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Sowing Dates Effect on Some Grain Biochemical and Technological Characteristics of Certain Wheat Cultivars

M.A. Fergany, M.S. El-Habbal and M.E. El-Temsah
Department of Agronomy, Faculty of Agricultural, Ain Shams University, Cairo, Egypt

Corresponding Author: M.A. Fergany, Department of Agronomy, Faculty of Agricultural, Ain Shams University, Cairo, Egypt

ABSTRACT

Two field experiments were carried out in two successive seasons of 2010/2011 and 2011/2012 at Agric. Experimental. Farm of Ain Shams Univ. To study the response of some bread wheat cultivars to sowing date. Each experiment included 15-treatment which were the combination between three wheat cultivars viz., Sakha 93, Giza 168 and Gemmiza 9 and five sowing dates i.e., October 1, October 16, November 1, November 16 and December 1. Split plot design in 6 replications was used. Results showed that variety Gemmiza 9 had significant highest Grain, Crude Protein Content (GCPC), test weight and 1000-grain weight. Meanwhile, mono and disaccharides and their total were slightly affected either by genetic make-up of the cultivar, sowing dates or their interaction. The maximum 1000-grain weight was obtained by sowing on 1st November. Sowing on 1st October produced the highest significant vitreosness percentage, GCPC, wet and dry gluten and statistically decreased by delaying sowing date. It could be conclude that sowing wheat cultivar Gemmiza 9 was the most adapted grown under the studied location.

Key words: *Triticum aestivum*, wheat cultivar, grain quality, sowing dates

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the major and essential grain crop in the world especially in Egypt because it is the stable food of the Egyptian people. Wheat production represent a special position in agricultural policies it is grown in Egypt on an area of 2.92 million faddan (4200 m^2) with an annual production of about 8.2 million tones and with an average yield of 2.65 tons $faddan^{-1}$ during the year 2009-2010 growing season (CLAC, 2011). Locations and seasons play a distinct role in respect to yield and quality of wheat varieties (Aslani and Mehrvar, 2012).

Increase concentrations of greenhouse gases will result in a continuous increase in earth's temperatures and this increase could significantly impact wheat plant life, productivity and grain quality. Abdullah *et al.* (2007) found that a small endosperm, lower grain weightwere accompanied to the raising intemperature in the post anthesis period of late sown as a result to shortened the grain filling period however and increased crude protein content. Therefore it is very important to 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. Therefore, the sowing date and genotype are the most important factor that affects grain quality. The optimum sowing date of wheat cultivars lead to increase 1000-grain weight (Ali *et al.*, 2010) and test weight, grain protein content as well as wet and dry gluten content (Jie *et al.*, 2005).

Zhu and Khan (2001) declared that protein and its quality traits were substantially affected by genotype, environment and their interaction. Motzo *et al.* (2007) indicated that the environmental condition pertaining befor and during grain filling greatly affecting quality of whea and can therefore be modified by manipulation of cultivar and sowing date. A delay in sowing date was associated with a decrease in main grain weight but not in grain nitrogen content, thus leading to an overall increase of crude protein percentage. The observed increase in protein% partially explained the smaller gluten index. Moreover, they suggested that temperature above 30°C at the end of the grain filling period has a negative effect on the gluten polymerization process.

Therefore, the target of the present study was to evaluate some grain chemical and technological properties of three wheat cultivars at five sowing dates.

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 dates. Each experiment included 15 treatments which were the combination between three wheat cultivars namely (Sakha 93, Giza 168 and Gemmiza 9) which were obtained from Wheat 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^{-1}. The N fertilizer was added in two equal portions. The first portion was added just before the first irrigation and the second portion was added just before the second irrigation. Phosphorus fertilizer was applied as calcium super-phosphate (15.5% P_2O_5) at a rate of 31 kg P_2O_5 fad^{-1} before sowing during the preparation of the experimental soil.

The experimental design was split plot design in 6-replication. The sowing dates were arranged in the main plot. Cultivars were allocated in the sub plots. The experimental unit area was 14 m^2 consisting of 20 rows each of 3.5 m in length and 20 cm apart, grains were drilled in a single row. The normal practical applications of growing wheat cultivar were applied.

At harvest a random sample of 1 m^2 of each treatment in three replications was chosen, dried at 105°C and the following data were recorded.

Grain chemical composition: About 100 g of grains or straw from each treatment in two replications were grounded and followed by fine grinding into fine powder for chemical analysis. Total nitrogen content was estimated using micro-Kjeldahl apparatus. The Grain Crude Protein Content (GCPC) was calculated by multiplying the total nitrogen percentage by 5.7. Reducing, none reducing and total sugars were determined according to Shaffer and Hartmann. The procedures were carried out according to AOAC (1995) and the data were calculated as percentage on dry matter basis at 105°C.

Wet and dry gluten were determined in fine air dried grains by hand-washing the meal according to the standard method of Pleshkof (1976) until starch was not detected in the washing water, then dried and weighed. Wet and dry gluten were calculated as percentage of air dry grains. The hydration capacity of gluten was calculated as follows:

$$\text{Hydartion (\%)} = \frac{(\text{Wetgluten} - \text{drygluten})}{\text{dry gluten}} \times 100$$

Statistical analysis: Data of the 3-replication were computed for proper statistical analysis according to SAS (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 cleared in Table 1 indicate that wheat variety Gemmiza 9 had significant highest Grain Crude Protein Content (GCPC) exhibiting 13.3%. Wheat varieties Giza168 and Sakha 93 were in the second and third orders being 12.7 and 12.9%, respectively with slight differences between them. The superiority of Gemmiza 9 may be due to higher rate of translocation of nitrogenous compounds from source to sink comparing to other studied cultivars. This finding could be attributed to genetic make-up of the cultivar and its tolerance to high temperature during grain filling period. Data of reducing and non reducing sugars as well as total minerals absorbed and translocated to the sink for all studied varieties were insignificantly differed ranged between 0.15 to 0.17, 0.16 to 0.19 and 1.6 to 1.8% for the above respective traits. Subsequently the total sugars were slightly differed ranging between 0.32 to 0.35%.

It means that the genetic make-up of wheat cultivar Gemmiza 9 was more adapted to grow under the environmental conditions of Kaluobia governorate. Increase protein storage in grains cultivar Gemmiza 9 might be attributed to improving the efficiency of nitrogen utilization. This could be achieved through either higher nitrogen uptake capacity of root system and/or through greater mobilization of nitrogenous compounds from the vegetative organs to the grains. This observation was close with that obtained by Motzo *et al.* (2007).

Data in Table 2 revealed that the studied wheat cultivars were significantly differed in their quality characters. Gemmiza 9 produced the highest test weight, weight of unit volume, 1000-grain weight, wet and dry gluten as well as gluten hydration percentage exhibiting 827.0 g L^{-1}, 52.2 g, 28.0, 10.4 and 167.5%, respectively. A slight difference was noticed between Gemmiza 9 and Giza 168 in test weight dry gluten percentage. Also there was no significant difference between Gemmiza 9 and Sakha 93 in gluten hydration.

Table 1: Varietal differences in some biochemical properties (% on dry matter basis) of wheat grain. Combined analysis of the two growing seasons

Wheat cultivars	Reducing sngars (%)	Non rednring sugars (%)	Total sugars (%)	GCPC ratio	Ash (%)
Giza 168	0.17	0.16	0.33	12.9	1.7
Sakha 93	0.15	0.17	0.32	12.7	1.6
Gemmiza 9	0.16	0.19	0.35	13.3	1.8
LSD at 5%	NS	NS	NS	0.3	0.1

Table 2: Varietal differences in some technological properties of wheat grain. Combined analysis of the two growing seasons

				Gluten (%)		
Cultivars	Test wt (g L^{-1})	1000-grain wt (g)	Vitreosness (%)	Wet	Dry	Hydration (%)
Giza 168	824	49.4	44.6	25.8	10.0	158.1
Sakha 93	765	53.1	36.3	23.6	9.1	161.0
Gemmiza 9	827	52.2	56.6	28.0	10.4	167.5
LSD at 5%	8.7	1.1	2.7	1.1	0.4	6.7

The differences in quality of studied cultivars might be attributed to their genetic make-up. These results are coincided with those of Shahzad *et al.* (2002, 2007). From the above data in Tables 1 and 2 it was cleared a positive relationship between GCPC, vitreosness wet gluten content; test weight and 1000-grain weight.

This observation was agreed with that reported by Motzo *et al.* (2007).

Effect of sowing date: The data of chemical composition of wheat grains versus sowing dates were also studied and the data are shown in Table 3. The data assumed that reducing, none reducing and ash content of wheat grains did not significantly affect versus late or early sowing dates, i.e., from 1st October up to 1st December. Their values ranged from 0.1 to 0.2% for each of reducing and none reducing sugars as well as, 0.3 to 0.4% for total sugars; 1.7% for Ash content. From the other side, the GCPC was gradually and markedly decreased from 13.7% at early sowing date on 1st October up to 16th November being 12.5%. This finding could be explained that, at earlier sowing, wheat plants removed more N from the soil than in optimum or late sowing. Therefore, the mean GCPC was higher by early sowing (Abdullah *et al.*, 2007). Thereafter, delaying sowing date to 1st December accompanied with substantial increase in crude protein content reaching 12.9%.

Regarding the effect of sowing date on some technological properties of wheat grains, the data of the studied traits are shown in Table 4. Data revealed that test weight was significantly and gradually increased versus sowing date of wheat till reached its maximum value by sowing on 1st November which produced significantly larger grains (824.0 g L^{-1}) and higher 1000-grain weight (52.2 g) comparing to sowing early or late in the season. It was also cleared from Table 4 that late sowing date in the season was corresponded with significant decrease of grain vitreosness, wet and dry gluten percentage. The effect of sowing date on grain quality was in accordance with Shahzad *et al.* (2002), Aslam *et al.* (2003) and Yan *et al.* (2008).

Table 3: Some biochemical properties of wheat grain (% of dry matter) as affected by sowing dates. Combined analysis of the two growing seasons

Sowing dates	Reducing sugars (%)	Non reducing sngars (%)	Total sngars (%)	GCPC (%)	Ash (%)
10Jan	0.1	0.2	0.3	13.7	1.7
16/10	0.2	0.1	0.3	13.0	1.7
11-Jan	0.2	0.2	0.4	12.7	1.7
16/11	0.2	0.2	0.4	12.5	1.7
12Jan	0.2	0.2	0.4	12.9	1.7
LSD at 5%	NS	NS	NS	0.3	NS

Table 4: Some technological properties of wheat grain as affected by sowing dates. Combined analysis of the two growing seasons

				Gluten (%)		
Sowing dates	Test wt (g L^{-1})	1000-grain wt (g)	Vitreosness (%)	Wet	Dry	Gluten hydration (%)
10Jan	26-Feb	50.7	48.3	29.5	10.9	169.3
16/10	816	52.1	48.0	27.0	10.1	166.6
11Jan	3-Apr	52.2	43.9	24.1	9.4	156.3
16/11	799	52.4	42.4	23.2	9.3	149.7
12Jan	700	50.5	46.4	25.3	9.4	169.2
LSD at 5%	11.9	1.0	3.9	0.9	0.2	8.0

Table 5: Effect of the interaction between wheat cultivars and sowing dates on some biochemical properties (% on dry matter basis) of wheat grains. Combined analysis of the two growing seasons

Sowing dates	Cultivars	Reducing sugars (%)	Non reducing sugars (%)	Total sngars (%)	CPC	Ash (%)
10Jan	Giza 168	0.1	0.2	0.3	13.7	1.8
	Sakha 93	0.1	0.2	0.3	13.4	1.5
	Gemmiza 9	0.1	0.2	0.3	14.1	1.9
16/10	Giza 168	0.2	0.1	0.3	12.9	1.7
	Sakha 93	0.2	0.1	0.3	12.9	1.7
	Gemmiza 9	0.2	0.2	0.4	13.1	1.7
11-Jan	Giza 168	0.2	0.2	0.4	12.5	1.6
	Sakha 93	0.2	0.2	0.4	12.5	1.7
	Gemmiza 9	0.2	0.2	0.4	13.0	1.7
16/11	Giza 168	0.2	0.2	0.4	12.4	1.7
	Sakha 93	0.2	0.2	0.4	12.2	1.7
	Gemmiza 9	0.2	0.2	0.4	12.9	1.8
12Jan	Giza 168	0.2	0.2	0.4	12.8	1.6
	Sakha 93	0.2	0.2	0.4	12.6	1.6
	Gemmiza 9	0.2	0.2	0.4	13.2	1.8
LSD at 5%		NS	NS	NS	NS	NS

Table 6: Effect of the interaction between wheat cultivars and sowing dates on some technological properties of wheat grains. Combined analysis of the two growing seasons

					Gluten (%)		
Sowing dates	Cultivars	Test wt (g L^{-1})	1000-grain wt (g)	Vitreo-sness (%)	Wet	Dry	Gluten hydration (%)
10Jan	Giza 168	812	49.5	48.5	29.8	11.1	168.5
	Sakha 93	746	51.2	38.3	26.8	10.2	162.8
	Gemmiza 9	806	51.3	58.3	31.8	11.5	176.6
16/10	Giza 168	826	51.2	46.0	26.6	10.2	160.8
	Sakha 93	790	52.9	37.0	25.4	9.40	171.8
	Gemmiza 9	832	52.2	61.0	28.9	10.8	167.2
11Jan	Giza 168	838	47.6	43.0	24.2	9.8	146.7
	Sakha 93	784	55.1	35.3	21.6	8.5	154.1
	Gemmiza 9	850	53.9	53.5	26.6	9.9	168.1
16/11	Giza 168	818	48.8	41.5	23.0	9.3	147.3
	Sakha 93	756	56.1	34.0	21.0	8.7	140.8
	Gemmiza 9	824	52.3	51.8	25.6	9.8	161.2
12Jan	Giza 168	826	49.9	44.0	25.4	9.5	167.5
	Sakha 93	750	50.4	36.8	23.4	8.5	175.4
	Gemmiza 9	824	51.2	58.5	27.0	10.2	164.8
LSD at 5%		19.5	2.5	6.0	NS	NS	NS

Effect of the interaction between wheat cultivars and sowing dates: The data in Table 5 indicate clearly that the effect of the interaction between sowing dates and wheat cultivars was found to be non significant in the all biological traits. Concerning GCPC it was found that th highest value was obtained by early sowing on 1st October. Delay sowing date up to 1st November was accompanied with increase of GCPC. It was also noticed that grains of wheat cultivar Gemmiza 9 is characterized by higher GCPC (14.1%).

The interaction between wheat cultivars and sowing dates on techno-logical quality properties were studied and the data are shown in Table 6. The data cleared that test weight, 1000-grain

weight and vitreosness were significantly varied among cultivars and sowing dates. Wheat cultivar Gemmiza 9 exhibited the highest value of test weight on 1st November being 850 g L^{-1}, 1000-grain weight (53.9 g) and vitreosness (53.5%). In addition, delaying sowing date had positive effect on test weight and negative effect on 1000-grain weight vitreosness.

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