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GROWTH OF THREE WHEAT CULTIVARS AND NITROGEN USE EFFICIENCY AS AFFECTED BY NITROGEN FERTILIZER LEVELS AND SEEDING RATES

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ABSTRACT

Two field experiments were carried out during 2014/2015 and 2015/2016 seasons at Agric. Exp. Res. Sta. at Giza, Fac. Agric., Cairo Univ. to study the influence of three nitrogen fertilizer levels (75, 100 and 125 kg N/fad.), three seeding rates (200, 300 and 400 grains/m^2), on growth of three wheat cultivars (Sakha-94, Gemmiza-9 and Giza-168). Nitrogen levels had significant effect on heading and plant height in the first season only and on flag leaf area in both seasons. Absolute growth rate (AGR) was significantly affected by N levels at 80 days from sowing. Leaf area index (LAI) was significantly affected by N levels at 80 and 100 days in the second season only. Net assimilation rate (NAR) significantly increased with increasing N levels. In general, all previous characters were increased with increasing N levels up to 125 kg N/fad. Nitrogen use efficiency (NUE) significantly decreased with increasing N levels. Seeding rates had significant effect on LAI at 80 days in the first season and on AGR at 80 in the first season as well as at 80 and 100 days in both seasons, respectively. The highest values for the previous traits were produced with seeding 300 or 400 grains/m^2. Seeding rates did not affect NAR. Nitrogen use efficiency was not affected by seeding rates. Plant height and heading significantly affected by cultivars. AGR at 80 days in the first season and at 100 days in both seasons significantly affected by cultivars. LAI at 60, 80 and 100 days significantly affected by cultivars. Cultivars significant affected NAR except at 100 days in the first season. Cultivars did not affect NUE. All interactions had a significant effect on growth characters in both seasons, except the effect of N levels × seeding rates on flag leaf area, LAI at 60 days, plant height and number of tillers/ m^2, N levels × cultivars on LAI at 60 days, plant height and number of tillers/m^2, seeding rates × cultivars on LAI at 100 days in both seasons, plant height and number of tillers/m^2 in the first season as well as LAI at 80 days in the second one and N levels × seeding rates × cultivars on flag leaf area, plant height and number of tillers/m^2 in the first season. The overall findings concluded that seeding Gemmiza-9 or Giza-168 with 300 or 400 grains/m^2 and application of 125 kg N/fad., could be more beneficial in the study area. Some interactions had significant effect on NAR. Moreover, none of studied interactions significantly affected NUE.

Key words: Wheat, growth, seeding rates, N levels, cultivars, NUE.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is cultivated worldwide primarily/mainly as a food commodity. It is one of the type dominate crop in the world as well as in Egypt. During recent years, many approaches have been made towards improvement yield potentials of wheat crop. Men depend on wheat crop for food and feed animals (Hussain *et al.,* 2012 ; Gheith *et al.,* 2013). Nitrogen fertilization is the most factors in front of wheat agronomist for achieving large grain yield targets. Crop growth parameters depend on environment condition. Achieving higher growth of wheat is well governed by planting on suitable density and applying of optimal nitrogen levels and favorable climatic condition. The growth

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attributes are directly influenced by different nitrogen levels (Iftikhar *et al.,* 2012; Achakzai, 2012; Gheith *et al.,* 2013) as well as by cultivars (Javaid Iqbal *et al.,* 2012; Gheith *et al.,* 2013). It is a well-established fact that plant structure is determined by growth parameters such as dry matter accumulation, flag leaf area, leaf area index, crop growth rate, relative growth rate, net assimilation rate, relative water content, relative chlorophyll content, plant height and number of tillers/m^2. These concepts not only involve the final crop yield and its components, but a probe into physiological events that have occurred early in the growth stages causing variation in yield potential (El-Seidy *et al.*, 2015). The present study was designed to investigate the effect of nitrogen fertilizer levels, seeding rates on growth characters of three wheat cultivars.

MATERIALS AND METHODS

Three wheat cultivars were studied under three seeding rates and three nitrogen fertilizer levels (Table 1). Experiments were conducted at Agric. Exp. Res. Sta., at Giza, Fac. Agric., Cairo Univ. during two successive winter seasons 2014/2015 and 2015/2016.

Two soil samples were randomly taken from the experimental area at a depth of 0 to 30 cm from soil surface before wheat sowing to evaluate the mechanical and chemical characters of the soil (Table 2).

The meteorological data recorded during cropping period (November to May) at the meteorological Sta. Agric. Res. Cent., Minis. Agric., Giza is presented in Table 3.

The preceding crop was corn in the two seasons. Grains of each cultivar were sown in 10 rows (2.0 m long and 20 cm apart) on the third week of November in both seasons. These experiments were laid out in a randomized complete block design having split-split-plot arrangement with four replications. All recommended culture practices were applied according to Ministry of Agriculture recommendations.

Data Recorded

Tillers of half long meter were randomly taken from the second inner rows of each plot at 60, 80 and 100 days ages after sowing to determine growth characters. Each sample was separated into stems and leaves, and then leaf area (blades area) was measured by portable area mater (Model El-3000 A). Tillers organs were dried separately in an electrical air-draft oven at 70°C until constant weight for determination whole dry weight. Growth characters were estimated as follows:

Absolute growth rate (AGR) is defined as the increase in dry weight of tillers per unit of time.

$$AGR = \frac{(W_2 - W_1)}{(T_2 - T_1)} = g/day$$

Where:

W_1 and W_2 refer to dry weight at time (T_1 and T_2), respectively, in days according to Radford (1967).

Net assimilation rate (NAR) is defined as the increase of plant material per unit of material present per unit assimilatory material per unit of time according to Rodford (1967).

$$NAR = \frac{(W_2 - W_1)\,(\log_e A_2 \;\; Loge\, A_1)}{(A_2 - A_1)\,(T_2 - T_1)}\ g/m^2/day$$

Where:

W_1, A_1 and W_2, A_2, respectively refer to dry weight and leaf area at time (T_1) and (T_2) in days.

Leaf area index (LAI) is defined as total area of leaves compared with the area of land occupied by the tillers according to Watson (1952) as described by the following formula:

$$LAI = \frac{\text{leaf area / tillers } (cm^2)}{\text{Tillers ground area } (cm^2)}$$

Nitrogen use efficiency (NUE) is defined as the extra grain yield harvest for each increase in applied nitrogen according to Good *et al.* (2004) and Rasmaussen *et al.* (2015).

At harvest, plant height and number of tillers/m^2 were measured. All the data collected during the both seasons were subjected to statistical analysis using Excel data sheet by using statistical software package MSTAT-C (Michigan State University, 1990). Least significant differences test (LSD) at 5% probability was used to test the significances among mean values of each treatment (Steel and Torrie, 1977).

Table 1. The studied wheat cultivars, seeding rates and nitrogen levels.

Wheat cultivar	Seeding rate (grain/m^2)	Nitrogen level (kg/fad.)
Sakha-94	200	75
Giza-168	300	100
Gemmiza-9	400	125

* One faddan= 4200 m^2

Table 2. Soil analyses of the experimental field in both seasons

Season	Mechanical characters				
	Particle size distribution			Texture class	Organic matter (%)
	Sand (%)	Silt (%)	Clay(%)		
2014/2015	38.4	23.4	38.2	Clay loam	1.6
2015/2016	38.2	24.6	37.2	Clay loam	1.9
	Chemical characters				
	Available N, P, K (ppm)			**pH**	**EC mmhos/cm 25 °C**
	N[1]	**P[2]**	**K[3]**		
2014/2015	46.5	13.7	366.0	7.6	2.3
2015/2016	49.8	15.3	367.4	7.7	2.4

1, 2 and 3= N, P and K were evaluated according to Jackson (1958), Olsien *et al.* (1954) and Pipper (1950), respectively.

Table 3. Temperature, average relative humidity and rainfall during the two growing seasons of wheat crop at Giza, Egypt

Month	Temperature (°C)				Relative Humidity (%)		Rainfall (mm.)	
	Max.	Min.	Max.	Min.				
	2014/2015 season		2015/2016 season		2014/2015 season	2015/2016 season	2014/2015 season	2015/2016 season
Nov.	25.1	13.9	26.9	15.7	59.0	46.0	2.5	1.0
Dec.	24.6	11.4	21.6	9.9	56.0	64.7	0.0	4.1
Jan.	19.9	7.1	18.9	10.0	54.0	53.2	4.0	5.2
Feb.	21.4	8.2	25.4	13.4	51.0	52.3	3.1	3.7
Mar.	25.4	12.1	26.5	15.9	52.0	52.4	0.3	0.2
Apr.	28.5	12.0	35.0	19.8	43.0	41.0	0.0	0.0

May	34.2	17.0	32.9	20.5	43.7	42.3	0.0	0.0

RESULTS AND DISCUSSION

Number of Days to 50% Heading

Results presented in Tables 4 and 5 show that significant effect for nitrogen levels in the first season. It is evident from these results that heading was delayed from 88.50 to 90.38 days in the first season and from 88.86 to 89.58 days in the second one by increasing N levels from 75 to 125 kg N/fad. The increment in heading period may be due to nitrogen addition that favored vegetative growth which in turn delayed time of heading. These results are in harmony with those obtained by Hamam and Khaled (2009) and Gheith *et al.* (2013). Results presented in Tables 4 and 5 show no significant effect for seeding rates on heading. Moreover, significant variations among the cultivars in number of days to heading were noticed (Tables 4 and 5). Gemmiza-9 ranked first (94.41 and 94.25 days) followed by Sakha-94 (91.11 and 90.63 days), while Giza-168 (83.27 and 82.83) ranked third in both seasons, respectively. These variations in cultivars partially reflect their different genetic background. These results are in agreement with those obtained by Gheith *et al.* (2013). Number of days to 50% heading was significantly affected by all studied interactions in both seasons (Tables 4 and 5). The earliest treatment was seeding Giza-168 with 200 or 400 grains/m^2 and fertilizing with 75 or 100 kg N/fad.

Flag Leaf Area

Flag leaf area was significantly affected by nitrogen levels in both seasons and by cultivars in the first season. On the contrary, this effect was not significant with seeding rates in both seasons (Tables 4 and 5). The highest flag leaf area (39.95 and 57.31 cm^2) was observed with application of 100 kg N/fad., while the lowest values (33.85 and 53.41 cm^2) were produced at 75 kg N/fad., in both seasons, respectively. These results are in harmony with those of Ali Rahimi (2012) and Gheith *et al.* (2013) who revealed those highly significant differences between N levels on this trait. Flag leaf area decreased with increasing seeding rates without any significant in both seasons. Moreover, Gemmiza-9 ranked 1st, Sakha-94 ranked 2nd and Giza-168 came 3rd in the first season. All interactions had a significant effect on flag leaf area in both seasons, except N levels × seeding rates and N levels × seeding rates × cultivars in the first season (Tables 4 and 5). Seeding Giza-168 with 300 grains/m^2 and application of 100 kg N/fad., had the largest flag leaf area.

Leaf Area Index (LAI)

Results reviled that differences in LAI throughout the different growth stages due to changing levels of nitrogen were significant at 80 and 100 days age in the second season only (Tables 4 and 5). Generally, LAI increased with increasing N application up to 125 kg N/fad. Increasing N levels up to 125 kg N/fad., increased LAI at 60, 80 and 100 days. The increase in LAI occurred may be due to the increase in leaf expansion. These results are in agreement with those obtained by Ali Rahimi (2012) and Alam (2013). LAI was not statistically affected by seeding rates at all samples in both seasons, except at 80 days in the first season, where the highest value (9.78) was observed at 400 grains/m^2. Cultivars had a significant effect on LAI at all growth stages in both seasons. The superior cultivar was Gemmiza-9 which produced the highest LAI, while the lowest values recorded by Giza-168 at all stages in both seasons. These results might be attributed to the prevailed differences in the makeup of cultivars. Results in Tables 4 and 5 show that all interactions had significant effect except N levels × seeding rates and N levels × cultivars in first season at 60 days. Whereas, at 80 days this trait significantly affected by all interactions except seeding rates × cultivars interaction in the second season. At 100 days, N level × cultivars and seeding rates × cultivars and all studied interactions significantly affected this trait. Generally, the largest value was obtained with seeding Gemmiza-9 or Giza-168 with 300 or 400 grains/m^2 and application of 125 kg N/fad.

Absolute Growth Rate (AGR)

The absolute growth rate (Tables 4 and 5) showed that AGR become slower at 80 days and declined again at 100 days. These observations are in harmony with those of Asif *et al*. (2010) and Gul *et al.* (2015). AGR was significantly lower with application of 75 kg N/fad., than 125 kg N/fad., at 80 days in both seasons and at 100

Table 4. Effect of nitrogen fertilizer levels, seeding rate and wheat cultivars on some growth characters and NUE in 2014/2015 season

Factors and its interactions	No. of days to 50% heading	Flag leaf area (cm^2)	LAI			AGR (g/day)		NAR (g/m^2/day)		Plant height (cm)	Tillers/ m^2	NUE
			60 days age	80 days age	100 days age	80 days age	100 days age	80 days age	100 days age			
N level (kg/fad.)												
75	88.50	33.85	4.40	8.22	9.17	1.07	1.69	3.30	4.17	92.95	596.11	38.64
100	89.91	39.95	4.85	9.05	9.18	1.14	1.77	3.37	4.18	94.74	605.83	27.24
125	90.38	39.62	5.29	9.14	9.29	1.14	1.79	3.56	4.21	95.05	612.78	23.97
LSD	1.35	2.70	NS	NS	NS	0.06	NS	NS	NS	1.50	15.70	9.21
Seeding rate (grains/m^2)												
200	89.52	39.09	4.06	7.94	9.02	1.11	1.60	3.61	4.01	93.86	551.78	27.36
300	89.55	38.37	5.57	8.71	9.33	1.08	1.77	3.06	4.15	94.54	635.28	31.25
400	89.72	37.96	4.91	9.78	9.29	1.17	1.87	3.56	4.04	94.34	628.06	31.23
LSD	NS	NS	NS	0.93	NS	NS	0.16	NS	NS	NS	62.37	NS
Wheat cultivar												
Sakha-94	91.11	38.48	4.65	8.94	9.24	0.95	1.79	3.07	4.11	96.54	622.50	31.33
Gemmiza-9	94.41	39.89	5.40	9.97	10.44	1.41	1.84	3.81	3.87	97.97	579.17	30.42
Giza-168	83.27	37.06	4.49	7.51	7.96	0.99	1.58	3.35	4.22	88.23	613.06	28.99
LSD	0.73	1.57	0.64	0.67	0.97	0.09	0.16	0.33	NS	1.53	NS	NS
Significance of studied factors and interactions												
N level (N)	*	*	NS	NS	NS	*	NS	NS	NS	*	*	*
Seeding rate (S)	NS	NS	NS	*	NS	NS	*	NS	NS	NS	*	NS
Cultivar (C)	*	*	*	*	*	*	*	*	NS	*	NS	NS
N × S	*	NS	NS	*	*	*	*	NS	*	NS	NS	NS
N × C	*	*	NS	*	NS	*	*	NS	*	NS	NS	NS
S × C	*	*	*	*	NS	*	*	*	*	NS	NS	NS
N × S × C	*	NS	*	*	*	*	*	*	*	NS	NS	NS

* = Significant and NS = Not significant at 0.05 level.

Table 5. Effect of nitrogen fertilizer levels, seeding rate and wheat cultivars on some growth characters and NUE in 2015/2016 season

Factors and its interactions	No. of days to 50% heading	FLA (cm^2)	LAI			AGR (g/day)		NAR (g/m^2/day)		Plant height (cm)	Tillers $/m^2$	NUE
			60 days age	80 days age	100 days age	80 days age	100 days age	80 days age	100 days age			
N levels (kg/fad.)												
75	88.86	53.41	4.97	10.65	9.63	1.36	2.54	3.50	3.67	97.38	569.16	32.76
100	89.27	57.31	5.60	11.67	11.23	1.55	3.12	4.08	3.93	98.26	570.00	22.78
125	89.58	55.12	5.61	12.27	11.71	1.58	3.39	4.16	4.07	98.42	624.16	22.05
LSD	NS	3.26	NS	1.23	0.29	0.10	0.42	0.47	0.32	NS	40.10	1.32
Seeding rate (grains/m^2)												
200	88.44	56.20	5.05	11.59	10.39	1.46	2.93	3.90	3.97	97.62	568.88	25.48
300	89.25	55.68	5.40	11.07	11.08	1.36	3.16	3.66	4.10	98.36	577.77	26.07
400	89.52	53.96	5.57	11.94	11.10	1.67	3.92	4.17	3.60	98.10	616.66	26.03
LSD	NS	NS	NS	NS	NS	0.14	0.45	NS	NS	NS	65.40	NS
Wheat cultivar												
Sakha-94	90.63	54.23	5.14	11.11	10.04	1.45	2.69	4.02	3.70	97.67	632.22	26.38
Gemmiza-9	94.25	55.64	5.92	13.31	12.01	1.46	3.03	3.27	3.41	102.23	548.61	25.73
Giza-168	82.83	55.97	5.12	10.19	10.53	1.58	3.32	4.44	4.56	94.16	582.50	25.47
LSD	0.75	NS	0.60	1.21	0.96	NS	0.45	0.54	0.58	1.25	38.02	NS
Significance of studied factors and interactions												
N level (N)	NS	*	NS	*	*	*	*	*	*	NS	*	*
Seeding rate (S)	NS	NS	NS	NS	NS	*	*	NS	NS	NS	*	NS
Cultivar (C)	*	NS	*	*	*	NS	*	*	*	*	*	NS
N × S	*	*	*	*	*	*	*	NS	*	*	*	NS
N × C	*	*	*	*	NS	*	*	NS	NS	*	*	NS
S × C	*	*	*	NS	NS	*	*	NS	NS	*	*	NS
N × S × C	*	*	*	*	*	*	*	NS	*	*	*	NS

* = Significant and NS = Not significant at 0.05 level.

days in the 2nd one (Tables 4 and 5). It quite clear that AGR with 125 kg N/fad., had superiority over that of 75 kg N/fad., AGR of wheat has a significant relation with nitrogen fertilization because most of plants were healthy and vigorous which may help the plants to absorb water and light more efficiency have resulted higher AGR (Gul *et al.*, 2013). These results are in harmony with those obtained by Asif *et al.* (2010), Alam (2013) and Gul *et al.* (2013). Concerning seeding rates, AGR significantly affected by changing in seeding rates at 80 and 100 days in both seasons, except at 80 days in the first one (Tables 4 and 5). It clear from these results that the highest values were recorded with seeding 400 grains/m^2. Moreover, the tested cultivars had a significant effect on AGR at both stages in both seasons, except at 80 days in the second season (Tables 4 and 5). Gemmiza-9 and Giza168 ranked 1st at both stages and seasons, respectively. All studied interactions had significant effect on AGR at both stages in both seasons (Tables 4 and 5). Generally, the best combination was seeding Gemmiza-9 or Giza-168 with 300 or 400 grains/m^2 and application of 125 kg N/fad.

Net Assimilation Rate (NAR)

The results indicated that NAR increased significantly with increasing N levels up to 125 kg N/fad., at both times in the second season (Tables 4 and 5). Seeding rates did not significantly affect NAR at both times and seasons. Moreover, cultivars significantly affected NAR at 80 days in the first season and at 80 and 100 days in second one. At 80 days, Gemmiza-9 ranked first, Giza-168 ranked second and Sakha-94 ranked third in the first season. Whereas, at 80 and 100 days Giza-168 ranked first, Sakha-94 ranked second and Gemmiza-9 ranked third in the second season. The differences in NAR between cultivars might be attributed to the differences in their genetic makeup. All studied interactions except seeding rates × cultivars did not significantly affect NAR at 80 days in both seasons. Whereas, all interactions except nitrogen × cultivars and seeding rates × cultivars had significant effect on this trait at 100 days in second season.

Plant Height

Plant height was statistically affected by nitrogen levels in the first season and cultivars in both seasons (Tables 4 and 5). The tallest plants (95.05 cm) were that fertilized with 125 kg N/fad., while the shortest plants (92.95 cm) were recorded at 75 kg N/fad. This finding was true but without any significant difference between the different N levels in the second season. These results may be due to the stimulation effect on internodes elongation. The vital role of N and its necessity for protoplasm formation, photosynthesis activity, cell division and meristematic activity in plant organs is clearly illustrated. Javaid Iqbal *et al.* (2012) and Gheith *et al.* (2013) reported similar results. Moreover, wheat cultivars were significantly differed in their plant height in both seasons. Plants of Gemmiza-9 were the tallest ones (97.97 and 102.23 cm) followed by Sakha-94 (96.54 and 97.67 cm) and Giza-168 (88.23 and 94.16 cm) in both seasons, respectively. The differences in plant height between cultivars might be attributed to the differences in their genetic makeup. These results are in agreement with those obtained by Javaid Iqbal *et al*. (2012) and Gheith *et al.* (2013). Moreover, all interactions between the tested factors were significant in the second season only (Tables 4 and 5). Seeding Gemmiza-9 or Giza-168 with 300 or 400 grains/m^2 fertilized with 125 kg N/fad., produced the tallest plants.

Number of Tillers/m^2

Crop yield are generally dependent upon many yield contributing agents. Number of tillers/m^2 of wheat was statistically affected by nitrogen levels and seeding rates in both seasons (Tables 4 and 5). Number of tillers/m^2 increased with increasing nitrogen fertilization in both seasons. Maximum number of tillers/m^2 (612.78 and 624.16) were observed with 125 kg N/fad., respectively. These results are in harmony with those obtained by Javaid Iqbal *et al.* (2012) and Gheith *et al.* (2013) who found that number of tillers/m^2 increased with increasing nitrogen levels. The differences in number of tillers/m^2 due to seeding rates were significant in both seasons. More number of tillers/m^2 (635.28 and 616.66) were observed when wheat was sown with 300 and 400 grains/m^2 in both seasons, respectively, while less number of tillers/m^2 (551.78 and 568.88) were noticed at the lowest seeding rate (200 grains/m^2). Moreover, the differences in number of tillers/m^2 due to cultivars were significant in second season, in favor of Sakha-94 which gave higher number of tillers/m^2 (622.50 and 632.22) more than Giza-168 (613.06 and 582.5) and Gemmiza-9 (579.17 and 548.61) in both seasons, respectively (Tables 4 and 5). These results are in agreement with those of Njuguna *et al.* (2010) and Gheith *et al.* (2013) who found that genotypes showed a different effect on this trait. The results presented in Tables 4 and 5 showed that all interactions had significant effect on this trait in the second season. The highest number of tillers/m^2 combination were that of Gemmiza-9 or Giza168 seeding with 300 or 400 grains/m^2 and fertilizing with 125kg N/fed.

Nitrogen Use Efficiency (NUE)

Nitrogen use efficiency was significantly affected by changing in nitrogen level in both seasons. Nitrogen use efficiency was gradually decreased with increasing nitrogen levels up to 125 kg N/fad. The highest NUE values (38.64 and 32.76) were produced at 75 kg N/fad., while the lowest values (23.97 and 22.78) were obtained at 125 kg N/fad. It is evident that when N levels were increased from 75 to 125 kg N/fad., NUE was decreased by 37% and 30% in both seasons, respectively. These results are in harmony with those obtained by Violeta *et al.* (2015) and Limin Gu *et al.* (2016) who concluded that the NUE of wheat decreased with increasing N fertilization levels. Moreover, Limin Gu *et al.* (2016) indicated that when N levels increased from 90 to 180 kg N/ha, NUE was decreased by an average of 19%. Also, Rahman *et al.* (2011) and Kumari (2011) found the same results. Moreover, seeding rates, cultivars and all studied interactions effects on NUE in both seasons were insignificant.

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تأثير مستويات السماد النيتروجينى ومعدلات التقاوى على نمو ثلاثة أصناف من القمح وكفاءة استخدام النيتروجين

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أجريت تجربتان حقليتان خلال موسمى الزراعة ٢٠١٥/٢٠١٤ و ٢٠١٦/٢٠١٥ بكلية الزراعة بالجيزة-جامعة القاهرة لدراسة تأثير ثلاث مستويات من السماد النيتروجينى (٧٥ و١٠٠و١٢٥ كجم نيتروجين/فدان) وثلاث معدلات من التقاوى (٢٠٠ و٣٠٠ و٤٠٠ حبة/م٢) على نمو ثلاث أصناف من القمح (سخا-٩٤ وجميزة-٩ وجيزة-١٦٨) وكفاءة استخدام النيتروجين حيث تم استخدام تصميم القطع المنشقة مرتين فى أربعة مكررات حيث وزعت عشوائيا مستويات السماد النيتروجينى فى القطع الرئيسية ومعدلات التقاوى فى القطع المنشقة الأولى والأصناف فى القطع المنشقة الثانية، وأظهرت النتائج أن كل من ظهور ٥٠% من السنابل وارتفاع النبات فى (الموسم الأول) ومساحة ورقة العلم عند عمر ٨٠ و١٠٠ يوم من الزراعة (فى الموسم الثانى) ومعدل النمو المطلق ودليل مساحة الأوراق ومعدل الكفاءة التمثيلية وكفاءة استخدام النيتروجين (فى الموسمين) قد أظهرت استجابة معنوية لإضافة السماد النيتروجينى حيث زادت معظم الصفات السابقة فيما عدا كفاءة استخدام النيتروجين بزيادة السماد النيتروجينى حتى ١٢٥ كجم نيتروجين/فدان، وقد أثرت معدلات التقاوى معنويا على كل من دليل مساحة الأوراق ومعدل النمو المطلق فى مراحل النمو المختلفة حيث أعطت هذه الصفات أعلى قيما لها عند الزراعة بمعدل ٣٠٠ أو ٤٠٠ حبة/م٢، بينما لم يظهر هذا التأثير على معدل الكفاءة التمثيلية وكفاءة استخدام النيتروجين، كما أظهر كل من التزهير وارتفاع النبات ومعدل النمو المطلق عند عمر ٨٠ يوم ومعدل الكفاءة التمثيلية عند عمر ٨٠ يوم استجابة معنوية لتغيير الأصناف، بينما لم يظهر هذا التأثير على كفاءة استخدام النيتروجين، أظهرت جميع التفاعلات تأثيرا معنويا على جميع الصفات فيما عدا التفاعل بين مستويات النيتروجين ومعدلات التقاوى على مساحة ورقة العلم ودليل مساحة الأوراق عند عمر ٦٠ يوم وارتفاع النبات وعدد الفروع/م٢ وكذلك التفاعل بين معدلات التقاوى والأصناف على دليل مساحة الأوراق عند عمر ١٠٠ يوم وكذلك التفاعل بين جميع العوامل على مساحة ورقة العلم وارتفاع النبات وعدد الفروع/م٢ فى الموسم الأول، كما أظهرت بعض التفاعلات تأثير معنويا على معدل الكفاءة التمثيلية فى حين لم تظهر أي من التفاعلات تأثيرا معنوياً على كفاءة استخدام النيتروجين ويستنتج من هذه الدراسة أن زراعة الصنف جميزة-٩ أو جيزة-١٦٨ بمعدل ٣٠٠ أو ٤٠٠ حبة/م٢ وإضافة ١٢٥ كجم نيتروجين هي الأنسب تحت ظروف منطقة الدراسة.

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