

## **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<sup>2</sup>, 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<sup>2</sup>, 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<sup>2</sup>, 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 Hagrais (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 behaviour 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 cultivars 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 23<sup>th</sup> and 25<sup>th</sup> 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<sub>2</sub>O<sub>5</sub>/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<sup>2</sup> 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<sup>2</sup> 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<sup>2</sup> 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<sup>2</sup>, 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<sup>2</sup>, 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 spikes/m<sup>2</sup>, 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 <sup>2</sup>	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 %
<b>First season (1996/97)</b>										
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
<b>Second season (1997/98)</b>										
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 <sup>2</sup>	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 %
<b>First season (1996/97)</b>										
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
<b>Second season (1997/98)</b>										
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<sup>2</sup> 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<sup>2</sup>, 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 is 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<sup>2</sup> 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<sup>2</sup>, 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<sup>2</sup> (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<sup>2</sup>, 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<sup>2</sup> (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 be 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 <sup>2</sup>	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 <sup>2</sup>	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

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## نمو وكفاءة إنتاجية بعض أصناف القمح تحت مستويات مختلفة من التسميد النيتروجيني

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تم إجراء هذا البحث بمزرعة مركز البحوث والتجارب الزراعية بكلية الزراعة بمشتهر بمحافظة اقليوبية خلال موسمي ٩٧/١٩٩٦ و ٩٨/١٩٩٧ لدراسة كفاءة إنتاجية أربعة أصناف من القمح وهي (جميزة ١ ، سدس ٧ ، جيزة ١٦٣ وسخا ٦٩) تحت مستويات مختلفة من التسميد النيتروجيني (٣٠ ، ٦٠ ، ٩٠ و ١٢٠ كجم نيتروجين/فدان). وأستخدم تصميم القطع المنشقة مرة واحدة في أربعة مكررات حيث وزعت الأصناف عشوائياً في القطع الرئيسية ومعاملات التسميد النيتروجيني في القطع الشقية. ويمكن تلخيص أهم النتائج المتحصلاً عليها فيما يلي:

- ١- تفوق صنف القمح جميزة ١ على باقي الأصناف في صفات: إرتفاع النبات ، عدد السنابل في المتر المربع ، عدد الحبوب/سنبل ، وزن حبوب السنبله وكذلك تفوق في محصول الحبوب (كجم/فدان) خلال موسمي التجربة.
- ٢- تفوق صنف القمح سدس ٧ على باقي الأصناف في صفات طول السنبله ووزن الألف حبة ونسبة البروتين ، بينما أعطى أقل محصول للحبوب عن باقي الأصناف خلال الموسمين.
- ٣- أعطى صنف القمح سخا ٦٩ أعلى وزن لسنابل القمح في الموسمين عن الأصناف الأخرى.
- ٤- أدت إضافة السماد النيتروجيني بمعدل ٩٠ كجم نيتروجين/فدان إلى أعلى قيمة في صفات: طول السنبله ، عدد السنابل في المتر المربع ، عدد الحبوب/سنبله ، وزن حبوب السنبله ووزن الألف حبة وأيضاً محصول الحبوب (كجم/فدان) ونسبة البروتين وذلك خلال الموسمين عن باقي المعدلات.
- ٥- أدت إضافة السماد النيتروجيني بمعدل ١٢٠ كجم نيتروجين/فدان إلى زيادة إرتفاع النبات وطول السنابل خلال الموسمين أيضاً زيادة محصول القش (كجم/فدان) في الموسم الأول فقط. أدى التسميد بمعدل ٦٠ كجم نيتروجين/فدان إلى زيادة وزن الألف حبة في الموسم الأول.
- ٦- أعطى التسميد بمعدل ٣٠ كجم نيتروجين/فدان (معامله المقارنة) أقل قيم للصفات تحت الدراسة في كلا الموسمين.
- ٧- اختلفت أصناف القمح في إستجابتها للتسميد النيتروجيني حيث كانت أفضل الأصناف إستجابة جميزة ١ عند معدل ٩٠ كجم نيتروجين/فدان على صفات: طول السنبله ومحصول القش في الموسم الأول. وجد أن أفضل إستجابة مع معدل ١٢٠ كجم نيتروجين/فدان على صفات: عدد السنابل/م<sup>٢</sup> / محصول الحبوب (كجم/فدان) في الموسم الثاني. في حين تفوق الصنف سدس ٧ عند التسميد بمعدل ١٢٠ كجم نيتروجين/فدان في نسبة البروتين في الموسم الأول ووزن الألف حبة في الموسم الثاني عن باقي الأصناف. كما أعطى صنف القمح سخا ٦٩ عند معدل ٩٠ كجم نيتروجين/فدان أعلى وزن للسنبله في الموسم الأول وأيضاً تفوق في عدد الحبوب/سنبله ، وزن حبوب السنبله ومحصول الحبوب للفدان وكذلك محصول القش للفدان في الموسم الثاني عن باقي الأصناف. بينما تفوق صنف القمح جيزة ١٦٣ عند معدل ٩٠ كجم نيتروجين/فدان في عدد حبوب السنبله في الموسم الثاني عن باقي الأصناف.