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Effect of Sowing Dates and Cultivars on Seed Yield of Wheat (*Triticum Aestivum* L.) in New Halfa Eastern Sudan

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Abstract: *A field experiment was conducted for two consecutive seasons during 2011/2012 and 2012/2013 at Research Station Farm, New Halfa, to investigate the effect of five sowing dates and three cultivars of wheat (Triticum aestivum L.) on yield and some of its related traits. The experiment consisted of fives sowing dates: 15th October, 30th October, 15th November, 30th November and 15th December, and three wheat cultivars: Condor (early mature), Nebta (medium mature) and Debeira (late mature). Split-plot design with three replications was used to arrange the treatments. The results showed that the early or delayed sowing dates significantly and negatively reduced yield attributes. Early sowing date (15th October) or delayed sowing (15th December) substantially reduced grain yield compare with the optimum sowing dates (mid and late of November). Cultivars showed non-significant effect in the grain yield per hectare. nevertheless, Debeira cultivar showed consistency and best performance in the studied sowing dates and it was stable in most of traits except maturity (it delayed in maturity) followed by Condor and Nebta cultivars.*

Keywords: *heat stress, photoperiod, critical stage, food crop*

1. INTRODUCTION

Wheat (*Triticum aestivum* L.), is one of the major food crops in the world. It is a cool–season, annual, monocot and C3 plant. Wheat belongs to the family Graminae which is common to temperate and savanna zones [1]. The crop is a winter crop with erect growth habit. It is grown from temperate, irrigated to dry and high – rain fall areas and from warm, humid to dry, cold environments [2].

During the last three production seasons (2010-2013), the average world wheat areas were about 224.7 million hectares producing 689.1 million metric tonnes with average yields estimated at 3.08 tonnes per hectare [3]. This explains the urgent need to raise yield by cultivation of high yielding and adapted varieties in low yielding wheat areas as well as improving cultural practices. Wheat cultivation in Sudan traces back to an era B.C., but until the 1940,s the production was confined to the Northern State whose inhabitants are traditionally wheat consumers. The scarcity of land and high cost of production in the Northern State, coupled with increasing demand for wheat consumption, led to the expansion of wheat growing area southward to irrigated schemes in central and eastern Sudan [4]. The crop in Sudan is grown under irrigation, during the short dry and comparatively cool winter season that extends from November to March [5]. The climatic conditions of the Sudan in the area devoted for wheat production is characterized by high temperatures during the short growing season [6].

Among different factors, drought (heat or water stress) emerges as a serious threat to increased productivity of wheat for farmers in New Halfa scheme for the past few years. Therefore, the best option for wheat yield improvement and yield stability under heat stress condition is to use the best variety or varieties adapted to the area and the best sowing date so that the critical stage of wheat development escape heat stress.

The current study carried out to evaluate the performance of five sowing dates and three wheat cultivars under New Halfa environment

2. MATERIALS AND METHODS

A field experiment was conducted for two consecutive seasons(2011/012 and 2012/013), at Research Station Farm in New Halfa, Sudan (Latitude 15° 19' N. Longitude 35° 36' E and Altitude 450 m above sea level) and Research Station Farm in New Halfa. The soil of the experimental site belongs to khashm ElGirba Series, classified as sodic Haplusters, very fine smectitic, isohyperthermic with a clay percentage around 60% and pH in the range of 4.8 to 8.8 [7]. The climate of the locality is semi-arid (rainy season during June to September) with mean day temperature around 23°C and 15.7°C during summer and winter, respectively. The monthly mean temperature, relative humidity, solar radiation, and wind speed during the experimental period were obtained from New Halfa Metrological Station. The experimental sites were ploughed in July and September using wide level disc, harrowed and ridged. The cultivars were sown on ridges with 80cm apart. Seeds were sown manually at a rate of 120kg/ha. The split plot experiment arranged in randomized complete block design was used with three replications at each of the two locations with sowing dates as main plot factor.

The gross plot size was 4x3.75 m^2. Five sowing dates were used these were: 15th and 30th October, 15th and 30th November and 15th December. Two to three times hand weeding were used by traditional tools as Torya and hand picking. Plants were irrigated every 14 days. Nitrogen fertilizer in the form of urea (46% nitrogen) was applied at sowing at a rate of 84kg/ha. Harvesting was carried out when the ears became yellow in color**.**

The following data were obtained from 10 plants, randomly selected from one meter square of the inner two rows of each plot: Number of spikes per plant, main stem spike length (cm), number of grains per spike, number of grains per plant, 1000-grain weight (g), grain yield per plant (g), grain yield per unit area (t/ha): Determined according to the following formula:

$$\text{Grain yield(kg/ha)} = \frac{\text{grain weight(kg/plot)}}{\text{plot area(m2)}} \times 1000$$

2.1. Statistical Analysis

All data were statistically analyzed according to the procedure described by Gomez and Gomez [8]. Using Mstat-C computer software package [9]. Analysis of variance of all studied traits were determined. Mean comparison were worked out by Duncan's Multiple Range test (DMRT) at 5% probability level.

3. RESULTS AND DISCUSSION

In spike length significant differences were reported among the varieties in the two seasons and for the interaction in season two. No significant differences were found among the sowing dates in the two seasons (Table1).

Table1. *Mean spike length in cm for the three wheat (Triticum aestivum) cultivars grown at five sowing dates at Research Farm, New Halfa in winter season 2011/2012 and 2012/2013*

Season 2011/2012						
Sowing date Cultivar	15th October	30th October	15th November	30th November	15th December	means
Condor	5.7	5.9	5.4	5.6	5.8	5.7c
Nebta	7.6	7.1	6.9	6.6	7.4	7.1b
Debeira	8.4	9.1	8.9	8.7	8.6	8.8a
Means	7.2	7.4	7.1	7.0	7.3	7.2
SE for SD	± 0.24					
SE for C	± 0.16					
SE for SD × C	± 0.26					
	Season 2012/2013					
Condor	5.9f	5.5g	6.0fg	6.6ef	6.1fg	6.0c
Nebta	7.2de	7.4de	7.4de	7.7cd	7.4de	7.4b
Debeira	8.5bc	8.9ab	9.5a	8.4bc	7.8cd	8.6a

Means	7.2	7.3	7.6	7.6	7.1	7.4
SE for SD	+ 0.20					
SE for C	+ 0.11					
SE for SD × C	+ 0.27					

Values within the row having different letters are significantly different. Italic and normal letters denote for cultivars and interaction, respectively using Duncan Multiple Range Test at 5% level of probability.

The non-significant differences in spike length, which were observed in this study, indicated that both different sowing dates and different varieties had no significant effect on spike length**.** Non significant differences among sowing dates were reported in number of grains per spike. Nebta and Condor cultivars in the two seasons recorded the highest and the lowest number of grains per spike, respectively (Table2).

Table2. *Mean number of grains/spike for the three wheat (Triticum aestivum) cultivars grown at five sowing dates at Research Farm, New Halfa in winter season 2011/2012 and 2012/2013*

Season 2011/2012						
Sowing date Cultivar	15th October	30th October	15th November	30th November	15th December	means
Condor	29.7	26.1	25.4	26.7	29.6	27.5*b*
Nebta	36.6	38.9	36.8	33.7	36.5	36.5*a*
Debeira	28.3	33.0	33.8	30.8	32.1	31.6*ab*
Means	31.5 ns	32.7 ns	32.0 ns	30.4 ns	32.7 ns	31.9
SE for SD	± 1.21					
SE for C	± 1.32					
SE for SD × C	± 2.60					
	Season 2012/2013					
Condor	25.0	22.1	26.1	28.5	25.1	25.4*c*
Nebta	36.5	35.7	31.6	37.0	32.3	34.6*a*
Debeira	28.0	31.1	33.2	29.7	23.9	29.2*b*
Means	29.8 ns	29.6 ns	30.3 ns	31.7 ns	27.1 ns	29.7
SE for SD	± 1.67					
SE for C	± 0.74					
SE for SD × C	± 2.52					

Values within the row having different letters are significantly different. Italic and normal letters denote for cultivars and interaction, respectively using Duncan Multiple Range Test at 5% level of probability.

Significant differences among sowing dates and among cultivars were observed in number of grains per plant, 1000seed weight, yield per plant and in grain yield kg/ha (Tables3,4,5 and6). The highest number of grains per plant which were obtained by the third sowing dates (15th November) could be caused by the highest number of productive tillers per plant. This results in line with Gorashi [10]. Sowing dates exert significant effect on 1000-seed weight in this study. Early sowing recorded the highest value of 1000-seed weight compared with late sowing dates. Similar observations were reported by many researches: Haj et al. [11], Gorashi [10], Ishag and Ageeb [12], Ishag [13], Ibrahim [14] and Sial et al. [15, 16, 17]. Cultivars revealed significant effect in 1000-seed weight. In this study, sowing dates showed significant effect in grain yields kg/ha but its effect is not consistent (the third sowing date (15th November) recorded the highest yield, followed by the forth sowing date (30th November) while the lowest one was produced by the later sowing date. No reason could explain this result other than inconsistent trend of temperature among the periods of sowing dates. This result is similar with that obtained by Haj et al. [11], Gorashi [10], Ishag and Ageeb [12] and Refay [18]. Cultivars revealed also significant effect on seed yield. Condor recorded the highest yield while Diebera recorded the lowest yield. This results agreed with that reported by Gorashi [10] , Ishag and Ageeb [12] and Refay [18].

Table3. *Mean number of grains/plant for the three wheat (Triticum aestivum) cultivars grown at five sowing dates at Research Farm, New Halfa in winter season 2011/2012 and 2012/2013*

Season 2011/2012						
Sowing date Cultivar	15th October	30th October	15th November	30th November	15th December	means

Condor	75.3g	91.5ab	77.8fg	93.8a	82.5de	84.2*b*
Nebta	80.0cd	89.1bc	89.4bc	90.6ab	94.8a	89.8*a*
Debeira	67.8h	89.4bc	85.1cd	76.4fg	79.7ef	79.7*c*
Means	76.0d	90.0a	84.1c	87.0b	85.7bc	84.6
SE for SD	± 0.70					
SE for C	± 0.23					
SE for SD × C	± 1.34					
	Season 2012/2013					
Condor	47.1fg	43.9gh	45.9gh	48.5efg	46.6fgh	46.4*c*
Nebta	62.4ab	60.1b	47.4efg	65.2a	58.4bc	58.7*a*
Debeira	41.9hi	54.7cd	52.3de	51.2def	37.6i	47.5*b*
Means	50.4**bc**	52.9**ab**	48.5**c**	55.0**a**	47.5**c**	50.9
SE for SD	± 0.91					
SE for C	± 0.21					
SE for SD × C	± 1.54					

Values within the row having different letters are significantly different. Italic and normal letters denote for cultivars and interaction, respectively using Duncan Multiple Range Test at 5% level of probability.

Table4. *Mean 1000 grain weight (g) for the three wheat (Triticum aestivum) cultivars grown at five sowing dates at Research Farm, New Halfa in winter season 2011/2012 and 2012/2013*

Season 2011/2012						
Sowing date Cultivar	15th October	30th October	15th November	30th November	15th December	means
Condor	35.1a	35.1a	35.4a	35.4a	30.2b	34.2*a*
Nebta	30.1b	31.4b	33.1ab	26.0c	29.6b	30.0*b*
Debeira	36.5a	36.9a	35.2a	29.4b	35.7a	34.7*a*
Means	33.9**a**	34.5**a**	34.6**a**	30.3**b**	31.9**ab**	33.0
SE for SD	± 0.96					
SE for C	± 0.91					
SE for SD × C	± 1.13					
	Season 2012/2013					
Condor	32.7ab	35.2a	30.4bc	28.1c	27.8c	30.8 ns
Nebta	30.5bc	29.9bc	28.6c	23.3d	27.9c	28.2 ns
Debeira	30.4bc	29.5bc	29.5bc	21.8d	30.8bc	28.4 ns
Means	31.2**a**	31.5**a**	29.5**a**	24.4**b**	29.2**a**	29.2
SE for SD	± 0.85					
SE for C	± 0.66					
SE for SD × C	± 1.06					

Values within the row having different letters are significantly different. Italic and normal letters denote for cultivars and interaction, respectively using Duncan Multiple Range Test at 5% level of probability

Table5. *Mean yield/plant (g) for the three wheat (Triticum aestivum) cultivars grown at five sowing dates at Research Farm, New Halfa in winter season 2012/2013*

Season 2011/2012						
Sowing date Cultivar	15th October	30th October	15th November	30th November	15th December	means
Condor	25.1f	34.9ab	27.9cdef	35.1a	25.2f	29.7*a*
Nebta	18.7g	26.0ef	30.1cde	26.3def	28.0cdef	25.8*b*
Debeira	24.6f	32.4abc	31.0abcd	28.1cdef	30.4bcde	29.3*a*
Means	22.8c	31.1a	29.7ab	29.8ab	27.9b	28.2
SE for SD	± 0.71					
SE for C	± 0.58					
SE for SD × C	± 1.41					
	Season 2012/2013					
Condor	16.9	14.7	17.4	13.6	13.9	15.3*ab*
Nebta	18.8	17.9	17.0	15.7	14.4	16.7*a*
Debeira	14.9	16.2	16.6	11.0	10.5	13.8*b*
Means	16.9a	16.3ab	17.0a	13.5bc	12.9c	15.3

SE for SD	± 0.98	
SE for C	± 0.55	
SE for SD × C	± 1.34	

Values within the row having different letters are significantly different. Italic and normal letters denote for cultivars and interaction, respectively using Duncan Multiple Range Test at 5% level of probability

Table6. *Mean grain yield(kg/ha) for the three wheat (Triticum aestivum) cultivars grown at five sowing dates at Research Farm, New Halfa in winter season 2011/2012 and 2012/2013*

Season 2011/2012						
Sowing date Cultivar	15th October	30th October	15th November	30th November	15th December	means
Condor	1220.4	2437.6	2893.9	2537.0	2201.0	2258.0 ns
Nebta	1632.0	2265.5	2883.6	2343.7	2176.7	2260.3 ns
Debeira	1880.7	2595.3	3041.3	2316.7	2000.0	2366.8 ns
Means	1577.7d	2432.8b	2939.6a	2399.1b	2125.9c	2295.0
SE for SD	± 48.5					
SE for C	± 44.4					
SE for SD × C	± 78.9					
	Season 2012/2013					
Condor	2264.7de	2600.0b	3139.4a	1946.7f	1913.3f	2372.8*a*
Nebta	2133.3e	2245.6de	2713.9b	2400.9cd	2543.3bc	2407.4*a*
Debeira	1202.8i	1443.0h	2604.4b	1633.4g	1160.7i	1608.9*b*
Means	1866.9c	2096.2b	2819.2a	1993.7b	1872.4c	2129.0
SE for SD	± 32.2					
SE for C	± 37.3					
SE for SD × C	± 56.0					

Values within the row having different letters are significantly different. Italic and normal letters denote for cultivars and interaction, respectively using Duncan Multiple Range Test at 5% level of probability

4. CONCLUSION

The optimum sowing date in New Halfa arranges 15th-30th November to avoid the effect of high temperature in critical stages. Debeira and Condor cultivar which gave best seed yield are suitable for this area.

REFERENCES

[1] Wall,G.W.;Garcia,R.L.;Kimball,B.A.;Hunsaker,D.J.;Printer,P.J.;Long,P.;Osborne,C.P.;Hendrix,D.L.;Wechsung,F.;Wechsung,G.;Leavitt,S.W.;LaMorte,R.L. and Idso,B.(2006). Interactive Effects of Elevated Carbon Dioxide and Drought on Wheat. Agron J 98:354-38.

[2] Acevedo,E.;Silva,H. and Silva.P.(1998).Effects of heat stress on wheat and possible selection tools for use in breeding for tolerance. In D.A Saunders,ed. Wheat for nontraditional warm areas. P 401-421.Mexico,DF, CIMMYT.

[3] FAO(Economic Co-operation and Development) OECD (2013). Agricultural Outlook 2013-2022 High lights; Feeding China: Prospects and Challenges in the next decade FAO, Rome, Italy Pp.70-74.

[4] Ageeb,O.A.A. (1993). Agronomic aspect of wheat production in Sudan, Wheat in Heat-Stressed Environments: Irrigated, Dry Areas and Rice-Wheat Farming Systems. In pages 67-74.Proceeding of International Conferences, Wheat in hot, Dry, Irrigated Environments, Wad Medani, Sudan 1-4 Feb. 1993.

[5] Ali,Z.I.;Dawelbeit,S.E and Salih,A.A.(1997). Effect of water stress and nitrogen application on grain yield of wheat. Gezira Research Station, Agricultural Research Corporation, Wad Medani, Sudan.

[6] El-ahmadi,A.B.(1993).Development of Wheat Germplasm Tolerant to Heat Stress in Sudan, Wheat in Heat-Stressed Environments: Irrigated, Dry Areas and Rice-Wheat Farming Systems. Proceeding of International Conferences, Wheat in hot, Dry, Irrigated Environments, Wad Medani, Sudan 1-4 Feb. 1993.

[7] Ali,Z.A (2001). The effect of three organic manures on the properties of Khashm Elgirba Soil Series and yield of wheat. Ph.D Thesis, University of Gezira, Sudan.

[8] Gomez,K. and Gomez, A.A.(1984). Statistical procedures for agricultural research, 4th. Ed. John Wiley and Sons. Inc. New York.

[9] Nelsen.G(1992). Microsoft Program for Design, Management and Analysis of Agronomy Research Experiment. Michigan State University. USA.

[10] Gorashi,A.M.(1989). The Response of 3 Cultivars of Wheat to 5 Sowing Dates at New Halfa (season 1988/1989). Annual National Wheat Coordination Meeting. 4-7 September, 1989. Agricultural Research Corporation Wad Medani, Sudan 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] Haj, Hussien M., Mohamed. Habiballa A., Eltayeb, and Eltohami I. (1990). Effects of Sowing Date and Irrigation Interval on Growth and Yield of Wheat (Triticum aestivum L.) and its Thermal Time Requirements under New Halfa Environment.

[12] Ishag, H.M., and O.A.A.Ageeb. 1991. The physiology of grain yield in wheat in an irrigated tropical environment. Experimental Agriculture 27:71-77.

[13] Ishag, H.M., 1994.Genotype differences in heat stressed wheat in the irrigated Gezira Scheme. In: Wheat Heat –Stressed Environments: Irrigated dry areas and Wheat-Rice Farming Systems Saunders, D.A. and G.H. Hotel (ed.). Proceeding of the International Conference of Wheat in hot, dry irrigated Environments. Wad Medani, Sudan, 14 February, 1993, pp: 170-174.

[14] Ibrahim, O.H., 1996.Effect of sowing time on wheat production. In: Wheat production and improvement in Sudan. Proceeding of the Natural Research Review Workshop, 27-30 August, Wad Medani, Sudan.

[15] 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.

[16] 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.

[17] 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.

[18] Refay, Y.A.2010. Yield and yield component parameters of bread wheat genotypes as affected by sowing dates. Plant production Department, College of Food and Agricultural Sciences, King S and University, P.O.Box 2460, Riyadh 11451, Saudi Arabia-Middle-East Journal of Scientific Research 7(4):484-489, 2011.ISSN 1990-9233-IDOSI Publications, 2011.

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