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Yield and Yield Component Parameters of Bread Wheat Genotypes as Affected by Sowing Dates

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Abstract: sowing date plays vital role in yield potential of wheat production. Varietal selections made by farmers also contribute to yield differences between farmers. Therefore, field experiments were conducted in split-plot design at Agriculture Research Station, College of Food and Agriculture Sciences, King Saud University, near Riyadh, during two growing winter seasons of 2008/2009 and 2009/2010. The investigation aimed to study the influences of genotypes, sowing dates and their interaction on grain yield and yield component characters of bread wheat. Two promising lines viz., KSU-105; KSU-106 and introduce C.V. Yecora Rojo, as well as two planting dates (November, 21 and December, 21) were selected. Detailed measurements in this study were crop development viz., main stem length, number of days to flowering, maturity and grain filling period. Yield component characters were also determined viz., number of spike/m^2, spike length (cm), biological yield, grain yield (ton/ha), 1000 kernels weight (g) and harvest index. Delayed sowing is associated with substantial losses in grain yield estimated by 7.98 % as compared with early sowing. KSU-106 surpassed the other two genotypes by 2.0 % and 11.3 %. The present study support the use of early sowing dates for obtaining maximum yield. However, the wheat yield can be raised significantly by cultivar selection.

Key words: Planting date · Varieties · Wheat (*Triticum aestivum* L.) · Genotypes x environment interaction · Yield components

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important food crop grown during the winter season. Much constraint limits wheat production. Variation in weather conditions among and within seasons is one of the most important constraints affecting yield potential [1,2]. Therefore, one of the requirements for obtaining high yield is the choice of the suitable sowing date and there are enough possibilities to increase wheat yields through developing new high yielding varieties and by adopting proper sowing date. Selecting sowing date in the different location depends upon temperature, rainfall pattern and the maturity period of the specific wheat variety [3]. Various researches concluded that, among favorable factors affecting growth, crop development and final grain yield is early sowing. Ahmad *et al.* [4] and Khan *et al.* [5] found that early planting increased dry matter production, leaf area, main shoot length, number of leaves and amount of nitrogen taken up by the crop. Whereas, late planting decreased the most of growth attributed characters [6]. Ibrahim [7] showed that delayed planting is often associated with substantial losses in grain yield estimated up to 86 % for short maturing varieties of 90 to 100 days. Iqbal *et al.* [8] also found yield reduction in grain wheat yield grown under Pakistan condition were 27 and 52 % when crop was sown on December 15 and 31, respectively as compared to 1st December sowing. Arain *et al.*[9,10], Sial *et al.* [1,11,12] suggested that sowing dates in terms of changed temperatures are critical for determining appropriate crop yields.

Concerning varietal differences previous studies clearly obvious that selecting varieties which have high tolerant to unfavorable conditions and use it by farmers may be a viable option for improving wheat yields. Ashour and Selim [13] concluded that relative tolerant wheat cultivars should be taken in consideration if successful yield have to be produced under arid condition of South Sinai Governorate. On field studied elsewhere, for example, in India, Ortiz-Monasterio *et al.* [14] reported

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that the three cultivars used in field experiment were differing in their response to sowing date. Fischer and Maurer [15] reported highly significant differences in yield contributing characters among cultivars. Murungu and Madanzi [2] concluded that yield potential of irrigated wheat varieties is highly dependant on temperature as affected by late sowing. Similarly, significant genotypes X environment interaction was also reported by many researchers. Nyamudeza and Mutema [16] reported significant interaction between sowing dates and variety on wheat yields. In another study, Arian *et al.* [10] and Sial *et al.* [1, 11, 12] reported that development stages of wheat were affected by genetic and environmental factors.

Overall objective, the present study was conducted to determine the optimize wheat yield under semi-arid environment of Saudi Arabia through appropriate planting date and cultivar selection.

MATERIALS AND METHODS

Plant Materials: Three wheat genotypes were used in this experiment, two promising lines selected from the wheat program of the plant production department, (KSU-106 and KSU-105) and common cultivar variety (Yecora Rojo) is imported from USA.

Field Experiment: The field experiment was conducted during the winter seasons of 2008/2009 and 2009/2010 at the Agricultural Research Station (24° 42' N latitude and 46° 44' E longitudes, Alt 600 m) near Riyadh, Saudi Arabia. The climate in this part of the country has been classified as arid environment with cold winter and hot summer. Mean, maximum and minimum temperature, maximum relative humidity and total amount of rainfall in mm. during 2008/2009 and 2009/2010 seasons, are shown in Table 1. Sample from 0-30 of soil layer of the experimental soil site was taken for chemical and physical analyses according to the methods described by Cottenie *et al.* [17] and But [18], results worthy clear that texture of soil site was sandy loam with pH in 1:2.5 soil water (8.15), EC (2.1 dS/m) in extracted soil paste (2:1)and $CaCO_3$ (29.9 %). Soil macronutrients N,P and K were 120.6,270.0 and 124.0 mg/Kg soil, respectively. The experiment was laid out in a split-plot design with four replications. The main plots consisted of two sowing dates, November, 21and December, 21. The genotypes were randomly assigned as sub-plots. The irrigation was applied by flood irrigation system through line pipes provided by meter gages for measuring water applied (50 mm). This amount of water was enough to bring soil to its field capacity in each irrigation. Seeds were sown in plots consisted of 10 rows 3.0 m in length and 20 cm apart (between rows). Seed rate of 140 kg/ha was used. The rate of 150 kg (P_2O_5) /ha as the form of superphosphate (16 % P_2O_5) broadcasting during soil preparation, where as recommended dose of N (200 kg N/ha) were applied in three split equal doses in the form of ammonium nitrate (33.3 % N) at sowing, during tillering and at anthesis. Potassium fertilizer, as the form of potassium sulphate (42 % K_2O) by the rate of 100 kg/ha K_2O were applied. The other cultural practices were carried out according to the conventional production practices followed in Riyadh area. During growth period at flowering stage, main stem length and number of days to flowering, maturity and grain filling were determined. At maturity, the inner four rows of each subplot unit were harvested to estimate grain yield ton per hectare and sub sample of one square meter was obtained for determining yield component characters viz., number of spike/m^2, spike length(cm),biological yield, 1000 kernels weight(g) and harvest index.

Table 1: Monthly temperature, relative humidity and total amount of rainfall, mm. in the period from November to April during 2008/2009 and 2009/2010 seasons

	Temperature (°C) Maximum		Minimum		Mean		Max Relative humidity %		Total amount of rainfall, mm	
Months	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010
November	25.86	29.23	12.71	14.03	19.29	21.63	74.97	61.49	1.27	0.00
December	21.10	22.95	8.60	9.44	14.85	16.19	78.10	79.64	3.20	4.31
January	19.70	23.65	6.20	6.24	12.90	14.94	72.60	63.42	0.00	0.00
February	23.80	27.98	9.70	10.56	16.80	19.27	69.50	51.57	0.00	0.00
March	30.16	31.69	15.27	12.79	22.71	22.24	42.41	43.07	0.00	1.27
April	34.03	34.77	18.01	20.07	26.02	27.42	54.00	53.65	3.30	4.06

Statistical Analysis: Data were statistically analyzed in each growing season for sowing dates, genotypes and sowing dates x genotype interaction using an analysis of variance procedure for split-plot design [19]. Since the data in both seasons took similar trends and variance were homogeneous according to Bartletts test, the combined analysis of the data of both seasons was done. Means of the treatments were compared by the Least Significant Differences Test (LSD), at (0.05) level of significance.

RESULTS AND DISCUSSION

Crop Development: Data presented in Table 2, appreciable improvement was observed in most of crop development characters viz., main stem height and number of days to 50% flowering, maturity except number of days for grain filling period associated with early sowing. Although, early sowing recorded lower value of grain filling period, the differences between two sowing dates was not statistically significant. Such effect ascribed that early sowing would have contributed favorably for enhance crop development characters. Whereas, late sowing date accompanying with lower values of most crop development characters except grain filling period, this may be due to, in the present study, to relatively lower temperatures detected early time during seed germination led to delay germination and flowering and finally affected in reducing growth period. This was true in the present study, sowing wheat at December, 21 reduced the number of days to flowering by eight days, maturity by seven days and grain filling period increased by two days as well as the reduction in main stem height was estimated by 7.42 cm. as compared with early sowing at November, 21. Similar findings were also reported by Khan *et al.* [5] and Iqbal *et al.* [8] stated that growing crops at different sowing dates pass through each developmental stage under different environmental conditions.

Concerning genotypic variation among the three genotypes, data manifested in Table 4, worthy demonstrated that the two genotypes KSU-106 and KSU-105 recorded nearly the same value for main stem height, number of days to 50% flowering, maturity and grain filling period, excelled Yecora Rojo genotype. Such effect was logic and expected due to both lines were selected under the same condition of the present study. These results are concur with those reported by Ishag[6] and Ishag and Mohamed [20] reported that different development stages of wheat were affected by genetic constituencies and environmental factors.

Table 2: Mean number of days to flowering, maturity period of grain filling, main and stem height for wheat varieties as affected by two planting dates. (Average two seasons)

	Number of days to			
Planting date	Flowering	Maturity	Grain filling	Main stem Height (cm)
November, 21	82.95	129.21	46.25	82.29
December, 21	74.50	122.50	48.00	74.87
LSD at 0.05 level	1.18	2.30	n.s	6.90

Table 3: Mean of some yield component characters for wheat varieties as affected by two planting dates. (Average two seasons)

Planting date	Spike length (cm)	No. Of spikes/m^2	Biological yield (ton/ha)	Grain yield (ton/ha)	Harvest Index	1000 kernels weight(g)
November, 21	11.54	779.17	16.66	6.09	0.366	39.47
December, 21	10.12	725.83	14.57	5.64	0.389	38.72
LSD at 0.05	0.88	ns	0.92	0.228	ns	ns

Table 4: Mean number of days to flowering, maturity and period of grain filling, main stem height and number of tillers/m^2 for wheat varieties as affected by varietal differences (Average two seasons)

	Number of days to			
Variety	Flowering	Maturity	Grain filling	Main stem height (cm)
KSU-105	81.56	126.62	45.06	84.46
KSU-106	81.43	126.37	44.93	84.37
Yecora Rojo	73.18	124.56	51.38	66.90
LSD at 0.05	0.86	0.84	1.15	3.13

Table 5: Mean of some yield component characters for wheat varieties as affected by varietal differences. (Average two seasons)

Variety	Spike length (cm)	No. of Spike/m^2	Biological yield (ton/ha)	Grain yield (ton/ha)	Harvest Index	1000 kernels weight(g)
KSU-105	11.27	820.00	15.95	5.99	0.377	40.950
KSU-106	10.61	732.50	16.31	6.11	0.375	38.870
Yecora Rojo	10.61	705.00	14.60	5.49	0.381	37.480
LSD at 0.05	0.59	84.92	1.06	0.34	n.s	1.917

Table 6: Mean number of days to flowering, grain filling as well as some yield component characters as affected by varieties x planting date interaction (Average two seasons)

		No. of days to			
Planting date	Variety	Flowering	Grain filling	No. of spikes/m^2	1000kernels weight(g)
November,21	KSU-105	86.12	44.13	822.50	40.25
	KSU-106	87.87	42.13	827.50	38.46
	Yecora Rojo	74.88	52.50	722.50	39.71
December,21	KSU-105	77.00	46.00	817.50	41.65
	KSU-106	75.00	47.75	637.50	39.29
	Yecora Rojo	71.50	50.25	687.50	35.25
LSD at 0.05 level	1.21	1.63	119.87	2.69	

As indicated in Table 6, genotype x environment interaction was statistically significant in number of days to flowering and for grain filling period. Showing that, all genotypes maintained higher values of number of days to flowering and lower value of grain filling period at early sowing date on November, 21. Such effect may be attributed to interaction effects between genetic constituencies and environment condition. Similar findings were reported by Ahmad *et al.* [4], Iqbal *et al.* [8], Arian *et al.* [10], Sial *et al.* [1, 11, 12] and Nyamudeza and Mutema [16].

Yield Component Characters: In general, yield component characters such as spike length, (cm); number of spike/m^2; biological yield (ton/ha) and1000 kernels weight, are highly correlated to the progressive in vegetative growth. As shown in Table 3, early sowing date excelled the late sowing date by registered higher value of yield component characters. Such effect was expected early since better effect in crop development characters was observed as the result of early sowing. These results evidently indicated that early sowing is favorable environment condition in turn favorably influenced the yield component characters. Similar results were earlier reported by Ishag [6], Ibrahim [7], Arain *et al.* [9, 10] and *Sial et al.* [1, 11, 12].

Taking genotypic variation into consideration, it was observed that most yield component characters were significantly influenced by the differences between genotypes. Both lines KSU-105 and KSU-106 behaved nearly the same effect and produced higher values of number of spike/m^2, spike length and weight of 1000 kernels (Table 5). Furthermore, KSU-106 ranked the first series and recorded the highest grain yield as compared to the other genotypes. In the same respect, data also clear that differences between Yecora Rojo and the local selected genotype KSU-105 were not statistically significant. Such effect was expected, since the same trend was observed in crop development characters (Table 2). This is in agreement with the findings of Ahmad *et al.* [4], Iqbal *et al.* [8] and Nyamudeza and Mutema [16] who reported that different in yield component characters can result from differences in the ability of cultivars to produce more values and sustain yield component characters.

Noticeably, from the data presented in Table 6, only significant differences due to the interaction between genotypes and sowing dates in spike number/m^2 and 1000 kernels weight. All genotypes appropriated higher value of both characters at early sowing date as compared with late sowing date. These findings were confirmed the results reported by Arian *et al.* [10] and Sial *et al.* [1, 11, 12].

Grain Yield and Harvest Index: Grain yield of wheat genotypes like many other crops greatly influenced by many factors. Results obtained in the present study, presented in Table 3 showed remarkable reduction in grain yield associated with late sowing as compared with the early sowing. Reduction in grain yield was estimated by 7.98 %, the phenomenon of grain yield depression due to late sowing may be attributed to the effect on delayed germination, decreasing number of days to 50 % flowering, maturity and increasing grain filling period. Considering the differences between the two sowing date, might be explained by the fact that agro-ecological conditions are critical for determining appropriate crop yield. This is in agreement with the findings of Arian *et al.* [10], Ashour and Selim [13] and Nyamudeza and Mutema [16]. The same trend was also observed in the value of harvest index. Late sowing date recorded the lower value. Such effect may be attribute to the decrement in biological yield by 17.33 % associated the late sowing. Similarly, the response of grain yield for different genotypes was varied (Table 5). KSU-106 excelled the other two genotypes and ranked the first series and recorded the highest grain yield (6.11 ton /ha), followed by KSU-105 produced (5.99 ton/ha).

Concerning the interaction, hence results reveal that significant differences were observed only in number of spike per square meter and 1000 kernels weight per gram. All varieties recorded the higher number of spike per square meter at early sowing date as compared with the late sowing, whereas, showed no defined trend. Only Yecora Rojo recorded the highest value of 1000 kernels weight at early sowing date and the other two genotypes excelled Yecora Rojo at late sowing date (Table 6).

CONCLUSION

The present study suggested that November, 21 is the most optimum time of sowing wheat as compared to sowing wheat after November. Furthermore, at late sowing farmers should first, expect lower yields from late sowing and second select varieties that perform well several sowing dates.

REFERENCES

1. Sial, M.A., M.A. Arian and M. Ahmad, 2000. Genotype x environment interaction on bread wheat grown over multiple sites and years in Pakistan. Pak. J. Bot., 32: 85-91.
2. Murungu, F.S. and T. Madanzi, 2010. Seed priming, genotype and sowing date effect on emergency, growth and yield of wheat in a tropical low altitude area of Zimbabwe. African J. Agric. Res., 5(17): 2341-2349.
3. Tanner, G.A., A. Gorfu and K. Zewde, 1991. Wheat Agronomy Research in Ethiopia, In: Wheat Research in Ethiopia, a Historical Perspective. Haila ciebre-Mariam, G.A. Tanner and Mengistu Hulluka (eds.) 73-94.Addis Ababa, LAR/CIMMYT.
4. Ahmad, J., M.H. Chaudhry, S. Din and M.A. Ali, 1996. Stability for grain yield in wheat. Pakistan J. Bot., 28: 61-66.
5. Khan, M.A., J. Anwar, A. Sattar and M.A. Akhtar, 2001. Effect of seed rate on wheat yield under different sowing dates and row spacing. J. Agric. Res., 39: 223-253.
6. Ishag, H.M., 1994. Genotype differences in heat stressed wheat in the irrigated Gezira Scheme. In: Wheat in Heat-Stressed Environments: Irrigated dry areas and wheat-Rice Farming Systems. Saunders, D.A. and G.H. Hottel (ed.). Proceedings of the International conference of Wheat in hot, dry irrigated Environments. Wad Medani; Sudan, 14 February, 1993, pp: 170-174.
7. Ibrahim, O.H., 1996. Effect of sowing time on wheat production. In: Wheat production and improvement in Sudan. Proceeding of the National Research Review Workshop, 27-30 August, Wad Medani, Sudan.
8. Iqbal, M.S., A. Yar, A. Ali, M.R. Anser, J. Iqbal and M.H. Akram, 2001. Effect of sowing dates and seed rate on grain yield of wheat (CV.93-BT-022). J. Agric. Res., 39: 217-238.
9. Arain, M.A., M. Ahmad and M.A. Rajput, 1999. Evaluation of wheat genotypes under varying environments induced through changing sowing dates. Proc. Symp. New Genetical Approaches to Crop Improvement-111.Nuclear Institute of Agriculture, Tando Jam, Pakistan, pp: 163-173.
10. Arain, M.A., M.A. Sial and M.A. Javed, 2001. Stability analysis of wheat genotypes tested in multi-environment trials (METs) in Sindh Province. Pak. J. Bot., 33: 761-765. (Special issue).
11. Sial, M.A., M.A. Arian, M.A. Javed and M.A. Rajput, 2001. Genotype-environment interaction for grain yield in bread wheat. Proceeding of Pakistan Academy of Plant Sciences, 38(1): 41-46.
12. Sial, M.A., M.A. Arian, S.K. Mazhar, H. Naqvi, M.U. Dahot and N.A. Nizamani, 2005. Yield and quality parameters of wheat genotypes as affected by sowing dates and high temperature stress. Pak. J. Bot., 37(3): 575-584.
13. Ashour, N.I. and M.M. Selim, 1994. Growth and yield response of some wheat cultivars to saline conditions in South Sinai Governorate. Egypt. J. Agron., 19(1-2): 139-148.

14. Ortiz-Monasterio, J.I.R., S.S. Dhillon and R.A. Fischer, 2004. Date of sowing effect on grain yield and yield components of irrigated spring wheat cultivars and relationships with radiation and temperature in Ludhiana, India. Field Crop Research, 37(3): 169-184.
15. Fischer, R.A. and R. Maurer, 2008. Drought resistance in spring wheat cultivars.1.Grain yield responses. Australian J. Agric. Res., 29(5): 897-912.
16. Nyamudeza, P. and Z. Mutema, 2002. Wheat sowing date trials. Lowveld Research Station Review and Planning Workshop. 22 August 2002. Chiredzi Research Station, P.O. Box 97, Chiredzi, Zimbabwe.
17. Cottenie, A., M. Verlo, L. Kjekens and R. Camerlynch, 1982. Chemical Analysis of Plant and Soil. Laboratory of Analytical Agro-chemistry. State Univ. Gent, Belgium, 42: 280-284.
18. But, R., 2004. Soil Survey laboratory Manual Report No.42 USDA, National Resources Conservation Service, Washington.
19. Gomez, K.A. and A. Gomez, 1984. Statistical Procedure for Agricultural Research. Hand Book John Wiley and Sons, New York.
20. Ishag, H.M. and B.A. Mohamed, 1995. Phasic development of spring wheat and its contribution to yield. J. Agric. Sci. Cambridge, 83: 117-140.