of the wheat grown today is of the hexaploid (2n=6×= 28) type used for pasta, macaronis and biscuits. Wheat production can be increased by development of high yielding wheat cultivars under different environmental conditions and selection for grain yield can be effective if sufficient genetic variation is present in the plant material. The grain yield is related to thousand grain weight and number of spikes per unit area. Moreover Dwivedi et al. found that number of tillers per plant exerted a substantial effect on grain yield, while Kumar et al. found high genetic advance for plant height, number of spikelet's per spike and thousand seed weight in wheat.

Wheat is grown under a wide range of environmental conditions in Pakistan and NWFP. Plant breeders aim to develop wheat cultivars that consistently have high yield in a variety of environments. Wheat cultivars are exposed to different soil types, soil fertility, moistures levels, temperatures and cultural practices. The adaptability of a variety is usually tested by the degree of its interaction with different environments. A variety or genotype is considered to be more adaptive or stable if it has a high mean yield with low degree of fluctuations in yielding ability grown over diverse climatic conditions the differentiate yield response of genotypes from one environment to another is called differentiate yield response of genotypes from one environment to another is called genotype x environment (GE) interaction. Some wheat cultivars are adapted to a broader range of environments while others have limited environmental adaption. The cultivars with consistence performance in different environments and locations are more stable in yield and others related of the economic importance.

Past research has shown that fluctuations in performance of the cultivars are due to plating time seeding rates, plant population $hectares^{-1}$, fertilizers rate, land preparation, weed management, water arrangement and mostly due to different environments. However, research should be conducted for development and improving the wheat cultivars for gaining more $yieldshectare^{-1}$, quality throughout

the world including Pakistan and especially in Khyber Pakhtunkhwa. Sustainable agricultural productivity might be achieved through a wise use of integrated nutrient management. It enhanced plant growth, water, and soil and land management. Integrated soil nutrient management increased the crop yield and insufficient amount of these nutrients. Integrated soil management has an implication on agricultural sustainability because it increases soil fertility and productivity. Farmyard manures have a high potential to boost up crop growth combined with chemical fertilizer.[4]

The current research study was under taken to fulfill the following objectives:

Objectives

a) To compare the performance of different wheat genotypes under rain-fed conditions of Haripur.

b) To find out the best wheat genotype based on yield and yield components.

Materials and Methods

Field experiment entitled "Evaluation of wheat lines for yield and yield components under rain-fed conditions" was conducted in winter season 2015-2016 at Agriculture Research Farm of University of Haripur. The seed of 20 wheat genotypes was obtained from Cereal Research Institute Nowshera Pirsabak.

Crop husbandry practices

Twenty wheat genotypes including two checks viz., Pirsabak 2015, Aas-2011, Entry#1, 2, 3,4,5, 6,7, 8,9,10, 11,12,13, 14,15,16,17 and 18 were sown on 20th November, 2015.Agriculture Farm of University, Pakistan using hand drill by seeding at 100kg ha^{-1}. The experiment was laid out in randomized complete block design and replicated thrice. The plot size is kept (1.5×1.8 m^2). A fertilizer doze of Nitrogen @ 120Kg ha^{-1} Nitrogen as Urea, 90Kg ha^{-1} P_2O_5 as DAP and 60 Kg ha^{-1} as potassium sulphate was applied at the time of sowing. Herbicide i.e. Buctril M (for broad leaf weeds) and Puma Super (for narrow leaf weeds) were used to control weeds in the research area.

Data recorded

Data on following parameters such as Plant height, days to 50% heading, length of spike, numbers of productive tillers, number of grains per spike, thousands grain weight, biological yield and grain yield which was recorded.

a) Days to 50% Heading: Days to 50% heading was recorded when approximately (50%) of heading occurred.

b) Plant Height (cm): At maturity Plant height of each lines or variety were recorded at 10 random places from each replication.

c) Length of Spike (cm): At maturity spike length of each lines or variety were measured at 10 random places from each replication.

d) Number of Productive Tillers m^{-2}: Number of productive tillers of each lines or variety was counted.

e) Number of Grains/Spike (g): Number of grains per spike of each lines or variety was counted at 10 random places from each variety.

f) 1000 Grains Weight (g): After threshing 1000 seeds of each variety were weighed with an electrical balance.

g) Biological Yield (kgha^{-1}): Each plot was harvested at the maturity and the whole bundle after sun drying for five days was weighed by a spring balance before threshing to measure the Biological yield.

h) Grain Yield (kgha^{-1}): After harvesting the wheat crop then the yield of each plot was threshed by hand then the obtained yield was weighted by electrical balance.

Statistical analysis

Replicated data was subjected to analysis of variance using Statistic 8.1. Means were compared using Tuckey HSD test at 0.05 probability level.

Results and discussion

Data collected for different morphological traits were analyzed using Statistic 8.1 computer software. The mean data are shown in Tables 1–4. And ANOVA Tables for each parameter is given after of the each parameter.

Table 1 Mean values of 50% heading and plant height (cm)

Entry	50% heading	Plant height (cm)
1	110.00 NS	85.833 NS
2	116	93.3
3	111.33	84.567
4	111	88.9
5	111.67	87.1
6	112.33	86.367
7	114	94.267
8	114.67	87.033
9	111	91.267
10	115.67	91.8
12	115	88.767
13	114	89.9
14	118.67	98.433
15	112.67	89.867
16	112.33	92.533
17	115.67	88.9
18	114	94.467
PS-2015 (local check)	112	86.233
Aas-2011 (local check)	112.67	92.033
LSD	10.193	15.292
CV (%)	2.91	5.5

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Table 2 Mean values for Length of Spike (cm) and Number of productive Tillers (m^2)

Entry	Spike length (cm)	Number of productive tillers(m^2)
1	10.367 NS	218.06 D
2	11.333	228.50 CD
3	11.833	234.56 BCD
4	11.1	256.06 ABC
5	11.2	250.17 ABC
6	12.633	254.72 ABC
7	10.233	261.33 AB
8	11.8	262.56 AB
9	11.8	267.50 A
10	12.833	264.05 AB
12	12.233	252.34 ABC
13	11.8	259.06 AB
14	10.367	237.89 ABCD
15	12.533	243.17 ABCD
16	13.633	246.78 ABCD
17	10.067	264.11 AB
18	12.567	256.33 ABC
PS-2015 (local check)	11.7	240.94 ABCD
Aas-2201 (local check)	11.967	257.44 ABC
LSD	11.91	3.86
CV (%)	4.295	29.817

Table 3 Mean values for no of grains/Spike(gm) and biological yield(kg/ha)

Entry	Grain per spike(gm)	Biological yield(kg/ha)
1	60.700 NS	13611 NS
2	58.7	12211
3	56.8	12282
4	55.167	12878
5	59.233	14072
6	58.6	12223
7	63.667	14556
8	62.433	13808
9	60.733	14834
10	62.867	15122
12	60.767	13889
13	59.933	14056
14	57.633	14474
15	54.867	12892
16	60	13463
17	59.067	14111
18	64.367	14285
PS-2015 (local check)	53.067	13041
Aas-2011 (local check)	56.933	13644
LSD	7.91	10.11
CV (%)	14.473	4263.7

Table 4 Mean values for 1000 Grains Weight(gm) and Grain Yield(kg/ha)

Entry No.	1000 grain weight(gm)	Grain yield(kg/ha)
1	42.667 NS	5077.8 ABC
2	42.667	4766.9 BC
3	40.333	4600.0 C
4	40.833	5211.1 ABC
5	40.167	5400.0 AB
6	42.667	4844.4 ABC
7	40	5566.7 A
8	38.667	5333.3 ABC
9	35	5544.4 AB
10	42.167	5100.0 ABC
12	41.167	4844.4 ABC
13	40	5122.2 ABC
14	46.333	4955.6 ABC
15	44.833	4855.6 ABC
16	41	5155.6 ABC
17	37.667	5600.0 A
18	39.667	5433.3 AB
PS-2015 (local check)	39.833	4813.3 ABC
Aas-2011 (local check)	42.333	5061.1 ABC
LSD	14.07	5.01
CV (%)	17.792	791.82

Days to 50 % heading

Statistical analysis of data showed significant differences for days to 50 % heading among wheat lines Table 1. The maximum days to 50 % heading were recorded in line 14(110 days) and the minimum number were recorded in line 1 (118days). As a result of comparison of lines showed that the performance of line 14 better than all over lines. It takes minimum time to reach 50 % heading. The differences in days to 50% heading among different wheat lines might be due to their different genetic makeup. In a similar research investigation in wheat with different genotypes Amin et al.,[5] obtained similar findings.

Plant height (cm)

Plant height was measured from soil surface to the base of the ear

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head of main shoot at maturity stage. The analysis of variance indicated that plant height varied significantly in different wheat lines. Among wheat lines, the maximum plant height (94.467cm) was recorded in line 18, and minimum plant height (84.567cm) was recorded in line 3. As a result of comparison of lines showed that the performance of line 18 better than all over lines. This indicates that line 18 proved to be the promising line of the future as regard to its height. These results are further supported by Yu[6] who reported considerable variation in the plant height of different wheat lines when planted under rain-fed conditions. Biological diversity was observed in different wheat lines under rain-fed conditions by Ozgen.[7] The result also confirm with Zubair et al.,[8] Chaudry et al.[9]

Spike length (cm)

The spike length was influenced significantly and different lines of wheat varied markedly for spike length. The spike length (12.633cm) in line 6. The lowest spike length (10.233cm) was recorded in line 7, these result are further supported by Voltas et al.,[10] who found that tillering capacity and spike length were genetically influenced by the breeding material for development of wheat lines developed in different rain-fed conditions. The results agree with Walton[11] Zubair et al.,[8] Khan & Bajwa[12] who reported the same results.

Number of productive tillers (m-2)

The result regarding productive tillers are presented in Table showed that all the varieties were significantly different for number of productive tillers per meter square. Analysis of the data revealed that higher productive tillers per meter square (267.50) were recorded in lines 9, while lower productive tiller per meter square (218.06) were recorded in line 1. The difference in productive tiller per m^2 might be due to differences in genetically make up, heavy rainfall and lodging. It was observed that line 9 was most promising wheat variety for cultivation under soil and climatic condition of Pakistan. These results are further supported by Piepho et al.[13] who were of the opinion that the tillers m^{-2} is generally associated with genetic makeup of the parental material of different wheat lines. These researches have also reported varied response of varieties for the number of tillers m^{-2} in wheat. The mean data of productive tillers m^{-2} is shown in Table 2.

Number of grains spike-1

The varietal effect on grains $spike^{-1}$ was significant and the results shown in Table 3 indicated that maximum grain $spike^{-1}$(64.367grains) was recorded in line 18. While the minimum grains (54.867) $spike^{-1}$ was recorded in line 15. It was observed that line 18 performed better than all over lines tested in the experiment. But the differences in the lines are non-significant, when compare to each other.

Biological yield (kg ha-1)

Biological yield of wheat lines were statistically found significantly different. Analysis of data revealed that maximum biological yield (15122) was recorded in line 10 and minimum biological yield was recorded (12211) in line 2. The results indicate that line 10 performed better. These results are in accordance with the findings reported by Dahleen et al. who reported varied quantities of total biomass for lines developed in the diversified region.

1000 grains weight (g)

Statistical analysis showed highly significant difference for 1000 grains weight among wheat lines shown in Table. 4. The maximum 1000 grains weight was found in line 14 (46.333gm), while the minimum 1000 grains weight was recorded in line 9(35.000gm). The result indicates that line 14 performed better in soil and climatic condition of Pakistan.

Grain yield (kg ha-1)

Statistical analysis indicates significant differences for grain yield among wheat lines. The results showed maximum grain yield in line 17(5600.0), followed by line 7(5566.7), line 9(5544.4) respectively. And the minimum grain yield (4600.0) was recorded in line 3. The result showed that the line 7 performed best in soil climatic condition of Pakistan. These results are agreement with those of Porfiri et al.[13] reported that the grain yield of wheat lines is mostly associated with the environmental conditions.[14–34]

Conclusion

It was concluded from the research investigation that line 3, 7, 9 and 17 showed best performance by producing highest number of productive tillers, number of grains $spike^{-1,}$ and hence highest grain yield kg ha^{-1} under rain-fed conditions.

Recommendations

These lines possess great genetic potential for further evaluation in the field under different locations for development of wheat cultivars under rain-fed environment.

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None.

Conflicts of interest

Author declares that there is no conflicts of interest.

References

1. Sinclair TR, Paulsen GM. Physiology and determination of crop yield. American Society of Agronomy, Madison, WI; 1994. p. 365–389.
2. Sohail M, Hussain I, Riaz-ud-din, et al. Effect of split N fertilizer application on physio-agronomic traits of wheat (Triticumaestivum L.) under rainfed conditions. *Pakistan J Agric Res*. 2013;26(2):71–78.
3. Byerlee D, Polanco EH. Wheat in the world food economy increasing role in developing countries. *Food Policy.* 1983;8:67–76.
4. Khan S, Khalil SK. Integrated use of organic and inorganic fertilizers in wheat and their residual effect on subsequent wheat bean. *Intl J Farm & Alli Sci*. 2014;3(8):835–844.
5. Amin M, Mohammad T, Khan AJ, et al. Yield stability of spring wheat (*Tritium aestivum* L.) in the North West frontier province Pakistan. *Smgklanakarin J Sci Technol*. 2005;27(6):1147–1150.
6. Yu Y. Sichuan wheat. Chengdu: Sichuan Sciences and Technology Press; 1998.
7. Ozgen M. Environment adaptation and stability relationship between grain yield and some agronomic traits in winter coat. *J Agron Crop Sci.* 1993;170:128–135.
8. Zubair M, Chaudhry AR, Khan & Bakhsh IA. Combining ability studies in bread wheat (*Triticum aestivum* L.). *Pak J Bot*. 1987;19(1):75-80.
9. Chaudhry MH, Subhani GM, Khan FA, et al. Combining ability for physiological and agronomic traits of wheat. *J Agri Res.* 1994;32(3):227–237.

10. Voltas, J, Lopez-Corcoles H, Borras G. Use ofbiplot analysis and factorial regression for the investigation of superior genotypes in multi-environment trails. *Eur J Agron*. 2005;22(3):309–324.
11. Walton PD. Heterosis in spring wheat. *Crop Sci.* 1971;11:422–424.
12. Khan NI, Bajwa MA, Salah-ud-Din S. Combining ability in a diallel cross of nine wheat varieties. *Pak J Agric Res*. 1990;12(1):1–6.
13. Porfiri O, Torricelli R, Silveri DD, et al. The Triticeae genetic resources of central Italy: Collection, evaluation and conservation. *Hereditas*. 2001;135(2–3):187–192.
14. Agriculture: Economic Survey of Pakistan 2006-07. Finance Ministry of Pakistan, Finance Division Economic Advisor's Wing, Islamabad; 2007.
15. Arain MA, Sial MA, Javed MS. Stability analysis of wheat genotypes tested in multi environment trails (METs) in Sindh province. *Pak J Bot*. 2001;33:761–165.
16. Ayaz A, Mujahid MY, Kisana NS, et al. Identification of Physiologically efficient genotypes in bread wheat. *Pak J Agric Res.* 1999;7(3):165–167.
17. Cotes JM, Crossa J, Sanches A, et al. A Bayesian approach for assessing the stability of genotypes. *Crop sci.* 2006;46(6):2654–2665.
18. Deswal Rk, Grakh SSS, Singh D, et al. Association of grain yield and it's contributing traits in wheat. *Crop Res Hisar.* 1997;13(3):609–613.
19. Dhanda SS, Sthi GS. Genetics and inter relationships of grain yield Related traits in bread wheat under irrigated and rain fed conditions. *Wheat Inform Serv*. 1996;83:19–27.
20. Donmez E, Sears RG, Schreyer JP, et al. Genetic gain in yield attribute of winter wheat in the Great Plains. *Crop sci*. 2001;41(5):1412–1419.
21. Ghanghro AS, Qureshi R, Baloca AW, et al. Yield Potential of exotic wheat genotypes under tando Jam conditions. *Pak J Bot.* 2010;33:637–640.
22. Hadajichristac Dovlou A. Breeding strategies for consistency of performance in Unstable environment. *P1breed Abs*. 1990;60:204.
23. Khalil IH, Aftab T shehzad, Subhan F. Genotype x location interaction for Yield and its associated traits in spring wheat. *sarhad J Agric.* 2005;21(1):29–32.
24. Krishna BRS, Sharma SP. Genetic variability in wheat under irrigated and moisture stress conditions crop res. *Hisar.* 1998;16(3):314–317.
25. Maric S, Beds M, Tartinae J, et al. Genetic variability of some winter Wheat traits from the breeding process. *Sjemenarstvo.* 1998;15(6):421–433.
26. Mohammad AIS. Promising durum wheat genotypes under normal and stress. Growing conditions in northern sundan. *Rachis.* 1999;18(2):64–68.
27. Rane JRK, Pannu VS, Sohu RS, et al. Performance of field and stability of advanced wheat genotypes under heat stress environments of the indo. Genetic plains. *Crop sci*. 2007;47:1561–1573.
28. Sarwar M, Ahmed N, Nabi G, et al. Effect of soil moisture stress on Different wheat varieties. *Pakistan J Agric Res.* 1991;12(4):275–280.
29. Shah SA, Muhammad T, Hassan A, et al. Genotype environment Interaction studies in wheat mutant lines. *The nucleus.* 1986;23(3–4):33–35.
30. Sharif AMA Tajammal, Hussain A. Genotype environment interaction and stability analysis of yield and grain characters in wheat. *Sci Technology & Development*. 1998;17(2):6–12.
31. Shen M, Sharma SK, luthra OP. Correlation of yield and yield associated traits in wheat. *Annals of boil*. 1997;13(1):37–40.
32. Sorkhi LB, Yazdi BS, Abd-Mishani C, et al. Study on the relationship between grain yield and quantities traits in 500 bread wheat lines using factor analysis. *Iranian J Agric Sci.* 1998;29(2):363–378.
33. Tanveer SK, Khan B, Kisana NS, et al. Comparison of Technology & varieties based on yield and yield components under rain fed conditions. *Sci technology & development*. 2002;21(4):35–37.
34. Trethowan RM, Van Ginkel M, Ammar K, et al. Associations among twenty years of international bread Wheat yield evaluation environments. *Crop sci.* 2003;43:1698–1711.

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