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Arab Univ.
J. Agric. Sci.,
Ain Shams Univ.,
Cairo, 22(1), 77-83, 2014

INTERPRETATION OF THREE WHEAT CULTIVARS YIELD AND ITS COMPONENTS WITH REFERENCE TO SOWING DATES

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Keywords: Wheat cultivar, *Triticum aestivum*, Yield and yield components of wheat

ABSTRACT

Two field experiments were carried out in Agric. Expt. Farm at Shalakan, Kaleobia Governorate, Cairo, Egypt during 2010/2011 and 2011/2012 growing seasons to study the response of some bread wheat cultivars to sowing dates. Each experiment included 15 treatments which were the combination between three wheat cultivars (Giza 168, Sakha 93 and Gemmiza 9) and five sowing dates (1st October, 16th October, 1st November, 16th November and 1st December). The experimental design used was split plot design in 6 replications. The data revealed that sowing dates and cultivars both significantly affected wheat yield and its components. Sowing on 1st November exhibited significant maximum plant height, number of spike/m^2, main spike length and weight, grains number of main spike as well as grain, straw and biological yields as compared to early or late sowing in the season. Concerning wheat cultivars, Gemmiza 9 gave significantly highest yield and its components in comparison to Sakha 93 and Giza 168. The effect of the interaction between wheat cultivars and sowing dates were significantly differed in plant height, main spike length and weight, grain weight/spike as well as grain, straw and biological yields as well as GCPY. Gemmiza 9 exhibited the significant highest parameters when sown on 1st November as compared to the other studied two cultivars. The data revealed that sowing Gemmiza 9 wheat cultivar on 1st November was the most suitable environmental conditions for growing wheat in Kaluobia Governorate.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the stable food crop in Egypt. The wheat production occupies a central position in forming agricultural policies and dominates all crops in acreage and production. Wheat is grown in Egypt on an area of 2.92 million feddan with an annual production of about 7.8 million tones and with an average yield of 2.65 tons per feddan during the year 2009-2010 growing season (**CLAC, 2011).**

Increase concentrations of greenhouse gases will result in a continuous increase in earth's temperatures and this increase could significantly affect wheat plant life and productivity. The yield levels of wheat are relatively not high, possibly due to their greater susceptibility to heat stress, particularly when the plants are exposed to high temperatures coincide spikes development at booting and heading stages. The change of environment temperatures during phenological stages of wheat growth are mainly attributes to environmental changes in sowing date. Sowing wheat in the optimum date yielded maximum grains No/spike, plant height, 1000-grain weight, grain and straw yields/ha **(Qasim *et al* 2008). Ansari (2002) and Ali *et al* (2010a and b)**. They concluded that average grain yield per plant was declined as delaying sowing date. The number of tillers per plant, grains per spike and 1000-grain weight also tended to decline as sowing was delayed. They attributed the reduction in wheat yield accured when temperature higher than 30°C coincided at initial stages of ear development. Generally hot environment limited the duration of all developmental stages. **Tao and Wei-Xing (2005)** added that grain yield of wheat is influenced by variation in genotypes, environmental factors, management practices and their interactions.

Soliman (2006) indicaed significant gradual decrease in plant height, spike length and grains No/spike, from the early and late sowing. Sowing date significantly affected 1000-grain weight and grain yield. The maximum grain yield was obtained when crop was sown on optimum date comparing with late and/or early sowing **(Tahir *et al* 2009)**.

(Received December 9, 2013)
(Accepted February 24, 2014)

The effect of late sowing exposed the plants to high temperature in the later part of the growth cycle especially at grain filling period lading to short duration and reduce grains number/spike, grain weight and ultimately reduced grain, straw and biological yields and grain quality (**Irfaq *et al* 2005**).

Appropriate sowing time of various field crops results in higher economic yield without involving extra cost as it helps varieties to express their full growth potential. Sowing time of wheat crop plays a pivotal role in a country, where climatic conditions vary throughout the country and affected wheat grain yield (**Ansari, 2002**). **Akhtar *et al* (2006)** concluded that, regardless of cultivars, better grain yield in optimum sowing than early or late sowings. They noted that each successive delay in sowing beyond the optimum date reduced the grain yield. **Shah and Akmal (2002)** concluded that early sowing favored, according to genotypic differences, some varieties and in contrast another variety might be better for late planting. **Shahzad *et al.* (2002) and Shah *et al* (2006)** recorded maximum grain yield when crop was sown on optimum date. **Hameed *et al* (2003)** reported that wheat varieties performed better when sown in last week of October or 1st week of November. **Subhan *et al* (2003) and Qasim *et al* (2008)** concluded that crop planted on optimum date produced higher grain yield as compared to late and early planting. **Ali *et al* (2004)** observed that 1st November to 20th November appeared to be optimum planting time to harvest maximum yield potential. It is important to define the optimal sowing date of winter wheat, due to the climate-change of Egypt, not only from agro-technical factors (sowing date), but also from economic point of view.

Shah *et al* (2006) and Tahir *et al* (2009) studied the response of certain wheat cultivars to six different sowing dates. Statistical analysis of the data revealed that different varieties affected significantly spike length, grain and biological yields.
The present investigation was organized to evaluate the behavior of certain wheat cultivars (*Triticum aestivum* L.) namely Giza 168, Sakha 93 and Gemmiza 9 to five sowing dates under environmental conditions of Caliobia Governorate, Egypt.

MATERIALS AND METHODS

Two field experiments were carried out in Agric. Expt. Farm, Fac. of Agric., Ain Shams Univ. at Shalakan, Kalubia Governorate, Egypt during 2010/2011 and 2011/2012 growing seasons to study the response of some bread wheat cultivars to sowing date. Each experiment included 15 treatments which were the combination between three wheat cultivars namely (Giza168, Sakha 93 and Gemmiza 9), which were obtained from Wheat Res. Dept., Agric. Res. Center (ARC), Ministry of Agric. at Giza and five sowing dates, which were: 1st October, 16th October, 1st November, 16th November and 1st December.

The mineral nitrogen fertilizer was applied as ammonium nitrate (33.5% N) at a rate of 80 kg N/fad. The N fertilizer was added in two equal portions. The first portion was added just before the first irrigation, and the second one was added just before the second irrigation. Phosphorus fertilizer was applied as calcium superphosphate (15.5% P_2O_5) at a rate of 31 kg P_2O_5/fad before sowing during the preparation of the experimental soil.

The experimental design was split plot design in 6 replications. The sowing dates were arranged in the main plot and cultivars were allocated in the sub plots. The experimental plot area was 14 m^2 consisting of 20 rows each of 3.5 m in length and 20 cm apart, grains were drilled in the rows. The other normal recommended practices of growing wheat cultivar were applied.

Data recorded at harvest

At harvest a sample of plants from 1 m^2 from each treatment in three replications was chosen at random and the following data were recorded:

Plant height (cm), spikes No/m^2, main spike length (cm), spike weight (g/main spike), grains No/main spike, grain yield (kg/fad), Straw yield (kg/fad), Biological yield (kg/fad), and Harvest index (HI) = Grain yield (kg/fad) x 100/Biological yield (kg/fad). About 50g of grain yield in three replications were fine grinding to determine nitrogen (N) percentage using microKjeldal method according to **AOAC (1995)**. The crude protein content (GCPC) was calculated by multiplying total N% by 5.7. The grain crude protein yield (GCPY) was calculated by multiplying grain yield by GCPC.

Statistical analysis

The obtained data in three replications were computed for proper statistical analysis according to **SAS Program (2003)**. The LSD at 5% level of significance was used to differentiate between means. Data of 2009/2010 and 2010/2011 growing seasons were subjected to homogeneity variance test for running the combined analysis of the data.

RESULTS AND DISCUSSION

Varietal differences

Data in **Table (1)** reveal that the studied wheat cultivars significantly differed in yield components. Gemmiza 9 produced the tallest plants (89.0 cm) followed by Giza 168 (82.8 cm) and Sakha 93 (74.3 cm). Gemmiza 9 exhibited the highest significant spikes number (705.7 spikes/m^2) followed by Giza (683.8) and the minimum number (661.5 spikes/m^2) was produced by Sakha 93. These results are in accordance with those of **Akhtar *et al* (2006)** and **Tahir *et al* (2009).** Main Spike length and weight were significantly affected by different wheat cultivars. Gemmiza 9 showed the maximum values being 10.1 cm and 4.9 g for the above respective traits. Meanwhile, Giza 168 was in the second order (9.6 cm and 4.7 g, respectively) followed by Sakha 93 that statistically exhibited the lowest values being 9.4 cm and 4.3 g, respectively. Number of grains per spike is an important yield contributing parameter and has a direct effect on the final grain yield of wheat. The studied traits were greatly affected by cultivar. The data were in descending relationship with Gemmiza 9, Giza 168 and Sakha 93 being 60.0, 56.6 and 53.4 grain/main spike, respectively.

Differences in yield components among varieties might be attributed to their genetic diversity and genetic make-up. These results are coincided with those reported by **Shah *et al* (2006), Akhtar *et al* (2006) and Tahir *et al* (2009).**

The grain yield was significantly affected by various cultivars. The data in Table 2 indicated that cultivar Gemmiza 9 produced significantly highest yield attributes, which reflected on its yield parameters and produced significant maximum grain yield (2705.5 kg/fad) followed by Giza 168 (2550.5 kg/fad) and Sakha 93 (2455.5 kg/fad).

Table 1. Yield components of wheat cultivars at harvest. Combined analysis of the two growing seasons

Wheat Cultivars	Plant height (cm)	Spikes No/m^2	Main spike length (cm)	Main spike Spike wt (g)	Main spike Grains No
Giza 168	82.8	683.8	9.6	4.7	56.6
Sakha 93	74.3	661.5	9.4	4.3	53.4
Gemmiza 9	89.0	705.7	10.1	4.9	60.0
LSD at 5%	**0.8**	**7.5**	**0.2**	**0.1**	**0.8**

The highest grain yield of wheat cultivar Gemmiza 9 could be attributed to more spikes number, number and weight of grains per main spike **(Table 1).** These results are in accordance with those of **Shah *et al* (2006) and Tahir *et al* (2009).** The straw yield was subsequently and significantly affected by cultivars. Gemmiza 9, Giza1 68 and Sakha 93 were in descending relationship with straw yield being 5288.2, 4967.1 and 4702.9 kg/fad, respectively. GCPY was significantly affected by various cultivars, wheat cultivar Gemmiza 9 produced the highest GCPY (357.3 kg/fad) followed by Giza 168 (326.1 kg/fad) and Sakha 93 (310.5 kg/fad). From the data in Tables 1 and 2, it could be concluded that the higher yield attributes, the higher grain and straw yields and subsequently the higher the biological yield. These findings indicate clearly that the genetic make-up of cultivar Gemmiza 9 was adapted to the environmental conditions of Caluobia Governorate. The data of the effect of sowing date on yield and yield attributes of wheat cultivars agree with those obtained by **Shah *et al* (2006)** and **Tahir *et al* (2009).**

On the other hand, the harvest index was slightly affected by genetic make-up of studied cultivars. It means that increase the grain yield was accompanied with increase of straw yield by the same trend and consequently resulted in slight differences in harvest index of studied cultivars ranging between 33.8 up to 34.5%.

Table 2. Effect of wheat cultivars on grain and straw yields (kg/fad) and harvest indices (%). Combined analysis of the two growing seasons

Wheat Cultivars	Yield (kg/fad) Grain	Straw	Biological	GCP	HI (%)
Giza 168	2550.5	4967.1	7517.3	326.1	34.0
Sakha 93	2455.5	4702.9	7158.1	310.5	34.5
Gemmiza 9	2705.5	5288.2	7994.1	357.3	33.8
LSD at 5%	**23.4**	**54.7**	**50.2**	**7.6**	**NS**

Effect of sowing dates

Sowing dates had remarkable effect on yield components of wheat plants including plant height, spikes No/m^2, main spike length and weight as well as grain No/main spike **(Table 3).** Number of grains per spike is an important yield contributing parameter and has a direct effect on the final grain yield of wheat. The Data revealed that sowing dates significantly affected number of grains per main spike. Maximum number of grains per main spike was obtained when crop was sown on 1st November (72.6 grain/main spike) versus the minimal value in case of sowing 1st October (43.14 grain/main spike). In addition, the reduction in all parameters was the highest due to early sowing than late sowing.

Table 3. Effect of sowing dates on yield components of wheat plants at harvest. Combined analysis of the two growing seasons

Sowing dates	Plant ht. (cm)	Spikes No/m^2	Main spike		
			length (cm)	Weight (g)	Grains No
1/10	74.4	510.0	6.8	3.4	43.1
16/10	79.9	653.6	9.0	4.0	46.6
1/11	95.0	784.9	11.4	5.9	72.6
16/11	84.9	769.3	11.0	5.2	64.4
1/12	76.2	700.7	10.3	4.9	56.6
LSD at 5%	**0.9**	**8.2**	**0.1**	**0.1**	**1.1**

It could be mentioned that maximal yield components were obtained when wheat plants were sown in 1st November. Early or delay sowing beyond 1st November progressively reduced the studied parameters. It was clearly noticed that the reduction was higher when wheat plants were sown early than that sown late in the season in comparison to sowing wheat plants at 1st November. Therefore, 1st November may be considered as the optimum date of wheat planting under Kaluobia Governorate. The crop may have enjoyed the better environmental conditions especially the soil and air temperatures and solar radiation. These results are in accordance with those of **Akhtar *et al* (2006); Shah *et al* (2006); Qasim *et al* (2008) and Tahir *et al* (2009)**.

The effect of sowing dates on each of grain, straw, biological and grain crude protein (GCP) yields as well as harvest indices are presented in **Table (4).** The data cleared that grain yield was at the maximal value when wheat plants were sown on 1st November being 3108.8 kg/fad. Each successive early or delay in sowing beyond 1st November progressively reduced grain, straw, biological and GCP yields. Grain was reduced by a rate of 35.2 and 26.1% when sowing was at 1st or 16th October, and by 7.3 and 17.0% versus delaying sowing date by 15 or 30 days, respectively. Therefore, 1st November may be considered as the optimum time of wheat planting. Higher grain yield on 1st November can be attributed to more number of spikes/m^2 and number of grains/main spike. These re- sults agree with early findings by **Subhan *et al* (2003) and Akhtar *et al* (2006); Qasim *et al* (2008) and Tahir *et al* (2009)**. The reduction in grain or biological yields was statistically by the same rate; therefore, the harvest index was slightly affected ranging between 33.4 to 34.4%.

3. Effect of the interaction between wheat cultivars and sowing dates

The yield components of wheat cultivars was affected significantly by sowing dates. on studied yield components. The data in **Table (5)** cleared that Gemmiza 9 exhibited maximum tallest plants, spikes No/plant; length, weight of main spike and grains No/main spike at all studied sowing dates reaching their maximum values when sown on 1st November. Wheat cultivars Giza 168 and Sakha 93 were in descending order with the above studied traits. This finding was true and decreased by early or late sowing in the season.

The high performance of cultivar Gemmiza 9 in yield attributes was reflected on its yield parameters **(Table 6).** These parameters reached the highest significant values followed by Giza 168 and Sakha 93.

The yield attributes of wheat cultivars were in positive relationship with the corresponded yield parameters versus sowing dates. These findings are true and coincided On the other hand, the interaction between sowing dates and cultivars effects was insignificant among HI ranging between 33.3 to 34.9%. These results indicated that maximum yield traits were obtained by sowing in optimum date. These finding are in good agreement with that obtained by **Subhan *et al* (2003)**; **Akhtar *et al* (2006)**; **Qasim *et al* (2008) and Tahir *et al* (2009)**. The stability of HI of wheat cultivars versus different sowing dates, **Ehdaie and Weins (2001)** attributed this stability to increase both grain and straw yields, so that HI was relatively constant. **In this respect Ehdaie and Weins (2001)** explained the stability of HI to increase both grain and biological yields.

From the above mentioned data, the authors recommended that bread wheat cultivar Gemmiza 9 was the best adapted cultivar could be grown on 1st October under the environmental conditions of Kaleobia Governorate.

Table 4. Effect of sowing dates on wheat yield (kg/fad) and harvest indices (%). Combined analysis of the two growing seasons

Sowing dates	Grain yield	% reduction	Straw Yield	Biological yield	GCPY	HI %
1/10	2010.8	35.3	3848.8	5859.2	276.5	34.4
16/10	2269.4	26.1	4343.7	6612.8	294.0	34.3
1/11	3108.8	0.0	6161.4	9270.0	394.0	33.4
16/11	2882.6	7.3	5607.2	8489.3	359.8	34.1
1/12	2581.1	17.0	4970.3	7551.2	332.2	34.2
LSD at 5%	**24.7**		**61.6**	**64.4**	**5.3**	**NS**

Table 5. Effect of the interaction between wheat cultivars and sowing dates on yield components. Combined analysis of the two growing seasons

Sowing Dates	Cultivars	Plant height (cm)	Spikes No/m^2	Main spike		
				Length (cm)	Weight (g)	Grains No
	Giza1 68	75.2	513.5	6.7	3.4	44.3
1/10	**Sakha 93**	65.8	492.3	6.3	3.2	39.4
	Gemmiza 9	82.2	524.2	7.3	3.5	45.7
	Giza1 68	81.7	647.8	9.1	4.0	47.9
16/10	**Sakha 93**	71.5	630.5	8.6	3.6	42.2
	Gemmiza 9	86.5	682.5	9.3	4.2	49.6
	Giza 168	94.3	790.3	11.1	5.8	70.2
1/11	**Sakha 93**	90.2	743.3	11.1	5.4	68.8
	Gemmiza 9	100.5	821.0	12.0	6.3	78.7
	Giza 168	85.3	761.2	11.0	5.3	64.2
16/11	**Sakha 93**	76.8	754.5	10.9	5.0	61.9
	Gemmiza 9	92.5	792.3	11.2	5.4	67.2
	Giza 168	77.7	706.3	10.3	5.0	56.5
1/12	**Sakha 93**	67.3	687.0	10.1	4.5	54.5
	Gemmiza 9	83.5	708.7	10.7	5.1	58.8
LSD at 5%		**1.7**	**16.8**	**0.3**	**0.2**	**1.8**

Table 6. Effect of the interaction between wheat cultivars and sowing dates on yield (kg/fad) and harvest indices (%). Combined analysis of the two growing seasons

Sowing dates	Cultivars	Yield (kg/fad)				HI (%)
		Grain	Straw	Biological	GCP	
	Giza1 68	1996.2	3843.5	5839.7	273.0	34.2
1/10	**Sakha 93**	1922.8	3595.3	5518.2	258.0	34.9
	Gemmiza 9	2112.7	4106.8	6219.5	298.5	34.0
	Giza 168	2273.5	4429.8	6703.3	292.5	33.9
16/10	**Sakha 93**	2178.0	4118.8	6296.8	280.0	34.6
	Gemmiza 9	2355.8	4481.8	6837.7	309.5	34.4
	Giza1 68	3073.3	6096.7	9170.0	384.5	33.5
1/11	**Sakha 93**	2927.7	5865.0	8792.7	366.5	33.3
	Gemmiza 9	3325.0	6521.7	9846.7	431.0	33.8
	Giza1 68	2850.8	5448.7	8299.5	354.0	34.4
16/11	**Sakha 93**	2764.2	5308.7	8072.8	335.5	34.2
	Gemmiza 9	3031.3	6063.7	9095.0	390.0	33.3
	Giza 168	2557.7	5016.0	7573.7	326.5	33.8
1/12	**Sakha 93**	2483.7	4625.5	7109.2	312.5	34.9
	Gemmiza 9	2701.3	5269.2	7970.5	357.5	33.9
LSD at 5%		**52.4**	**122.3**	**112.3**	**17.0**	**NS**

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