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GROWTH AND PRODUCTIVITY PERFORMANCE OF SOME WHEAT CULTIVARS UNDER VARIOUS NITROGEN FERTILIZATION LEVELS

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ABSTRACT

Two field experiments were carried out in the Research and Experiment Center of the Faculty of Agriculture at Moshtohor, Kalubia Governorate, Zagazig University during 1996/97 and 1997/98 seasons to study the response of some wheat cultivars (Gemmeiza 1, Sids 7, Giza 163 and Sakha 69) to different nitrogen fertilization levels (30, 60, 90 and 120 kg N/fed). Results indicated that increasing nitrogen fertilization levels significantly increased wheat growth, yield and its components compared to the control which fertilized with 30 kg N/fed. Nitrogen level of 90 kg N/fed gave the best results for most of the studied wheat character as spike length, number of spikes/m^2, weight of spike, number of grain/spike, weight of grains/spike, grain yield (kg/fed) and protein percentage as well as 1000-grain weight and straw yield in the first season. Such results were obtained in the two growing seasons. However, the superiority of the application of 120 kg N/fed was noticed only with plant height and spike length in the two seasons, and straw yield per feddan in the first season. Meanwhile, nitrogen fertilization level of 60 kg N/fed produced the highest 1000-grain weight in 1996/97 season only.

Regarding wheat cultivars, Gemmeiza 1 produced the highest values of plant height, number of spikes/m^2, number of grain/spike, weight of grains/spike, grain and straw yields/fed in the two growing seasons. While, Sids 7 produced the tallest spikes, heaviest 1000-grain weight and highest protein percentage in each of the two growing seasons. On the other hand, the lowest grain yield/fed was produced from Sids 7 wheat cultivar in both seasons. Also, Sakha 69 gave the heaviest value for weight of spike in the two seasons.

The interaction between cultivars and N rates significantly affected number of spikes/m^2, number of grains/spike, grain yield/fed and straw yield/fed in both seasons. In addition, spike length, weight of spike and protein percentage were significantly affected by cultivars X N levels in the first season only, whereas of weight of grains/spike and 1000-grain weight in the second season.

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is one of the most important nutritional cereal crops in Egypt and all over the world. Wheat production is not sufficient for local consumption in all of the development countries. Therefore, great efforts have been made to achieve suitable agronomic practices for obtaining higher yield of higher productivity of different wheat varieties. Nitrogen fertilization is considered one of the most essential factors for obtaining higher wheat grain yield of the required quality.

Recently, there is a trend towards using new wheat varieties of better response to higher fertilization levels. Wheat cultivars usually differ in yield and its components especially under various environmental circumstance as reported by Hagras (1985), Shams EL-Din and EL-Habbak (1992); EL-Bana and Ali (1993), EL-Kalla et al. (1994), Sultan et al. (1994), Abd EL-Ghany (1997) and Abo-Warda (1997).

Almost all of the grown cereal crops in most of Egyptian soils showed significant increase in yield as a result of increasing nitrogen application rates to the soil. Moreover, several investigators noticed positive effect of nitrogen application on plant characters, yield and yield components of wheat (Shams EL-Din and EL-Habbak,1992 ; EL-Zein, 1994 ; Mady, 1996 ; Abd EL-Ghany, 1997 ; Abo-Warda, 1997 ; Hamed, 1998 and Mehasen 1999).

This investigation aimed to evaluate the growth behaviuor of wheat and productivity and its parameter of four wheat cultivars using different nitrogen fertilization levels under the circumstance of Southern Delta.

MATERIALS AND METHODS

Two field trails were carried out at the Research and Experimental Center of the Faculty of Agriculture at Moshtohor, Kalubia Governorate, Zagazig University, during the two successive winter seasons of 1996/97 and 1997/98 to evaluate the response of some wheat cultivates to different nitrogen fertilization levels in respect of yield and its components. Wheat cultivars under study were Gemmeiza 1, Sids 7, Giza 163 and Sakha 69. each of the above mentioned cultivars was fertilized with four N levels (30, 60, 90 and 120 kg N/fed).

Soil of the field experimental site was clay in texture with pH value of 7.8 and 7.79, organic matter content of 1.86 %, 1.75 % and 55.49 ppm available N during the two respective growing seasons.

Split-plot design was used in this study with four replications. The tested varieties were set up randomly in the main plots, while the N levels were distributed randomly in the sub plots which were 3 X 3.5 m in an area of 1/400 fed.

Cotton was the preceding crop for the two seasons. Wheat varieties were sown on 23th and 25th November in 1996/97 and 1997/98 seasons, respectively. Nitrogen fertilization was given in the form of ammonium nitrate (33.5 % N) in two equal doses (before the first and second irrigation). Phosphorus was applied during soil preparation as calcium superphosphate (16 % P_2O_5/fed) at 1000 kg/fed. The other required cultural practices for growing wheat were followed properly as recommended for the region.

At harvest, ten plants were randomly chosen from each plot experimental unit to estimate: plant height (cm), length of main spike (cm), number and weight of grains per spike, weight of spike (g) and 1000-grain weight. The yield of grain and straw (kg) per feddan were estimated on the whole sub plot basis, in addition to the ten plants of the previously taken samples. Number of fertile spikes/m^2 was also estimated.

Total nitrogen was determined using microkjeldahl method according to (A.O.A.C., 1975). Protein content of grains was obtained by multiplying nitrogen % by 5.7 (Pregl, 1945).

The obtained data were statistically analysed according to Steel and Torrie (1980) and Least Significant Differences (LSD) was used to compare between treatments means.

RESULTS AND DISCUSSION

I- Effect of cultivars:

Data in Table (1) clearly showed significant differences among the growing wheat cultivars in all of the studied traits in each of the two seasons, except plant height, number of spikes/m^2 and weight of spike in the first season. Moreover, it is clear from Table (1) that Gemmeiza 1 cultivar gave the highest values of plant height, number of spikes/m^2 and number of grains/spike, weight of grains/spike as well as grain and straw yields per feddan compared to the other cultivars. This trend was noticed in the two growing seasons. Such results are in harmony with those reported by (Shams EL-Din and Habbak, 1992 ; EL-Zein, 1994 ; Mady, 1996 ; Abd EL-Ghany, 1997 ; Abo-Warda, 1997 ; Hamed, 1998 and Mehasen 1999).

As for yield and its attributes, namely plant height, number of spikes/m^2, weight of grains/spike as well as grain and straw yields per feddan, results indicated clearly that wheat variety Sids 7 gave the lowest values as compared with the other varieties in all of the studied yield parameters during the two seasons. The cultivar Sids 7 was superior in spike length, weight of 1000 grains and protein percentage as compared with Gemmeiaz 1, Giza 163 and Sakha 69 in the two growing seasons. These results agree with those obtained by Abo EL-Ela, Sabah (2001).

The wheat cultivar Gemmeiza 1 produced the highest values for number of spikes/m^2, number of grains/spike, grain yield/fed and straw yield/fed than any of the grown wheat cultivars in the two seasons. Similar results were obtained by Shams EL-Din and Habbak (1992) and Abo-Warda (1997). These results may be attributed to the differences in their genetical make-up and their interaction with the prevailing environmental conditions and the other circumstance of this study.

Data presented in Table (1) showed that Gemmeiza 1 wheat cultivar was of better performance in grain yield per feddan followed by Sakha 69, then Giza 163. Whereas, Sids 7 cultivar gave the lowest value of grain yield/fed during the two seasons. It could be concluded that varietal differences among wheat cultivars were more likely due to its unique genetical make-up which exert its impact on growth and productivity under prevailing environmental conditions. The grain yield superiority was for Gemmeiza 1 cultivar followed by Sakha 69 as compared with Giza 163 and Sids 7 cultivars. This might be due to the increase in its yield components as, number of spiks/m^2, number of grains/spike and weight of grains/spike Similar results were previously obtained by Shams EL-Din and EL-Habbak (1992), Abd EL-Ghany (1997) and Abo-Warda (1997). They noticed marked differences among wheat varieties in their yield and yield components.

Regarding straw yield/fed, the obtained data in Table (1) showed that Gemmeiza 1 wheat cultivar was the best variety, followed by Sakha 69 then Giza 163 and Sids 7 in the first season. But, in the second season, Giza 163 was superior than Sakha 69 in this studied trait. This result might indicate that the relatively taller plant height was more likely reflected on straw yield.

Table 1: Growth characters, yield and its components of some wheat varieties during the two growing seasons.

Characters / Varieties	Plant height (cm)	Spike length (cm)	No. of spikes /m^2	Weight of spike (g)	No. of grains/ spike	Weight of grains /spike (g)	1000-grain weight (g)	Grain yield (kg/fed)	Straw yield (kg/fed)	Protein %
First season (1996/97)										
Gemmeiza 1	97.6	10.1	323.4	2.3	60.3	3.1	48.3	2035.6	3123.0	12.90
Sids 7	92.8	10.2	315.2	2.2	48.8	2.2	50.3	1817.4	2468.1	13.10
Giza 163	95.2	8.9	318.7	2.3	50.4	2.9	46.8	1910.3	2808.4	12.20
Sakha 69	97.1	7.9	320.9	2.4	57.2	2.3	44.8	1942.7	3000.7	12.00
L.S.D. 5 %	NS	0.60	NS	NS	4.24	0.24	1.63	102.5	165.3	0.61
Second season (1997/98)										
Gemmeiza 1	112.6	10.5	343.5	2.1	61.1	3.2	48.5	2213.5	3387.3	12.80
Sids 7	101.4	10.8	279.6	2.3	54.3	2.2	51.9	1853.8	2960.8	13.20
Giza 163	107.4	8.8	328.3	1.5	49.1	2.8	46.4	1950.2	3327.1	12.30
Sakha 69	103.4	10.5	332.4	2.4	56.0	2.8	47.8	2117.1	3073.1	12.70
L.S.D. 5 %	6.7	1.2	31.3	0.42	5.22	0.31	1.43	205.5	136.5	0.60

Table 2: Effect of nitrogen fertilization levels on growth, yield and its components of wheat during the two growing seasons..

Characters / N levels	Plant height (cm)	Spike length (cm)	No. of spikes /m^2	Weight of spike (g)	No. of grains/ spike	Weight of grains /spike (g)	1000-grain weight (g)	Grain yield (kg/fed)	Straw yield (kg/fed)	Protein %
First season (1996/97)										
30 kg N/fed	79.3	7.8	300.4	2.0	52.1	2.5	46.8	1792.8	2117.1	11.8
60 kg N/fed	100.0	9.8	325.0	2.4	54.9	2.6	48.1	1982.1	3057.9	12.8
90 kg N/fed	100.4	10.0	330.6	2.7	56.1	2.7	47.9	2002.8	3081.8	13.2
120 kg N/fed	103.1	9.8	322.2	2.3	54.7	2.6	47.4	1928.3	3143.4	12.4
L.S.D. 5 %	6.2	0.5	NS	0.23	2.1	0.12	1.1	144.9	143.2	0.87
Second season (1997/98)										
30 kg N/fed	102.3	9.6	313.3	2.0	51.0	2.6	48.2	1812.1	2511.8	11.8
60 kg N/fed	106.0	10.2	323.9	2.1	58.0	2.8	48.9	2164.2	3453.3	12.8
90 kg N/fed	107.8	10.2	327.9	2.2	58.6	2.9	49.0	2169.8	3464.9	13.3
120 kg N/fed	109.1	10.7	318.7	2.0	54.4	2.8	48.5	1988.6	3318.4	12.9
L.S.D. 5 %	4.37	0.52	NS	NS	4.5	0.16	NS	149.5	138.2	0.85

These results are confirmed what was obtained by Shams EL-Din and EL-Habbak (1992)and Abo-Warda (1997).

Concerning protein percentage of wheat cultivars (Table 1), data showed that significant differences among the tested cultivars in the two growing seasons. Wheat cultivar Sids 7 produced the highest content protein on dry matter basis in grain followed by Gemmeiza 1, in both seasons. This result is in agreements with those obtained by Abo EL-Ela, Sabah (2001)

II- Effect of nitrogen fertilization:

Data in Table (2) indicated that, plant height and spike length were significantly affected by increasing N fertilization rates as compared to the control plants which were fertilized with 30 kg N/fed. These results were noticed in the two growing seasons. Nitrogen fertilization rate of 120 kg N/fed produced the tallest plants and highest spike length followed by plants fertilized with 90 and 60 kg N/fed. The stimulation of internode elongation could be real reason for each increase in plant height and spike length which all contributed in the obtained increase in straw yield of wheat as a result of increasing fertilization rates of wheat up to 60 or 90 kg/fed. Similar results were reported by Mahmoud (1987), Khalil (1989) and Shams EL-Din and EL-Habbak (1992).

Number of spikes/m^2 in the two growing seasons and weight of spike in 1997/98 were not significantly affected by applied nitrogen rates. Whereas, weight of spike was significantly affected by increasing N rates in the first season. The highest values were obtained when nitrogen was applied at a rate of 90 kg N/fed compared with the lowest and highest levels in the two seasons.

The application of N fertilizer significantly increased number and weight of grains/spike. Applying 90 kg N/fed produced the highest values during the two growing seasons, followed by the application of 60 and 120 kg N/fed compared to the control (fertilized with 30 kg N/fed). It could be also noticed that the differences between 60, 90 and 120 kg N/fed were not significant for the above mentioned parameters such as a number and weight of grains/spike in the two seasons (Table 2). Also, 1000-grain weight was significantly affected by the application of N levels in the first season. The heaviest weight of grains was obtained from wheat was fertilized with 60 kg N/fed, in the first season and by 90 kg N/fed in the second season. These results agree with those obtained by Shams EL-Din and EL-Habbak (1992) and Abo-Warda (1997).

Data presented in Table (2) showed that the application of 60, 90 and 120 kg N/fed significantly increased grain and straw yields/fed compared with wheat plants that fertilized with 30 kg N / fed (control) in the two growing seasons. The respective increases in grain yield/fed were 10.6, 11.7 and 7.6 % compared with wheat plants of the control (fertilized with 30 kg N/fed) in the first season. The corresponding grain yield increases were 19.4, 19.7 and 9.7 % for the respective N application levels in the second season. It is obviously clear that the greatest increase was obtained by applying 90 kg N/fed, which was superior to any of the applied nitrogen levels in the two seasons. The increase in wheat grain yield per feddan with increasing nitrogen levels up to 90 kg N/fed may be as a result of producing higher number of spikes/m^2, number of grains/spike and weight of grains/spike, which were enhanced and produced by nitrogen which is a major component in chlorophyll and other cellular constituents of plants. Nitrogen proved to have an important essential role in photosynthetic activities which resulted in more carbohydrates formation and accumulation of the other plant constituents which ended up with more growth and yield of wheat.

Concerning straw yield, results in Table (2) showed that the application of 60, 90 and 120 kg N/fed significantly increased straw yield by 44.4, 45.6 and 48.5 % respectively in the first season. It is clear that the highest straw yield was obtained by applying 120 kg N/fed in the first season and 90 kg N/fed in the second season without significant differences between both levels in the first season. Such obtained increase in straw yield/fed by increasing N application rates in more likely due to the obtained increase in plant height and vegetative growth.

The above mentioned results might be attributed to the effect of nitrogen in encouraging cell elongation and division resulting in producing taller internodes, which led to increasing plant and spike length. Similar results were reported by Abd EL-Gawad et al. (1975) who observed an increase in the metabolic processes in wheat plants which in turn stimulated its growth. These reasons account for the obtained superiority of grains number/spike, weight of grains/spike and number of spike/m^2 which induce their impact in increasing grain and straw yield/fed. These results are in agreement with those obtained by Shams EL-Din and EL-Habbak (1992), Abd EL-Ghany (1997), Abo-Warda (1997), Hamed (1998) and Mehasen (1999).

Results in Table (2) indicated that the highest protein content in wheat was produced with the application of 90 kg N/fed in the two seasons, followed by 60 kg N/fed in the first season and by 120 kg N/fed in the second season. It is generally clear that increasing nitrogen levels significantly increased nitrogen content of wheat grains compared with the control (30 kg N/fed) in the two seasons.

III- The interaction effect:

The obtained results showed that significant interaction effect on some of the studied traits of wheat cultivars fertilized with different levels of nitrogen in each of the two seasons (Table 3). Significant interaction effect between varieties and nitrogen levels in 1996/97 season was on the following characters: spike length, number of spikes/m^2, weight of spike, number of grains/spike, grain and straw yields/fed as well as protein percentage.

However, the highest value of spike length was 11.5 cm produced by Gemmeiza 1 wheat cultivar fertilized with 90 kg N/fed. The combination between Gemmeiza 1 and 120 kg N/fed was superior on the number of spikes/m^2 (350.3). Wheat variety Sakha 69 supplied with 90 kg N/fed gave the highest weight of spike (3.01 g). On the other hand, Giza 163 cultivar receiving 90 kg N/fed was the best combination regarding number of grains/spike (63.5). Whereas, Gemmeiza 1 cultivar fertilized with 120 kg

N/fed produced the highest grain yield/fed (2250.3 kg) as well as producing the highest straw yield/fed (3647.2 kg) when supplied with 90 kg N/fed.

The highest protein percentage was 13.42 % produced by Sids 7 cultivar supplied with 120 kg N/fed. In 1997/98 season, the six characters of number of spikes/m^2, weight of grains/spike, number of grains/spike, 1000-grain weight, grain and straw yields/fed were significantly affected by variety X N interaction. The cultivar Gemmeiza 1 receiving 120 kg N/fed produced the greatest number of spikes/m^2 (353.4). Sakha 69 wheat cultivar receiving 90 kg N/fed was the best combination for number of grains/spike (62.9), weight of grains/spike (3.32 g), grain yield/fed (2229.5 kg) and straw yield/fed (3630.5 kg). Meanwhile, Sids 7 wheat cultivar fertilized with 120 kg N/fed produced the heaviest 1000-grain weight (56.1 g).

It could be concluded that under the circumstance of this study, Gemmeiza 1 and Sakha 69 wheat cultivars proved to the most suitable when fertilized with 90 kg N/fed, and could be recommended as far as the grain yield of wheat is concerned.

Table 3: The obtained significant interaction effects of wheat varieties and nitrogen levels during the two growing seasons.

Characters	Treatments	Highest values
1996/97 season		
Spike length (cm)	Gemmeiza 1 X 90 kg N/fed	11.5
No. of spikes/m^2	Gemmeiza 1 X 120 kg N/fed	360.1
Weight of spike (g)	Sakha 69 X 90 kg N/fed	3.01
No. of grains/spike	Giza 163 X 90 kg N/fed	63.5
Grain yield (kg/fed)	Gemmeiza 1 X 120 kg N/fed	2250.3
Straw/yield (kg/fed)	Gemmeiza 1 X 90 kg N/fed	3647.2
Protein %	Sids 7 X 120 kg N/fed	13.42
1997/98 season		
No. of spikes/m^2	Gemmeiza 1 X 120 kg N/fed	353.4
No. of grains/spike	Sakha 69 X 90 kg N/fed	62.9
Weight of grains/spike (g)	Sakha 69 X 90 kg N/fed	3.32
1000-grain weight (g)	Sids 7 X 120 kg N/fed	56.1
Grain yield (kg/fed)	Sakha 69 X 90 kg N/fed	2229.5
Straw/yield (kg/fed)	Sakha 69 X 90 kg N/fed	3630.5

REFERENCES

A.O.A.C. (1975). Official Methods of Analysis, Association of Official Agricultural Chemists, 12th Ed., Washington, D.C.

Abd EL-Gawad, A.M ; M.A. Badr ; N.A. Nour-EL-Din and K.I EL-Sayed (1975). Comparative studies of Giza 155 and Mexibac cultivar of wheat. 1- Effect of nitrogen on growth and yield. Annals Agric. Sci. Moshtohor, 3: 3-11.

Abd EL-Ghany, H.M.A. (1997). Response of some new wheat varieties to some agricultural practices. M. Sc. Thesis, Fac. of Agric. Menofyia Univ., Egypt.

Abou EL-Ela, Sabah, H. (2001). Response of some wheat varieties to mineral and biological nitrogenous fertilizer. Ph. D. Thesis, Fac. of Agric. Moshtohor, Zagazig Univ., Egypt.

Abo-Warda, A.M.A. (1997). Productivity of some wheat cultivars and lines in sandy soils. Egypt. J. Appli. Sci., 12(12): 86-90.

EL-Bana, A.Y.A. and R.M. Ali (1993). Effect of nitrogen fertilization levels on yield and yield attributes of some wheat cultivars (*Triticum aestivum*, L.) in newly cultivated sandy soil. Zagazig J. Agric. Res., 20(6): 1739-1747.

EL-Kalla, S.E. ; A.A. Leilah ; A.H. Basiony and S.H. Hussein (1994). Effect of irrigation and foliar nutrition treatments on growth and yield of some wheat cultivars under AL-Arish area conditions. Proc. of 6^{th} Agron. Conf., AL-Azhar Univ., Egypt, Vol. 1: 365-378.

EL-Zein, A.A.N.I (1994). Effect of levels and forms of nitrogen fertilizer on wheat. Ph. D. Thesis, Fac. of Agric., AL-Azhar Univ.

Hagras, A.M. (1985). Effect of seed rates and nitrogen levels on yield, yield components and protein percentage of some triticale varieties. Annals of Agric. Sci. Fac. of Agric. Ain Shams Univ., 30(2): 951-974.

Hamed, M.F. (1998). Wheat response to inoculation, source and rate of nitrogen fertilization. J. Agric. Sci. Mansoura Univ., 23(3): 1021-1027.

Khalil, M.K. (1989). Effect of nitrogenous fertilization and chemical weed control on growth, yield and technological properties of wheat (*Triticum aestivum*, L.). M. Sc. Thesis, Fac. of Agric , Moshtohor, Zagazig Univ., Egypt, pp: 32-38.

Mady, A.A. (1996). Effect of some cultural practices on yield and seed quality in wheat. M. Sc. Thesis, Fac of Agric Kafr EL-Shikh Univ., Egypt.

Mahmoud, M.A.H. (1987). Effect of some agricultural practices on yield and yield components of some wheat varieties. M. Sc. Thesis, Fac. of Agric. Minia Univ., Egypt pp: 74.82.

Mehasen, S.A.S. (1999) Wheat yield as affected by bio and nitrogen fertilization. Annals Agric. Sci. Moshtohor, 37(1): 157-170.

Pregl, (1945). Quantitative organic micro-analysis. 4^{th} Ed. J. and A. Churchill LTD London.

Shams EL-Din, G.M. and K. EL-Habbak (1992). Response of some wheat varieties to nitrogen fertilization rates. Annals of Agric. Sci Fac. of Agric. Ain Shams Univ., 37(1): 61-68.

Steel, R.C.D. and J.H. Torrie (1980). Principles and procedures of statistics. Mc Grow Hill Book Co, Inc. New York, USA.

Sultan, M.S. ; M.M. Zein EL-Din ; A.M. Salama and I.M. Metwally (1994). Effect of some weed control treatments and N-levels on growth and yield of two wheat cultivars. J. Union Arab. Biolo., 1(B). 149-161.

نمو وكفاءة إنتاجية بعض أصناف القمح تحت مستويات مختلفة من التسميد النيتروجينى

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تم إجراء هذا البحث بمزرعة مركز البحوث والتجارب الزراعية بكلية الزراعة بمشتهر بمحافظة القليوبية خلال موسمى ١٩٩٦/٩٧ و١٩٩٧/٩٨ لدراسة كفاءة إنتاجية أربعة أصناف من القمح وهى (جميزة ١ ، سدس ٧ ، جيزة ١٦٣ وسخا ٦٩) تحت مستويات مختلفة من التسميد النيتروجينى (٣٠ ، ٦٠ ، ٩٠ و١٢٠ كجم نيتروجين/فدان). واستخدم تصميم القطع المنشقة مرة واحدة فى أربعة مكررات حيث وزعت الأصناف عشوائيا فى القطع الرئيسية ومعاملات التسميد النيتروجينى فى القطع الشقية. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

١- تفوق صنف القمح جميزة ١ على باقى الأصناف فى صفات: إرتفاع النبات ، عدد السنابل فى المتر المربع ، عدد الحبوب/سنبلة ، وزن حبوب السنبلة وكذلك تفوق فى محصول الحبوب (كجم/فدان) خلال موسمى التجربة.
٢- تفوق صنف القمح سدس ٧ على باقى الأصناف فى صفات طول السنبلة ووزن الألف حبة ونسبة البروتين ، بينما أعطى أقل محصول للحبوب عن باقى الأصناف خلال الموسمين.
٣- أعطى صنف القمح سخا ٦٩ أعلى وزن لسنابل القمح فى الموسمين عن الأصناف الأخرى.
٤- أدت إضافة السماد النيتروجينى بمعدل ٩٠ كجم نيتروجين/فدان إلى أعلى قيمة فى صفات: طول السنبلة ، عدد السنابل فى المتر المربع ، عدد الحبوب/سنبلة ، وزن حبوب السنبلة ووزن الألف حبة وأيضا محصول الحبوب (كجم/فدان) ونسبة البروتين وذلك خلال الموسمين عن باقى المعدلات.
٥- أدت إضافة السماد النيتروجينى بمعدل ١٢٠ كجم نيتروجين/فدان إلى زيادة إرتفاع النبات وطول السنابل خلال الموسمين أيضا زيادة محصول القش (كجم/فدان) فى الموسم الأول فقط. أدى التسميد بمعدل ٦٠ كجم نيتروجين/فدان إلى زيادة وزن الألف حبة فى الموسم الأول.
٦- أعطى التسميد بمعدل ٣٠ كجم نيتروجين/فدان (معاملة المقارنة) أقل قيم للصفات تحت الدراسة فى كلا الموسمين.
٧- إختلفت أصناف القمح فى إستجابتها للتسميد النيتروجينى حيث كانت أفضل الأصناف إستجابة جميزة ١ عند معدل ٩٠ كجم نيتروجين/فدان على صفات: طول السنبلة ومحصول القش فى الموسم الأول. وجد أن أفضل إستجابة مع معدل ١٢٠ كجم نيتروجين/فدان على صفات: عدد السنابل/م٢ / محصول الحبوب (كجم/فدان) فى الموسم الثانى. فى حين تفوق الصنف سدس ٧ عند التسميد بمعدل ١٢٠ كجم نيتروجين/فدان فى نسبة البروتين فى الموسم الأول ووزن الألف حبة فى الموسم الثانى عن باقى الأصناف. كما أعطى صنف القمح سخا ٦٩ عند معدل ٩٠ كجم نيتروجين/فدان أعلى وزن للسنبلة فى الموسم الأول وأيضا تفوق فى عدد الحبوب/سنبلة ، وزن حبوب السنبلة ومحصول الحبوب للفدان وكذلك محصول القش للفدان فى الموسم الثانى عن باقى الأصناف. بينما تفوق صنف القمح جيزة ١٦٣ عند معدل ٩٠ كجم نيتروجين/فدان فى عدد حبوب السنبلة فى الموسم الثانى عن باقى الأصناف.

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EFFECT OF WATER STRESS AND PACLOBUTRAZOL APPLICATION ON GROWTH AND YIELD OF WHEAT PLANTS

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ABSTRACT

Two field experiments were carried out at the Agricultural Experimental Station of National Research Centre, at Shalakan, Kalubia Governorate during 2000/2001 and 2001/2002 seasons to study the effect of water stress (missing one irrigation at tillering, heading and milk-ripe stage) and paclobutrazol concentrations (0, 25, 50 and 100 ppm) on growth, yield and its attributes as well as grain total carbohydrates of wheat (Sakha 69 cv.). The results revealed that missing one irrigation at any of the three studied stages significantly reduced growth parameters and yield characters as well as the percentage of total carbohydrate and total carbohydrates yield as compared with the control plants (irrigation every 30 days).

The depressing effects of soil moisture stress were comparatively, high at tillering, intermediate at heading and low at milk-ripe stage. On the other hand, increasing the concentration of paclobutrazol up to 50 ppm significantly increased the aforementioned parameters as compared to the untreated plants. Increasing the concentrations of paclobutrazol up to 50 ppm increased weight of grain per plant, straw and biological yields per feddan and total carbohydrate percentage under the different irrigation treatments. The results suggested that irrigation every 30 days and application of paclobutrazol concentration at 50 ppm could be recommended for maximum yield of wheat plants under similar conditions.
Keywords: Water stress, Paclobutrazol, Wheat, Growth, Yield.

INTRODUCTION

Wheat (*Triticum aestivum vulgare* L.) is considered the main cereal grain crop in the world as well as in Egypt. Therefore, increasing grains production is considered one of the most important national aims in Egypt to face the great demand of the highly increasing population . Additional data (Mc Master *et al* 1994) demonstrated that water stress near jointing is a critical limitation to final yield production by reducing the number of secondary tiller spikes and later-appearing of primary tiller spikes. Further studies (Abo-Shetaia & Abd El-Gawad, 1995; Sawires, 2000; Kandil *et al* 2001 and Kassab *et al* 2004) revealed that skipping an irrigation either at tillering, heading, milk-ripe or dough-ripe stage depressed all growth characters studied, yield and yield attributes.

On the other hand, chemical plant growth regulators are increasingly being used to manipulate plant growth and yield. Paclobutrazol (PP_{333}) is a plant growth retardant and has been extensively used to reduce shoot vegetative growth, increase the yield of many different crops and to improve plant tolerance to water stress (Zhou & Xi, 1993; Wen xun *et al* 1995 and Abo El-Kheir *et al* 2000).

Therefore, the present study was undertaken to determine the efficiency of paclobutrazol to overcome the harmful effects of water stress on growth, yield and its attributes as well as grain total carbohydrate of wheat plants.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons 2000/2001 and 2001/2002 at the Agricultural Experimental Station of the National Research Centre at Shalakan, Kalubia Governorate, Egypt in order to study the efficiency of paclobutrazol application on wheat plants grown under moisture stress imposed at three reproductive stages.

The investigation included 16 treatments which are the combination of four irrigation treatments and four paclobutrazol concentrations. A split-plot design with three replications was employed. The main plots were devoted to irrigation treatment and the sub plots were assigned for paclobutrazol concentrations.

Water stress treatments were imposed to the plants by missing one irrigation at tillering, heading and milk-ripe stages which were corresponding to 60, 90 and 120 days from sowing, respectively.

In both seasons, wheat plants of each water stress treatment were sprayed till drip, twice at 55 and 85 days after sowing, with either tap water (as control), or aqueous solution of paclobutrazol (25, 50 and 100 ppm). Paclobutrazol (PP_{333}) is a plant growth retardant and chemically known as (2RS, 3RS)-1- (4-Chlorophenyl)-4, 4-dimethyl 1-2 (1H-1, 2,4-triazol-1-y1) pentan-3-01.

The experimental plot area was 10.5 m^2 (3.5 x 3.0 m). Plots were isolated by borders of 1.5 m in width from all sides to avoid the effect of lateral movement of irrigation water. The soil texture was clay loam in both seasons. Wheat grains (*Triticum aestivum vulgare* L.) cv. Sakha 69 were sown on November 19 and November 17 in the first and second season, respectively. Phosphorus and potassium fertilizers were added to the soil before sowing at the rate of 30 kg P_2O_5/fed. in the form of calcium superphosphate (15.5% P_2O_5) and 24 kg K_2O/ fed. in the form of potassium sulphate (48% K_2O). Ammonium nitrate (33.5% N) was applied at the rate of 60 kg N/fed. in two equal portions before the first and second irrigation. Harvest date was 14^{th} and 16^{th} of May in the first and second season, respectively. Representative plant sample was collected from three replicates of each treatment after 137 days from planting and the following growth characters were measured: Plant height, number of both tillers, leaves and spikes per plant as well as root, stem, leaves, spikes and total dry matter per plant. At harvesting the middle one meter square was harvested from three replicates for each treatment for calculating grain weight per plant, 1000-grain weight, grain, straw and biological yields per feddan. Moreover, a representative samples were taken from three replicates to estimate grain yield/plant. Total carbohydrate content in the harvested grains was determined using the method adopted by Dubois *et al* (1956). The carbohydrate yield/fed. was calculated by multiplying the percentage of each constituent by grain yield / fed. The obtained data were subjected to the statistical analysis of variance described by Snedecor and Cochran (1980) and the combined analysis of results of the two seasons were applied according to the method adopted by Steel and Torrie (1960).

RESULTS AND DISCUSSION

1. Vegetative growth

Data presented in Table (1) show that exposing wheat plants to water stress at each tillering, heading or milk ripe stages resulted in significant reduction in plant height, number of tillers, leaves and spikes per plant as well as the dry matter of root, stem, leaves, spikes and total per plant as compared with control treatment (irrigation every 30 days). This was true when one irrigation was skipped at each tillering, heading or milk-ripe stage. However, the response of wheat plants to water stress was more pronounced at tillering stage than the other two stages. The effect of water stress on cell division and enlargement has been carefully discussed by Kramer and Boyer (1995). These results are in agreement with those obtained by Abd El-Gawad *et al* (1993a); Abo Shetaia & ABd El-Gawad (1995) and Kandil *et al* (2001).

Such depression may be attributed to the general retardation of the enzymatic processes particularly those concerning with the reduction in photosynthetic rates (Abd El-Gawad *et al* 1993a).

The obtained results reveal further that foliar application of paclobutrazol significantly affected the vegetative growth i.e. Plant height, number of tillers, leaves and spikes per plant as well as the dry matter of root, stem, leaves, spikes and total per plant. Increasing the concentration of paclobutrazol up to 50 ppm caused a significant increase in the aforementioned parameters. Similar results were obtained by Zhou and Xi (1993) on rape, Wen Xun *et al* (1995) on rice and Abo El-Kheir *et al* (2000) on sunflower

The interaction effect between water stress and paclobutrazol concentrations was significant for plant height, number of tillers, leaves and spikes per plant as well as the dry matter of root, stem, leaves, spikes and total per plant, it can be clearly noticed that increasing the concentration of paclobutrazol up to 50 ppm(control treatment), increased the aforementioned parameters as compared with the other treatments (Table, 1).

2- Yield, its attributes and grain total carbohydrate

Data shown in Table (2) elucidate that shortage of water at either tillering, heading or milk ripe-stage caused a significant reduction in the weight of grain per plant 1000-grain weight, grain, straw and biological yields per feddan as well as total carbohydrate percentage and carbohydrate yield per feddan as compared with well irrigated plants. This was true if one irrigation was missed at each tillering, heading or milk-ripe stage. However, the response of wheat plants to water stress was more pronounced at tillering stage than the other two stages.

These results are in agreement with those obtained by Abd El-Gawad *et al* (1993b); Abo-Shetaia & Abd El-Gawad (1995); Sawires (2000); Kandil *et al* (2001) and Kassab *et al* (2004).

Table (1): Effect of water stress, paclobutrazol and their interaction on growth characters of wheat plants at 137 days from sowing (combined analysis of 2000/2001 and 2001/2002 seasons).

Treatments			Plant height (cm)	No. of Tillers/ plant	No. of Leaves/ plant	No. of spikes/ plant	Dry matter / plant (g) Root	Stem	Leaves	Spikes	Total
Water Stress (WS)	Unstressed (control)		120.39	5.30	15.39	5.50	3.33	10.61	4.47	7.25	25.66
	Missing one irrigation at tillering stage		104.25	3.42	12.08	3.47	2.11	7.36	2.22	3.50	15.19
	Missing one irrigation at heading stage		110.25	4.00	13.16	4.08	2.31	8.08	2.94	4.39	17.72
	Missing one irrigation at milk-ripe stage		114.47	4.19	14.05	4.50	2.75	9.39	3.42	5.47	21.02
L.S.D at 5% level for: WS			1.05	0.16	0.17	0.42	0.24	0.31	0.11	0.24	0.37
Paclobutrazol concentrations (PP)	0		106.19	3.36	12.66	3.56	2.28	7.47	2.05	3.83	15.63
	25		111.25	3.97	13.55	4.17	2.53	8.53	3.11	4.86	19.02
	50		118.89	5.39	15.00	5.58	3.16	10.89	4.61	6.80	25.47
	100		113.03	4.19	13.47	4.25	2.53	8.55	3.28	5.11	19.47
L.S.D at 5% level for: PP			0.89	0.16	0.22	0.36	0.12	0.17	0.15	0.22	0.36
Interaction (WS x PP)	Unstressed (control)	0	114.33	4.22	14.11	4.33	3.00	9.11	3.11	5.55	20.77
		25	118.33	4.78	14.78	4.89	3.22	10.11	4.11	7.11	24.55
		50	128.78	7.11	17.66	7.33	4.00	13.00	6.33	9.11	32.44
		100	120.11	5.11	15.00	5.44	3.11	10.22	4.33	7.22	24.88
	Missing one irrigation at tillering stage	0	97.11	3.00	11.00	3.00	2.00	6.111	1.33	2.55	11.99
		25	103.00	3.00	12.11	3.44	2.00	7.00	2.22	3.22	14.44
		50	111.22	4.11	13.11	4.00	2.33	9.22	3.11	5.00	19.66
		100	105.67	3.55	12.11	3.44	2.11	7.11	2.22	3.22	14.66
	Missing one irrigation at heading stage	0	104.11	3.00	12.33	3.11	2.00	6.55	1.78	3.11	13.44
		25	110.55	4.00	13.22	4.00	2.11	7.78	3.00	4.11	16.89
		50	115.11	5.00	14.11	5.22	3.00	10.22	4.00	6.22	23.44
		100	111.22	4.00	13.00	4.00	2.11	7.78	3.00	4.22	17.11
	Missing one irrigation at milk-ripe stage	0	109.22	3.22	13.22	3.78	2.11	8.11	2.00	4.11	16.33
		25	113.11	4.11	14.11	4.33	2.78	9.22	3.11	5.11	20.22
		50	120.44	5.33	15.11	5.78	3.33	11.11	5.00	6.89	26.33
		100	115.11	4.11	13.78	4.11	2.78	9.11	3.55	5.78	21.22
L.S.D at 5% level for: WS x PP			1.78	0.32	0.44	0.73	0.24	0.35	0.31	0.45	0.72

Table (2): Effect of water stress, paclobutrazol and their interaction on yield, its attributes and grain total carbohydrates (%) of wheat (combined analysis of 2000/2001 and 2001/2002 seasons).

Treatments			Wt. of grains /plant (g)	1000-grain wt. (g)	Grain yield/ fed. (kg)	Straw yield/fed. (kg)	Biological yield /fed. (kg)	Carbohydrate yield /fed. (kg)	Total carbohydrate (%)
Water	Unstressed (control)		17.90	41.48	2383.08	3276.75	5659.83	1561.33	65.41
Stress	Missing one irrigation at tillering stage		11.05	37.55	1718.17	2723.83	4442.00	1088.97	63.25
(WS)	Missing one irrigation at heading stage		12.68	35.33	1945.83	2940.75	4886.58	1196.55	61.35
	Missing one irrigation at milk-ripe stage		14.59	33.37	2211.25	3043.17	5254.42	1338.24	60.44
L.S.D at 5% level for: WS			0.15	1.32	32.09	45.09	20.71	19.46	0.17
Paclobutrazol concentrations (PP)	0		12.33	35.33	1852.92	2795.25	4648.17	1128.48	60.78
	25		13.96	36.63	2037.42	2965.92	5003.33	1270.99	62.34
	50		16.50	38.78	2283.83	3236.08	5519.92	1476.58	64.59
	100		13.42	37.00	2084.17	2987.25	5071.42	1309.04	62.76
L.S.D at 5% level for: PP			0.17	0.76	29.85	44.00	35.73	18.69	0.14
Interaction (WS x PP)	Unstressed (control)	0	16.12	40.16	2160.00	3062.00	5222.00	1369.83	63.42
		25	17.87	41.19	2343.00	3214.67	5557.67	1526.13	65.14
		50	20.33	43.26	2619.67	3606.33	6226.00	1773.06	67.68
		100	17.28	41.32	2409.67	3224.00	5633.67	1576.29	65.42
	Missing one irrigation at tillering stage	0	9.18	35.50	1512.33	2541.00	4053.33	923.47	61.06
		25	11.35	37.96	1685.33	2742.67	4428.00	1064.52	63.16
		50	13.14	39.58	1932.33	2901.33	4833.67	1259.58	65.19
		100	10.52	37.19	1742.67	2710.33	4453.00	1108.32	63.60
	Missing one irrigation at heading stage	0	11.10	33.30	1735.67	2734.33	4470.00	1036.81	59.55
		25	12.30	35.15	1925.33	2950.33	4875.67	1174.04	60.98
		50	15.07	37.65	2141.67	3115.00	5256.67	1357.90	63.40
		100	12.24	35.22	1980.67	2963.33	4944.00	1217 46	61.47
	Missing one irrigation at milk-ripe stage	0	12.93	32.35	2003.67	2843.67	4847.33	1183.81	59.08
		25	14.32	32.23	2196.00	2956.00	5152.00	1319.29	60.08
		50	17.45	34.63	2441.67	3321.67	5763.33	1515 77	62.08
		100	13.64	34.28	2203.67	3051.33	5255.00	1334.09	60.54
L.S.D at 5% level for: WS x PP			0.35	N.S	N.S	87.99	71.46	N.S	0.29

تأثير الإجهاد المائي والمعاملة بالباكلوبترازول علي نمو ومحصول نباتات القمح

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أقيمت تجربتان حقليتان بمزرعة المركز القومي للبحوث بشلقان (محافظة القليوبية) خلال موسمي ٢٠٠٠-٢٠٠١، ٢٠٠١-٢٠٠٢ بهدف دراسة تأثير معاملات الري (الري كل ٣٠ يوم، حرمان رية واحدة عند كل من مرحلة التفريع، وطرد السنابل، وطور النضج اللبني) وتركيزات منظم النمو الباكلوبترازول (صفر، ٢٥، ٥٠، ١٠٠ جزء في المليون) علي النمو والمحصول وصفاته ومحتوى ومحصول الكربوهيدرات الكلية للقمح صنف سخا ٦٩.

ويمكن إيجاز أهم النتائج فيما يلي:

- أدى تعريض النباتات للإجهاد المائي نتيجة الحرمان من الري في أي من المراحل الثلاث المشار إليها إلي نقص معنوي في صفات النمو (وهي ارتفاع النبات وعدد كل من الأشطاء والأوراق والسنابل للنبات وكذلك المادة الجافة لكل من الجذور والساق والأوراق والسنابل للنبات والمادة الجافة الكلية للنبات)، والمحصول وصفاته (وهو وزن الحبوب للنبات ووزن الـ ١٠٠٠ حبه ومحصول كل من الحبوب والقش والمحصول البيولوجي للفدان) ومحتوى ومحصول الكربوهيدرات الكلية مقارنة بنباتات الري المنتظم (معاملة المقارنة)- وكان هذا التأثير السلبي مرتفعا نسبيا عند مرحلة التفريع، ومتوسطا عند مرحلة طرد السنابل وقليلا عند مرحلة النضج اللبني.
- أدت معاملة نباتات القمح بمنظم النمو الباكلوبترازول بتركيز حتى ٥٠ جزء في المليون إلي زيادة معنوية في معظم الصفات المدروسة للنمو والمحصول وصفاته ومحتوى ومحصول الكربوهيدرات الكلية مقارنة بالنباتات غير المعاملة.
- بالنسبة للتفاعل بين الإجهاد المائي والمعاملة بالباكلوبترازول أدى زيادة تركيز الباكلوبترازول حتى ٥٠ جزء في المليون إلى زيادة صفة وزن حبوب النبات ، محصول القش، المحصول البيولوجي للفدان ومحتوى الكربوهيدرات تحت معاملات الري المختلفة.
- يمكن التوصية برش نباتات القمح بمنظم النمو الباكلوبترازول بتركيز ٥٠ جزء في المليون مع استمرار الري كل ٣٠ يوما وذلك لتحقيق أعلى محصول من نباتات القمح.