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PRODUCTIVITY OF SOME WHEAT CULTIVARS AS AFFECTED BY SEEDING RATE AND NITROGEN SOURCES

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ABSTRACT:

Two field Experiments were conducted during 2005/2006 and 2006/2007 seasons at the Experimental Farm of the Faculty of Agriculture, Zagazig University, Zagazig, Sharkia Governorate, Egypt. The study aimed to investigate the response of some wheat cultivars namely Giza 168, Gemmiza 7, Gemmiza 9 and Sakha 93 to three seeding rates which were 300, 400 and 500 grains / m^2 under three nitrogen sources included ammonium sulphate, ammonium nitrate and urea in both growing seasons. The most important results could be summarized as follows:

Wheat cultivars differed significantly regarding their plant height and number of spikes / m^2, as well as, grain and straw yields and most of their attributes where Gemmiza 9 followed by Gemmiza 7 recorded higher grain, straw and total yields than Giza 168 and Sakha 93, however, the four wheat cultivars showed closer spike length and harvest index.

Increasing planting density from 300 to 400 and 500 grain / m^2 significantly increased plant height, number of spikes / m^2, grain, straw and total yields / fad but, significantly decreased spike length, number of spikelet / spike, number of grains / spike, thousand grain weight and grain weight / spike. Harvest index was not affected significantly due to raising number of grains / m^2.

Addition of nitrogen in the form of ammonium sulphate (AS) was superior to all N forms applied where the highest averages were recorded by ammonium sulphate followed by ammonium nitrate (AN) however the lowest averages were recorded by urea (U) in most characters of yield and yield attributes, but thousand grain weight and harvest index were not affected by varying N sources.

The significant interaction effects between the studied factors indicated that best yield and yield attributes could be obtained by Gemmiza 9 cultivar when dense planting of 400 or 500 grain / m^2 and ammonium sulphate were applied.

Grain yield was positively and significantly correlated with plant height, number of spikes / m^2, number of spikelets / spike, number of grains / spike, thousand grain weight, grain weight / spike and grain and straw as well as total yields / fad.

Results cleared that the highest yield could be obtained from sowing Gemmiza 9 wheat cultivar when planting with 400 or 500 grain / m^2 and ammonium sulphate were applied.

Key words: Wheat cultivars, ammonium sulphate, ammonium nitrate, urea.

INTRODUCTION

Results cleared that the highest yield could be obtained from sowing Gemmiza 9 wheat cultivar when planting with 400 or 500 grain / m^2 and ammonium sulphate were applied.

In Egypt, sustaining wheat production through maximizing unit land area productivity and increasing the cultivated area is the most important national target in order to minimize the gab between production and consumption. Cultivating high yielding genotypes parallel with improved agronomic practices can increase the productivity per unit area. Several workers reported significant varietal differences in yield attributes and yield potentiality among different Egyptian wheat cultivars (El-Hawary, 2000; Mowafy, 2002; Allam, 2003; Ali *et al.,* 2004; Allam, 2005; Table *et al.,* 2005; El-Sawi *et al.,* 2006; Gafaar, 2007; Omar, 2007; Zeidan *et al.,* 2007 and Mowafy, 2008).

Wheat planting densities therefore appear to strongly influence early dry matter accumulation. There is experimental evidence that increasing density not only improves light capture early in the season but also the uptake of soil resources (Satorre and Slafer, 1999). Most of the previous studies have shown different effects for seeding rate on yield and yield attributes of wheat. El-Bana (2000) indicated that increasing seeding rate from 50, 70 and 90 kg grains / fad significantly increased plant height, number of spikes / m^2 and grain and straw yields / fad but, decrease spike length and number of grains / spike. Similar findings were reported by El- Kholy (2000) and Abd-Alla (2002). On the other hand, Saleh (2002) reported that increasing seeding rate had no significant effect on plant height, 1000-grain weight and grain yield / fad. Ali *et al.* (2004) observed that increasing planting density from 300 to 400 or 500 grains / m^2 significantly increased plant height, number of spikes / m^2, grain, straw and biological yields / fad but, significantly decreased grain weight / spike and 1000-grain weight. Also Khalil and El-Ganbeeby (2004) reported that increasing planting density from 96 to 144 and 192 kg grains / ha significantly increased plant height, number of spikes / m^2 and straw and grain yields / ha, but decrease number of grains / spike and thousand grain weight. Lioveras *et al.* (2004) tested six seeding plant densities *i.e.* 150, 175, 250, 300, 400 and 500 grains / m^2. They reported that the optimum planting densities for giving the highest yield were at least 400 to 500 grains / m^2 for most the studied varieties. Abu-Grab *et al.* (2006) noticed that the heavy planting densities (300 or 400 grains / m^2) significantly increased plant height, number of spikes / m^2 and grain and straw yields / fad. Omar (2007) indicated that the dense planting (500 grains / m^2), produced the highest grain yield followed by 400 grains and then by 300 grains / m^2 though 1000-grain weight and spike grain number showed the vice versa but spike number / m^2 was the highest with the dense planting.

Among the available number of nitrogenous fertilizers, ammonium sulphate, ammonium nitrate and urea are widely used in wheat cultivation. Thus, the evaluation of these forms under clay soil conditions with regard to their effects on wheat productivity is of great importance. In this respect, many investigators reported that ammonium sulphate was more effective in increasing wheat yield and its components including El-Hefnawy *et al.* (1991), Mohamed *et al.* (1992), Madkour (1995), AbdulGalil *et al.* (1997), Abd El-Mottaleb (2002) and Abd El-Haffez (2004). Moreover, Moursi and Abdel-Majeed (2005) noticed that splitting application of ammonium sulphate into four or five equal doses achieved the highest grain, straw and yield components. Under alkaline soil conditions, ammonium sulphate was found to be the most efficient N form, due to the more acidity released during biological oxidation of NH_4 along with the release of SO_4 which increase acidity and hence might decrease the rate of NH_3 losses (Tisdale and Nelson, 1970).

Therefore, the present investigation was designed to study the performance and productivity of some wheat cultivars grown under different seeding rates and N sources.

MATERIALS AND METHODS

Two field Experiments were conducted during 2005/2006 and 2006/2007 seasons at the Experimental Farm of the Faculty of Agriculture, Zagazig University, Zagazig, Sharkia Governorate, Egypt. The study aimed to investigate the response of some wheat cultivars to seeding rates and nitrogen sources. The soil of the experiment is clay in texture where it had a particle size distribution of 60.8%, 22.6% and 16.6% for clay, silt and sand, respectively. The upper 30 cm soil depth as average over the two seasons had an average pH value of 7.84 and organic matter content of 1.54%. The available N, P and K contents were 51.0, 10.9 and 245 ppm, respectively. Each experiment included 36 treatments, which were the combination of four wheat cultivars (Giza 168, Gemmiza 7, Gemmiza 9 and Sakha 93) replaced in the main plots of a split-split plot design with three replications. The sub-plots were devoted to the three seeding rates (i.e. 300, 400 and 500 grain / m^2). While the sub-sub plot units contained three N sources (i.e. Ammonium sulphate 20.5% N, Ammonium nitrate 33.5% N and Urea 46%N).

The area of the experimental plot was (13.5 m^2) included 20 rows, 15 cm apart (3m in width and 4.5m in length). Seeds were hand drilled at a rate of

300 or 400 and 500 seeds / m^2 for all the tested cultivars on November 23^{rd} and 25^{th} in the two following seasons, respectively. Calcium super phosphate (15.5% P_2O_5) at a rate of 100 kg / fad was added before sowing. Nitrogen fertilizer was applied at a rate of 80 kg N / fad for the tested N sources in three equal doses (*i.e*. before sowing and before the first and the second irrigation, respectively). The preceding crop was maize in both seasons. Harvest date was during the last week of April for Sakha 93, Giza 168 and Gemmiza 7 and in the second week of May for Gemmiza 9 in the two seasons. The other cultural practices for growing wheat under these conditions were applied. At harvest, 25 competitive plants were randomly taken from the second inner rows of each plot to determine plant height (cm), spike length (cm), number of spikelets / spike, number of grains / spike, thousand grain weight (gm) and grain weight / spike (gm). Thereafter, bulk samples included all wheat plants in central area of 3 m^2 in each plot were used to calculate: number of spikes / m^2, grain yield (ton / fad), straw yield (ton / fad), total yield (grain + straw yields, ton / fad) and harvest index (Grain yield / total yield).

Data of the two seasons and their combined were analyzed according to Snedecor and Cochran (1981). In interaction Tables, capital and small letters were used to compare rows and column means, respectively, *, ** and N.S denote the significant and highly significant and the insignificant differences in respective order. The combined data of yield and yield attributes were subjected to simple correlation calculated according to Sváb (1973).

RESULTS AND DISCUSSION

Effects of planting density and N sources on the productivity of four wheat cultivars are presented in Tables 1, 2 and 3.

Cultivar differences:

Combined data presented in Tables 1, 2 and 3 show that the four wheat cultivars varied significantly in grain and straw yields as well as all other yield components, but the differences did not reach the level of significance regarding to spike length and harvest index. However, Gemmiza 9 followed by Gemmiza 7 had the tallest plants and the largest number of spikes / m^2 as well as number of grains / spike. But Gemmiza 7 was superior in the thousand grain weight, however, these cultivars did not vary in each of number of spikelets / spike and grain weight / spike. Both Giza 168 and Sakha 93cultivars had the lowest averages in this respect. Regarding grain and straw and total yields Gemmiza 9 followed by Gemmiza 7 had higher averages than Giza 168 and Sakha 93. Then Gemmiza 9 produced grain yield of 2.839 ton / fad whereas Gemmiza 7, Giza 168 and Sakha 93 produced 2.717, 2.100 and 1.990 ton / fad in respective order. This superiority was also observed in total yield /

fad where the four following cultivars produced 7.971, 7.599, 6.009 and 5.766 ton / fad, respectively. These varietal variations are expected since the four cultivars differed in their genetic make up. Also, El-Hawary (2000), Mowafy (2002), Allam (2003), Ali *et al.* (2004) Allam (2005), Table *et al.* (2005), El-Sawi *et al.* (2006), Gafaar (2007), Omar (2007), Zeidan *et al.* (2007) and Mowafy (2008) agreed with such varietal variation.

Seeding rate effect:

Planting density results indicate highly significant differences, whereas increasing planting density from 300 to 400 and then to 500 grain / m^2 appeared to be gradually increased plant height and number of spikes / m^2. Then, the dense planting of 500 grain / m^2 had the tallest plants and the largest number of spikes / m^2. Such increase in number of spikes / m^2 achieved by dense planting is mainly due to the increase in number of plants / m^2 at the higher seeding rate. The only yield component which was increased by dense planting is number of spikes / m^2. Such increase in number of spikes / m^2 regarding increasing planting density was not absolute, number of seeds was increased from 300 to 400 (33.33%) met with an increase in number of spikes by only 7.79%. Likewise, when number of planted seed / m^2 was increased from 400 to 500 (25%), the increase in number of spikes / m^2 amounted to only 10.72%. Spike length showed significant differences, while increase the rate of seeding was met with significant reduction in spike length (Table 1).

It is evident from Table 2 that the results reveal highly significant differences through the seasons and the combined analysis whereas gradual decrease was observed in number of spikelets / spike as planting density increased from 300 to 400 and up to 500 grain / m^2. Then, the highest number of spikelets / spike was achieved by the light density of 300 grain / m^2, while the lowest number of spikelet was given by dense planting of 500 grain / m^2. These results almost followed the same patterns of number of grains / spike and thousand grain weight in addition to grain weight / spike whereas all of these yield attributes were decreased as planting density was increased which could be attributed to the competition between plants (spikes, spikelet and grains) for available nutrients in the surrounding of closer media while the reverse direction was observed with number of spikes / m^2.

Grain yield usually declines as seed rate decreased due to rapid reduction in number of spikes / m^2. Grain yield decrease at every seed rate due to a reduction in the contribution of kernels / spike and kernel weight. Between these two extremes there is a large plateaus area where yield changes slowly relative to seed rate (Briggs and Alytenfisu, 1979). Hence, grain yield / fad appeared to be gradually increased as planting density increased from 300 to 400 or 500 grain / m^2. This general trend was confirmed significantly throughout the seasons and the combined. The superiority of dense planting of 500 grain / m^2 over lighter densities of 300 and 400 grain / m^2 amounted to about 9.67 and 4.69%. Increasing number of spikes / m^2 was responsible for the increase in grain yield / fad associated with dense planting of wheat. Straw yield is mainly a function of plant height, the straw yield data (Table 3) is matching with plant height data (Table 2). Total yield showed similar trend with both grain and straw yields. This is rather expected since total yield is the sum of both yields which increased with increasing seeding rate. Harvest index did not show significant variation.

As seem, the planting density has exerted significant effects on the different characters recorded in the different tables. One way increasing planting density decreased spike length, number of grains / spike, thousand grain weight, number of spikelets / spike and weight of spike grain. The other way was positive. These were increase in number of spikes / m^2 and the three yields i.e. grain, straw and total yields. Also, the magnitude of reduction were less than the magnitude increase in spike number which could compensate for these reductions consequently the grain yield showed significant increase as the sowing density increase. This may be explained on the light of the fact that increasing densities creates a competition between plants. The factor of selecting optimum planting density is to have the one which its competition does not cause a reduction in grain yield. These findings are in harmony with those of El-Bana (2000), El-Kholy (2000) and Abd-Alla (2002) who reached to 90 kg grains / fad and Khalil and El-Ganbeeby (2004) who reached 192 kg grains / ha as an optimum which others like Ali *et al.,* 2004 and Abu-Grab *et al.,* 2006 (400 seeds / m^2). Also, Lioveras *et al.* (2004) who reached to 500 seeds as an optimum. Similar findings were obtained by Omar (2007) but Saleh (2002) reported that increasing seeding rate had no significant effect on plant height, 1000-grain weight and grain yield / fad.

Nitrogen sources effect:

In the two seasons and their combined, ammonium sulphate was more efficient than AN and U as far as plant height, number of spikes / m^2, spike length, number of spikelet and grain / spike, grain weight / spike and grain and straw yields / fad as well as total yield / fad are concerned. But, N sources had no significant effect on thousand grain weight and harvest index. The highest grain yield (2.524 ton / fad) was recorded by AS, whereas, the lowest one (2.310 ton / fad) was recorded by U. similar effects were observed in each of plant height, number of spikes / m^2, spike length (Table 1), number of spikelets and grains / spike, grain weight / spike (Table 2) and straw and total yields / fad (Table 3).

It may be explained that wheat made better use of ammonium sulphate and ammonium nitrate than urea due to more acidity released from the formers than the latter. The high efficiency of AS and AN compared to U could be partly attributed to more N volatilization losses from urea under alkaline soil conditions (Alessi and Power, 1972). In this respect, many investigators reported that ammonium sulphate was more effective in increasing wheat yield and its components such as El-Hefnawy *et al.* (1991), Mohamed *et al.* (1992), Madkour (1995), AbdulGalil *et al.* (1997), Abd El-Mottaleb (2002) and Abd El- Haffez (2004). In addition, similar findings were obtained by Moursi and Abdel-Majeed (2005).

Interaction effect:

The significant interaction effects between cultivars and planting density showed differential response to increasing planting density with different cultivars investigated. Gemmiza 9 produced taller plants and higher number of spikes / m^2 under different planting densities particularly when dense planting of 500 grain / m^2 was used, but spike length was reduced by dense planting. Thus the highest plant height and number of spikes / m^2 of 102.5 and 385.0 were obtained by Gemmiza 9 cultivar when dense planting of 500 grain / m^2 used (Table 1-a).

Table 1-a. Plant height, number of spikes / m^2 and spike length as affected by cultivars x seeding rate interaction (combined).

Seeding rate	Cultivars			
(number of grains / m^2)	Giza 168	Gemmiza 7	Gemmiza 9	Sakha 93
		Plant height (cm)		
	D	B	A	C
300	82.45 c	88.70 c	92.38 c	87.26 c
	C	A	A	B
400	85.01 b	94.49 b	94.28 b	90.24 b
	D	B	A	C
500	85.94 a	99.46 a	102.50 a	91.34 a
Regression coefficient	1.75	5.38	5.06	2.04
		Number of spikes / m^2		
	C	B	A	C
300	305.9 c	310.7 c	320.6 c	304.8 c
	C	B	A	C
400	326.1 b	336.3 b	351.0 b	325.6 b
	C	B	A	C
500	360.9 a	375.8 a	385.0 a	360.8 a
Regression coefficient	27.5	32.6	32.2	28.0
		Spike length (cm)		
	C	A	A	B
300	9.071 a	10.779 a	10.798 a	9.166 a
	C	A	B	D
400	7.974 b	9.404 b	9.194 b	7.937 b
	C	A	B	C
500	7.294 c	8.285 c	8.133 c	7.347 c
Regression coefficient	- 0.889	- 1.247	- 1.333	- 0.909

Data combined analysis presented in (Table 2-a) showed that reducing planting density from 500 to 400 and 300 grain / m^2 tended to increase number of spikelets and grains / spike and grain weight / spike under different cultivars investigated. Gemmiza 9 and Gemmiza 7 produced higher number of spikelets / spike and heaviest grain weight / spike under different planting densities. Therefore, the highest values of number of spikelets / spike, number of grains / spike and grain weight / spike (20.76, 51.81 and 2.482) could be obtained when Gemmiza was planting with 300 grain / m^2.

Table 2-a: Number of spikelets/spike, number of grains/spike and grain weight/spike as affected by cultivars x seeding rate interaction (Combined).

Seeding rate (number of grains / m^2)	Cultivars			
	Giza 168	**Gemmiza 7**	**Gemmiza 9**	**Sakha 93**
	Number of spikelets/spike			
	B	A	A	B
300	17.19 a	20.66 a	20.76 a	17.26 a
	B	A	A	B
400	15.04 b	18.25 b	18.27 b	15.10 b
	B	A	A	B
500	13.64 c	16.62 c	16.60 c	13.72 c
Regression coefficient	- 1.78	- 2.02	- 2.08	- 1.77
	Number of grains/spike			
	D	B	A	C
300	43.81 a	49.14 a	51.81 a	44.16 a
	C	B	A	D
400	42.01 b	46.87 b	49.90 b	41.16 b
	C	B	A	C
500	39.16 c	43.40 c	47.67 c	38.92 c
Regression coefficient	- 2.325	- 2.87	- 2.07	- 2.62
	Grain weight/spike (gm)			
	B	A	A	B
300	1.905 a	2.482 a	2.476 a	1.923 a
	B	A	A	B
400	1.741 b	2.236 b	2.234 b	1.720 b
	B	A	A	B
500	1.576 c	1.981 c	2.064 c	1.569 c
Regression coefficient	- 0.165	- 0.251	- 0.206	- 0.177

It is quite clear from Table 3-a that differential response could be detected concerning to increasing planting density with different cultivars investigated. On the other hand, dense planting of 500 grain / m^2 tended to produce higher straw and total yields / fad with all wheat cultivars investigated.

Table 3-a. Straw and total yields / fad as affected by cultivars x seeding rate interaction (Combined).

Seeding rate (number of grains / m^2)	Cultivars Giza 168	Gemmiza 7	Gemmiza 9	Sakha 93
Straw yield (ton / fad)				
	B	A	A	C
300	3.685 b	4.696 b	4.879 b	3.273 c
	C	B	A	C
400	3.770 b	4.841 b	5.228 a	3.715 b
	B	A	A	B
500	4.272 a	5.108 a	5.289 a	4.341 a
Regression coefficient	0.294	0.206	0.205	0.534
Total yield (ton / fad)				
	B	A	A	B
300	5.690 b	7.276 b	7.598 b	5.120 c
	C	B	A	C
400	5.851 b	7.536 b	8.121 a	5.702 b
	B	A	A	B
500	6.486 a	7.984 a	8.195 a	6.475 a
Regression coefficient	0.398	0.354	0.299	0.678

Thus, the highest values of straw and total yields / fad (5.289 and 8.195 ton / fad) could be obtained when Gemmiza 9 planting with 400 or 500 grain / m^2.

Correlation analysis:

Data in Table 4 show that the grain yield was significantly and positively correlated with plant height, number of spikes / m^2, number of spikelets / spike, number of grain / spike, thousand grain weight, grain weight / spike and grain and both straw and total yields / fad.

The other correlation coefficients presented in the same Table are between the different characters recorded in this study. In this respect El-Bana (2000) and Omar (2007) found significant and positive association of different attributes with grain yield.

Conclusively, results cleared that the highest yield could be obtained from sowing Gemmiza 9 wheat cultivar when planting with 400 or 500 grain / m^2 and N fertilization by ammonium sulphate under clay soil conditions of Sharkia Governorate.

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تأثير معدل التقاوي ومصدر السماد النيتروجيني على إنتاجية بعض أصناف القمح

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قسم المحاصيل – كلية الزراعة – جامعة الزقازيق – مصر

أقيمت تجربتان حقليتان بمزرعة كلية الزراعة – جامعة الزقازيق (مزرعة الزقازيق) – محافظة الشرقية خلال موسمي ٢٠٠٥/٢٠٠٦ و ٢٠٠٦/٢٠٠٧ لدراسة إستجابة أربعة أصناف من القمح (جيزة ١٦٨، جميزة ٧، جميزة ٩ ، سخا ٩٣) لثلاث معدلات تقاوي (٣٠٠، ٤٠٠ ،٥٠٠ حبة / م^{٢}) تحت ثلاث مصادر للنيتروجين (سلفات نشادر، نترات أمونيوم و يوريا) ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي:

لوحظ وجود إختلافات معنوية بين أصناف القمح في كل من إرتفاع النبات، عدد السنابل / م^{٢}، محصولي الحبوب والقش ومعظم مساهمات المحصول حيث سجل الصنف جميزة ٩ وتبعه الصنف جميزة ٧ أعلى محصول حبوب وقش ومحصول كلي عن كلا من جيزة ١٦٨ وسخا ٩٣، بينما لم تلاحظ فروق بين الأصناف تحت الدراسة في كل من طول السنبلة ودليل الحصاد.

لوحظ أن زيادة الكثافة النباتية من ٣٠٠ إلى ٤٠٠ ثم ٥٠٠ حبة / م^{٢} أدت لزيادة معنوية في كل من إرتفاع النبات، عدد السنابل / م^{٢}، محصولي الحبوب والقش والمحصو الكلي / فدان ولكن كان هناك إنخفاضاً معنوياً في كل من طول السنبلة، عدد السنيبلات / السنبلة، عدد حبوب السنبلة، وزن ١٠٠٠ حبة، وزن حبوب السنبلة بينما لم يتأثر دليل الحصاد بتغير الكثافة النباتية خلال موسمي الزراعة والتحليل التجميعي للموسمين.

أدت إضافة النيتروجين على صورة سلفات أمونيوم إلى زيادة معنوية في كل من أرتفاع النبات، عدد السنابل / م^{٢}، طول السنبلة، عدد السنيبلات / سنبلة، عدد حبوب السنبلة، وزن حبوب السنبلة، محصولي الحبوب والقش والمحصول الكلي للفدان في حين سجلت اليوريا أدنى المتوسطات. بينما لم تتاثر كل من وزن ١٠٠٠ حبة ودليل الحصاد بإستخدام أي من صور السماد النيتروجيني.

أظهرت نتائج التفاعل بين عوامل الدراسة تفوق الصنف جميزة ٩ على باقي الأصناف في كل من أرتفاع النبات، عدد السنابل / م٢، عدد حبوب السنبلة ومحصولي القش والكلي للفدان عند زراعته بكثافة نباتية ٤٠٠ أو ٥٠٠ حبة / م٢.

أظهر محصول الحبوب إرتباط موجب ومعنوي مع كل من إرتفاع النبات، عدد السنابل / م٢، عدد السنيبلات / سنبلة، عدد حبوب السنبلة، وزن ١٠٠٠ حبة، وزن حبوب السنبلة، محصول القش / فدان والمحصول الكلي.

التوصيـــــة: توصي الدراسة من خلال النتائج المتحصل عليها بزراعة الصنف جميزة ٩ وبكثافة نباتية ٤٠٠ أو ٥٠٠ حبة / م٢ والتسميد بالنيتروجين على صورة سلفات أمونيوم للحصول على إنتاجية عالية من القمح تحت ظروف الأراضي الطينية بمحافظة الشرقية.