Zagazig J. Agric. Res., Vol. 51 No. (5) 2024 927-939

Plant Production Science

Available online at http://zjar.journals.ekb.eg
http:/www.journals.zu.edu.eg/journalDisplay.aspx?JournalId=1&queryType=Master

GROWTH AND QUALITY OF SOME BREAD WHEAT CULTIVARS AS INFLUENCED BY NITROGEN FERTILIZER LEVEL

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Received: 10/09/2024; Accepted: 17/09/2024

ABSTRACT: Two field experiments were conducted at Al-Hussainiya District, Sharkia Governorate, Northeast Delta Region, Egypt during the two successive winter seasons 2019/2020 and 2020/2021. This study was performed to investigate the response of five wheat cultivars *i.e.* Giza 171, Gemmeiza 12, Sids 14, Misr 1and Shandweel 1 to four N levels (0, 35, 70 and 105 kg /fad). The results showed that increasing N level up to 105 kg N/fad significantly increased plant height, number of tillers/m^2 at 15, 30 and 45 DAS, flag leaf area, chlorophyll content, protein content, protein yield/fad, carbohydrate content and carbohydrate yield/fad. Whereas the number of days to 50% heading was not significantly increased due to the increase of N level. The results cleared significant differences among wheat cultivars for plant height, number of tillers at 15, 30 and 40 DAS, flag leaf area, number of days to 50% heading and chlorophyll content, as well as protein and carbohydrate % and protein and carbohydrate yield/fad. Both Giza 171 and Gemmeiza 12 cultivars recorded the highest value of plant height, number of tillers/m^2 at 15, 30 and 45 DAS and flag leaf area as well as protein and carbohydrate yield/fad. However, Sids 14 cultivar recorded highest value towards the delay in 50% heading. The results also cleared that Gemmeiza 12 cultivar had the highest values of grain protein and carbohydrate content. However, the lowest value of protein and carbohydrate content was recorded by Shandweel 1 cultivar. In conclusion, wheat cultivars Giza 171 and Gemmieza 12 greatly responded to nitrogen fertilization under experimental conditions.

Key words: Wheat, cultivars, nitrogen fertilizer levels, physiological characters, quality characters

INTRODUCTION

Wheat (*Tritium aestivum* L.) is one of the most important cereal crops in the world. In Egypt, it is considered the main food crop. The cultivated area of wheat was about 1.43 million hectares with a production around 9.7 million tons **(FAO, 2022).** Egypt suffered a considerable gab between national production and consumption where, the imported quantity amounted to 8.01 million tons, worth 3.8 million dollars **(FAO, 2022)**. To improve the productivity of wheat, introduction of cultivars with a high yield potential is necessary **Satyanarayana *et al.* (2017)**, who reported that cultivars provide more than 50 percent of the increased production.

Nitrogen (N) plays an important role in plant growth and it is considered the most important fertilizer needed for maximizing yield of wheat **Mohamed *et al*. (2022**). In other meaning, N is the key input for achieving highly wheat grain yield per unit land area. All the biochemical and physiological processes in plants are mainly dominated by N and its related compounds which make it vital for the growth and development of wheat **Ullah *et al.* (2018).** Hence, the application of N fertilizer is important for increasing grain protein content of wheat **Mohamed (2017) and Gheith *et al.* (2021),** plant height and effective tillers/m^2 **Iqbal *et al.* (2012)**. The optimum N level for wheat yield in Egypt various greatly depending on soil texture and fertility level and ranges

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between 80 to 160 kg N/fad. **Atta Allah and Mohamed (2003).** Moreover, **Rafiq *et al.* (2023)** showed that, increasing N level up to 200 kg/ha., significantly increased protein content, plant height and number of tillers/m^2.

Wheat cultivars Giza 171, Gemmeiza 12, Sids 14, Misr 1 and Shandweel 1 are the new and important cultivars in Egypt, with good study about the favorable N fertilizer level Wheat cultivars display varied behavior with different levels of available nitrogen as revealed by **Zaki *et al.* (2007), Gheith *et al.* (2013), Khalid *et al.* (2014), Ali (2017) and Muhammad *et al.* (2018).** In Egypt, **Khaled and Hammad (2014)** indicated that increasing N levels up to 105 kg N/fad significantly increased plant height and number of days to heading. **El-Lethy *et al.* (2013)** found that wheat cultivar Sakha 93 surpassed Gemmeiza 9 in plant height and leaves content of chlorophyll a, b and carotenoids. Also, **Abd El-Dayem *et al.* (2024)** cleared that wheat cultivars (Giza 171, Sids 14, Sakha 95 and Misr 3) differ in the response to N levels (40, 60 and 80 kg N/fad.,). Sakha 95 that fertilized with 40 kg N/fad., recorded the lowest number of days to 50% heading and Giza 171 that fertilized with 80 kg N/fed had the highest value of plant height. Therefore, the present investigation aimed to evaluate the behavior of some wheat cultivars under different levels of nitrogen fertilizer.

MATERIALS AND METHODS

Two field experiments were conducted at Al-Hussainiya District, Sharkia Governorate, Northeast Delta Region, Egypt (30°51′54″ N, 31°57′55″ E) during the two winter seasons 2019/2020 and 2020/2021. This study aimed to search for the response of five wheat (*Triticum aestivum* L.) cultivars Giza 171 (C_1) , Gemmieza 12 (C_2), Sids 14 (C_3), $Misr_1$ (C_4) and $Shandweel_1$ (C_5) at different levels of nitrogen 0 kg N/fad., (N_0) , 35 kg N/fad., (N_1), 70 kg N/fad., (N_2), and 105 kg N/fad., (N_3) were applied as urea (46% N) as per treatment in three splits, 1/3 at the time of sowing ,1/3 at the time of first irrigation (30 DAS) and 1/3 at the time of second irrigation (50 DAS).

Experimental Design and Agronomic Practices

The experiment was laid out in a spilt plot design with three replications, where N levels were assigned in the main plots, whereas wheat cultivars were distributed in the sub plots. The area of each sub plot was 9 m^2 (3.0 m wide and 3.0 m in length) which included 20 rows 15 cm apart. Soil texture of the experimental site was clay. Soil samples were collected from the sites at the depth of 0 – 30 cm before sowing to determine soil physical and chemical properties as presented in Table 1.

Wheat cultivars were sown at the seeding rate of 400 seeds/m^2. The sowing was done using a drill hand machine on 17th and 14th November in the two growing seasons, respectively. The preceding crop was maize in both seasons. Calcium super phosphate (15.5% P_2O_5) at rate of 100 kg/fad., and potassium sulphate (50% K2O) at rate of 100 kg/fad., were added during seedbed preparation. Surface irrigation using Nile water was used. Harvesting was practiced on April 22nd and 23nd for all cultivars in the first and second seasons, respectively. The other culture practices were applied as recommended.

Recorded Data

Three samples of one meter long were taken randomly at 15, 30 and 45 DAS from the 3rd, 4th, and 5th row of each plot to estimate number of tillers/m^2. Twenty tillers were taken randomly at heading from the 3rd, 4th, and 5th row of each experimental unit to estimate; plant height (cm), flag leaf chlorophyll content (SPAD reading) by using a SPAD-502 **(Minolta 1989)** and flag leaf area (FLA) was calculated as:

$$FLA\ (cm^2) = K\ (L*W)$$

Where, K: Constant (0.72), L: Maximum leaf length (cm) and W= Maximum leaf width (cm) according to **Lal and Subba Roa (1951**). Number of days to 50% heading was measured based on plot mean.

To determinate crude protein content, samples of dried grains were ground to fine powder and N content was determined using the modified micro-kjeldhl apparatus as described by **AOAC (2000)**. The obtained values were multiplied by

Table 1. Some physical and chemical properties of the experimental soil in the two growing seasons.

Soil characteristics Soil particles distribution	1st season	2nd season
Sand %	13.24	13.19
Silt %	34.18	33.88
Clay %	52.58	52.93
Texture	Clay	Clay
Saturation point%	45.87	44.65
Field capacity %	22.93	22.32
Organic matter %	0.65	0.61
pH*	8.02	8.04
EC (dsm-1) **	1.87	1.92
CaCo3%	0.50	0.49
Soluble cations and anions		
Ca++	8.02	7.76
Mg++	5.31	5.49
Na+	3.45	3.65
K+	1.22	2.19
CO3=	0.00	0.00
HCO3-	9.45	7.78
Cl-	4.12	5.80
SO4=	4.43	5.42
Available N, (mg Kg-1 soil)	41.03	38.64
Available P, (mg Kg-1 soil)	19.13	17.98
Available K, (mg Kg-1 soil)	280	265
Available Fe, (mg Kg-1 soil)	1.33	1.21
Available Zn, (mg Kg-1 soil)	0.39	0.29
Available Cu, (mg Kg-1 soil)	0.67	0.60
Available Mn, (mg Kg-1 soil)	0.52	0.64

Source: Central Laboratory, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

Statistical Analysis

Analysis of variance and combined analyses for the two seasons were carried out as described by **Gomez and Gomez (1984)**. For comparison between means, Duncan's multiple range tests were used **(Duncan, 1955).** Statistical analysis was performed by using analysis of variance technique of **MSTAT-C (1989)** computer software package. The combined analyses of variance was performed for the data of the two seasons after test the homogeneity of error by bartellet's test **Steel *et al.* (1997**).

RESULTS AND DISCUSSION

Number of Tillers/m^2

Results relating to the effect of N fertilizer levels and wheat cultivars on number tillers/m^2 at 15, 30 and 45 DAS in the two seasons and their combined analyses are presented in Table 2. Results showed highly significant ($P < 0.01$) effect of N levels and cultivars on number of tillers /m^2.

Nitrogen fertilizer level effect

Nitrogen levels had a highly significant effect on number of tillers/m^2 at 15, 30 and 45 DAS in the two seasons and the combined analyses (Table 2). Results cleared that increasing N level from 0 to 70 kg N/fad., resulted in progressive increase in number tillers/m^2 at all sampling dates in two seasons and combined analyses. Results obtained of combined at all sampling dates revealed that the relative increase in number of tillers/m^2 due to increasing nitrogen fertilizer level from check to 70 Kg N/fad., was

Table 2. Number of tillers/m^2 (at 15, 30 and 45 DAS) as affected by nitrogen fertilizer level, wheat cultivar and their interaction during two seasons (2019/2020 and 2020/2021) and their combined

Main effects and interactions	Number of tillers/m^2								
	At 15 DAS			At 30 DAS			At 45 DAS		
	2019/ 2020	2020/ 2021	Comb.	2019/ 2020	2020/ 2021	Comb.	2019/ 2020	2020/ 2021	Comb.
Nitrogen level (N):									
Check	397.8 c	424.8c	411.3 c	521.8c	567.4b	544.6b	601.8c	615.7b	608.7b
35 kg N/fad.	439.3bc	447.1bc	443.2bc	578.5b	619.7a	599.1b	629.9bc	645.7ab	637.8b
70 kg N/fad.	480.8ab	485.5ab	483.1ab	624.1ab	633.1a	628.6a	651.3ab	650.3a	650.8a
105 kg N/fad.	511.1 a	517.5a	514.3a	651.5a	641.7a	646.6a	670.5a	666.1a	668.3a
F.test	**	**	**	**	**	**	**	**	**
Cultivar (C):									
Giza 171	481.4a	489.6a	485.5a	628.5a	644.1ab	636.3a	645.2ab	666.0a	655.6a
Gemmeiza 12	485.2a	493.5a	489.3a	631.3a	636.6ab	633.8a	692.5a	691.7a	692.1a
Sids 14	407.2c	411.8c	409.5 c	520.7b	535.9c	528.3c	591.5b	558.1c	574.8c
Misr 1	477.7a	488.6a	483.1 a	628.5a	667.2a	647.8a	666.4ab	678.3a	672.3a
Shandweel 1	434.7b	460.1b	477.4 b	560.7ab	593.6b	577.1b	596.3b	628.2b	612.3b
F-test	**	**	**	**	**	**	**	**	**
Interaction									
N x C	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S

*, ** and N.S. indicate significance at 0.05 and 0.01 levels and insignificancy of differences, in respective order.

17.45, 15.42 and 6.91 % at 15, 30 and 45 DAS, respectively. Similar results were obtained by **Iqbal *et al.* (2012), Khalid *et al.* (2014) and Rafiq *et al.* (2023)** who reported that number of tillers/m^2 was highest at 125 kg N /ha level and lowest at zero level of nitrogen.

Cultivar differences effect:

The obtained results (Table 2) revealed that wheat cultivars had highly significant effects on number of tillers/m^2 in both seasons and their combined at 15, 30 and 45 DAS. The combined analyses showed that, Gemmeiza 12, Giza171, and Misr 1 cultivars recorded the maximum number of tillers/m^2, greatly superior to the other two evaluated cultivars These results are in agreement with those obtained by **Zaki *et al.* (2007), Gheith *et al.* (2013) and Abd El-Dayem *et al.* (2024)** who reported that number of productive tillers depends on genotype and environment.

Interaction effect

The interaction effect between nitrogen fertilizer levels and wheat cultivars on number of tillers/m^2 at 15, 30 and 450 DAS was found to be non-significant.

Plant Height and Flag Leaf Area

Nitrogen fertilizer level effect

Results of the combined analyses in Table 3 showed that increasing N fertilizer level up to 105 kg N/fad., significantly increased flag leaf area (cm^2) and plant height (cm). These results are consistent with those obtained by **Zaki *et al.* (2007), Fadle *et al.* (2016) , Shehab-Eldeen *et al.* (2021) and Rafiq *et al*. (2023)** who indicated that addition sufficient nitrogen fertilizer amount could improve wheat growth.

Table 3. Plant height (cm) and flag leaf area (cm^2) as affected by nitrogen fertilizer level, wheat cultivar and their interaction during two seasons (2019/2020 and 2020/2021) and their combined

Main effects and interaction	Plant height (cm)			Flag leaf area (cm^2)		
	2019/2020	2020/2021	Comb.	2019/2020	2020/2021	Comb.
Nitrogen level (N):						
Check	94.72 c	95.21 d	94.97 d	15.92 b	24.13 c	20.02 d
35 kg N/fad.	98.80 b	96.85 c	97.83 c	17.62 b	26.73 b	22.17 c
70 kg N/fad.	101.21 ab	98.66 b	99.94 b	18.93 ab	28.73 a	23.83 b
105 kg N/fad.	102.53 a	100.68 a	101.61 a	21.30 a	29.66 a	25.48 a
F-test	**	**	**	**	**	**
Cultivar (C):						
Giza 171	101.37 a	101.37 a	99.08 a	19.60 a	28.08 a	23.84 a
Gemmeiza 12	100.65 ab	98.17 ab	99.41 ab	17.24 b	28.16 a	22.70 bc
Sids 14	97.53 b	97.91 ab	97.72 bc	20.70 a	29.83 a	25.26 a
Misr 1	99.11 ab	97.76 ab	98.44 bc	17.17 b	24.91 b	21.04 d
Shandweel 1	97.93 b	96.35 b	97.14 c	17.50 b	25.58 b	21.54 cd
F-test	*	*	*	**	**	**
Interactions:						
N x C	*	N. S	**	N. S	N. S	N. S

*, ** and N.S. indicate significance at 0.05 and 0.01 levels and insignificancy of differences, in respective order.

Cultivar differences effect

The obtained results showed that cultivars had a highly significant effect on plant height and flag leaf area in the two seasons as well as their combined analyses at heading (Table 3). Results of the combined analyses cleared that plant height recorded 99.08, 99.41, 98.44, 97.72 and 97.14 cm for Giza 171, Gemmieza 12, Misr1, Sids 14 and Shandweel 1, respectively. The reasons for differences in plant height might be attributed to of genetic variation. These results are in regularity with those gained by **Muhammad *et al.*, (2018) , Seleiman *et al.* (2021) and Abd El-Dayem *et al.* (2024).** Mean through Giza 171 and Sids 14 cvs. gave the highest flag leaf area (23.84 and 25.26 cm^2) in the combined compared to the other tested cultivars. Cultivar differences for flag leaf area were also reported by **Fadle *et al.* (2016) and Shehab-Eldeen *et al.* (2021).**

Interaction effect

Results in Table 3-a showed that the interaction effect between nitrogen fertilizer levels and wheat cultivars on plant height at heading was significant. The interaction effect of plant height was significant and revealed that the tallest plants (105.0 cm) were obtained at 105 kg N/fad., with Giza 171 cultivar. Whereas, no significant interactions were obtained between nitrogen fertilizer levels and wheat cultivars on flag leaf area.

Number of Days to 50% Heading and Chlorophyll Content

Nitrogen fertilizer levels effect

Results presented in Table 4 clearly indicate that number of days to 50% heading had no significant effect by nitrogen fertilizer levels in two seasons and their combined. Results of both seasons as well as their combined indicated to significant differences between nitrogen levels where, chlorophyll content increased with increasing N fertilizer levels from 0 to 105 kg N/fad. These results are in harmony with those obtained by **Youssef *et al.* (2013), Fadle *et al.* (2016), Mohamed (2017) and Shehab-Eldeen *et al.* (2021),** who cleared that chlorophyll a and b showed significant increase due to increasing N fertilizer level.

Table 3-a. Plant height as affected by nitrogen fertilizer level and wheat cultivar interaction (combined analyses over seasons)

N-fertilizer level	Wheat cultivar				
	Giza 171	**Gemmeiza 12**	**Sids 14**	**Misr 1**	**Shandweel 1**
Check	B	AB	A	AB	AB
	93.0c	95.8 b	96.1 a	95.2 c	94.6 c
35 kg N/fad	A	B	B	B	B
	100.5 b	97.6 b	97.5 a	97.5 bc	95.9 bc
70 kg N/fad	A	AB	B	B	B
	102.3 ab	101.2 a	98.5 a	99.9 b	98.7 ab
105 kg N/fad	A	AB	D	BC	CD
	105.0 a	103.0 a	98.7 a	102.1 a	99.2 a

Capital and small letters were used to denote significant differences among columns and rows means, respectively.

Table 4. Number of days to 50% heading and chlorophyll content (SPAD reading) as affected by nitrogen fertilizer level, wheat cultivar and their interaction during two seasons (2019/2020 and 2020/2021) and their combined

Main effects and interaction	No. days to 50% heading			Chlorophyll content		
	2019/2020	**2020/2021**	**Comb.**	**2019/2020**	**2020/2021**	**Comb.**
Nitrogen level (N):						
Check	88.26	82.47	85.36	32.497 c	35.767 b	34.132 d
35 kg N/fad.	89.33	83.40	86,36	33.320 c	39.788 ab	36.509 c
70 kg N/fad.	89.53	84.33	86.93	37.081 b	41.313 ab	39.197 b
105 kg N/fad.	90.13	85.80	87.96	40.741 a	43.767 a	42.254 a
F-test	N. S	N. S	N. S	**	*	**
Cultivar (C):						
Giza 171	88.58 ab	82.66 ab	85.62 b	37.452 a	42.442 a	38.947 a
Gemmieza 12	88.25 b	83.16 ab	85.71 b	36.088 b	40.025 b	38.056 a
Sids 14	91.08 a	85.91 ab	88.50 a	35.308 b	41.458 b	38.383 a
Misr 1	89.08 ab	86.58 a	87.83 ab	35.877 b	39.933 b	37.905 a
Shandweel 1	89.58 ab	81.88 b	85.62 b	34.713 c	36.932 c	35.822 b
F-test	*	*	**	*	**	*
Interactions:						
N x C	N. S	N. S	N. S	N. S	N. S	N. S

*, ** and N.S. indicate significance at 0.05 and 0.01 levels and insignificancy of differences, in respective order.

Cultivar differences effect

The combined analyses (Table 4) revealed significant differences between wheat cultivars for days to 50% heading. Wheat cultivars Sids 14 and Misr 1 had the highest values (88.50 and 87.83 day) followed by Gemmeiza 12, Giza 171 and Shandweel1 (85.71, 85.62 and 85.62 day) respectively. Cultivar differences for days to 50% heading were also reported by **Gheith *et al.* (2013), El Sayed *et al.* (2018) and Abd El-Dayem *et al.* (2024)** who, found that wheat cultivars differed in days to heading. It could be terminated that differences among wheat cultivars may be due to genotype cultivars and differences between genotypes about production and partitioning of dry matter, where wheat cultivars differed in yield energy per plant and per fad., as revealed by **Abd-El-Gawad *et al.* (1987) and Said *et al.* (1999).** In both seasons, Giza 171 gave highest value of chlorophyll content (37.452 and 42.442) whereas, the lowest one was recorded by Shandweel 1 (34.713 and 36.932) for first and second seasons, respectively. Results of combined cleared that Giza 171, Sids 14, Gemmieza 12, Misr 1 cultivars recorded the highest chlorophyll content, followed by Shandweel 1 cultivar (35.822), respectively. These results are in agreement with those gained by **Awaad *et al.* (2013), El-Lethy *et al.* (2013) and Fadle *et al.* (2016),** who, indicated that the superiority of both Misr 1 and Gemmeiza 11 cvs., in, total chlorophyll content at heading.

Interaction effect

No significant interaction effect between nitrogen fertilizer level and wheat cultivars on number of days to heading and chlorophyll content (Table 4).

Protein and Carbohydrate Content

Nitrogen fertilizer level effect

Regarding the effect of N fertilizer levels on protein and carbohydrate content, results presented in Table 5, showed that there was highly significant effect in combined analyses. Results indicated that increasing N level up to 70 kg N/fad., significantly increased protein content in both seasons and their combined analyses and carbohydrates content in the second season only. The relative increase in protein content due to raising N level up to 70 kg N/fad was 7.33, 6.35 and 6.83 % in the first, second seasons and the combined, respectively. Comparable results were also recorded by **Mondal *et al.* (2015), Kaur and Ram (2017), Shehab-Eldeen *et al.* (2021) and Rafiq *et al*. (2023)** who, reported that the major reason of crude protein percentage of wheat grain is mostly related to the amount of nitrogen addition. N is an essential mineral nutrient required in high concentrations for plant growth, and quality (**Koutroubas *et al.*, 2014).** According to combined analyses wheat grains content of carbohydrates increased significantly by increasing nitrogen levels up to 105 kg N/fad. Similar results were found by **EL-Guibali (2016) and Kaur and Ram (2017)** who, presented that increasing N rates increased total carbohydrates and this increase in total carbohydrates may be due to the increase in vegetative growth, where nitrogen consider main component of chlorophyll which increases photosynthetic activity, resulting in assimilation of more carbohydrates.

Cultivar differences effect

Respecting cultivar differences, wheat cultivars were differed significantly in their protein and carbohydrate content (Table 5). Gemmeiza 12 cultivar had the highest value of protein content followed by Sids 14, Misr1, Giza171 and then Shandweel 1. Cultivar differences for protein percentage were also reported by **El Sayed *et al.* (2018), Ibrahim *et al.* (2019), Gheith *et al.* (2021), Seleiman *et al.* (2021) and Awaad *et al*. (2024).** The combined analyses cleared significant differences between wheat cultivars, for carbohydrates percentage. Giza 171, Gemmeiza 12 and Misr-1 cultivars had the highest values followed by Sids 14 and then Shandweel 1. Cultivar differences for carbohydrates percentage was also found by **Zaki *et al.* (2007),** who registered differences in carbohydrate percentage among wheat cultivars. This finding established the results obtained in the current study.

Interaction effect

The interaction between N fertilizer levels and wheat cultivars had a significant effect on protein content (Table 5-a). The highest grain protein content (8.90%) was attained in Gemmeiza 12 cultivar and combined with 70 kg N/fad. Whereas the lowest value (7.71%) occurred in Sids 14 variety without nitrogen fertilization.

Table 5. Protein and carbohydrate content (%) of wheat grains as affected by nitrogen fertilizer level, wheat cultivar and their interaction during two seasons (2019/2020 and 2020/ 2021) and their combined

Main effects and interaction	Protein content (%)			Carbohydrate content (%)		
	2019/2020	2020/2021	Comb.	2019/2020	2020/2021	Comb.
Nitrogen level (N):						
Check	7.99 ab	8.17 b	8.08 c	68.11	65.18 c	66.65 d
35 kg N/fad.	8.29 b	8.50 ab	8.40 b	68.43	67.54 b	67.99 c
70 kg N/fad.	8.57 a	8.68 a	8.63 a	69.02	69.20 a	69.11 b
105 kg N/fad.	8.70 a	8.81 a	8.76 a	69.84	70.67 a	70.26 a
F-test	**	*	**	N. S	**	**
Cultivar (C):						
Giza 171	8.41 ab	8.48	8.44 ab	69.48 a	68.68 a	69.08 a
Gemmieza 12	8.62 a	8.64	8.63 a	69.68 a	69.12 a	69.40 a
Sids 14	8.44 ab	8.50	8.47 ab	67.72 b	68.07 a	67.90 b
Misr 1	8.29 bc	8.61	8.45 ab	69.06 ab	68.27 a	68.67 a
Shandweel 1	8.18 c	8.48	8.33 b	68.31 ab	66.60 b	67.46 b
F-test	**	N. S	*	**	**	**
Interactions:						
N x C	*	N. S	*	**	*	**

*, ** and N.S. indicate significance at 0.05 and 0.01 levels and insignificancy of differences, in respective order.

Table 5-a. Protein content of wheat grains as affected by nitrogen fertilizer level and wheat cultivar interaction (combined analyses over seasons)

N-fertilizer level	Wheat cultivar				
	Giza 171	Gemmieza 12	Sids 14	Misr 1	Shandweel 1
Check	A	A	B	A	A
	8.09 b	8.21 b	7.71 c	8.28 b	8.09 b
35 kg N/fd	AB	A	AB	AB	B
	8.40 ab	8.57 a	8.47 b	8.34 b	8.20 b
70 kg N/fad	BC	A	AB	C	C
	8.54 a	8.90 a	8.84 a	8.45ab	8.41 ab
105 kg N/fad	A	A	A	A	A
	8.74 a	8.84 a	8.87 a	8.71 a	8.62 a

Capital and small letters were used to denote significant differences among columns and rows means, respectively.

Furthermore, the interaction effect between nitrogen fertilizer levels and wheat cultivars was highly significant for carbohydrate content (%) (Table 5-b). The highest carbohydrate content (72.27%) was attained in wheat cultivar Gemmieza 12 and fertilization with 105 kg N/fad. Whereas the lowest value (64.97%) occurred in Giza 171 without nitrogen fertilization.

Protein and Carbohydrate Yield/fad. (kg)

Nitrogen fertilizer level effect

Nitrogen fertilizer levels had a highly significant effect on protein and carbohydrate yield/fad of wheat in the two seasons and combined analyses (Table 6). The combined analyses cleared that increasing N level up to 105 kg N/fad., significantly increased protein yield/fad., in the first season and combined analyses and carbohydrate yield in both seasons and combined analyses. Comparable results were also recorded by **Kaur and Ram (2017) and Shehab-Eldeen *et al.* (2021).**

Cultivar differences effect

The combined analyses (Table 6) revealed highly significant differences between wheat cultivars for protein and carbohydrate yield/fad. Gemmeiza 12 cultivar had the highest value of protein yield followed by both Giza 171 and Misr-1 and then both Sids 14 and Shandweel1. Cultivar differences for protein yield were also reported by **Satyanarayana *et al.* (2017), Ibrahim *et al.* (2019), Gheith *et al.* (2021) and Shehab-Eldeen *et al.* (2021).** Both wheat cultivars Gemmeiza 12 and Giza 171 had the highest values of carbohydrate yield/fad., followed by Misr1, Sids 14 and Shandweel 1 cultivars. Variation between wheat cultivars in carbohydrate (%) was also found by **Zaki *et al.* (2007)**.

Interaction effect

No significant interaction effect between nitrogen fertilizer level and wheat cultivars on protein and carbohydrate yield/fad. Hereby, wheat cultivars behaved the same under different N-levels.

Conclusions

According to the results of this study, it can be concluded that, Giza 171 and Gemmeiza 12 cvs., responded significantly to N fertilization and had the greatest grain protein and carbohydrate content (%). Additionally, it was also observed that the application of N fertilizer at rate of 70 or 105 kg N/fad resulted in an improvement in wheat growth traits.

Table 5-b. Carbohydrates content of wheat grains as affected by nitrogen fertilizer level and wheat cultivar interaction (combined analyses over seasons)

N-fertilizer level	Wheat cultivar				
	Giza 171	Gemmieza 12	Sids 14	Misr 1	Shandweel 1
Check	B	A	B	A	B
	64.97 c	67.81 b	65.86 c	68.37 ab	66.22 b
35 kg N/fad	A	A	AB	AB	B
	69.38 b	68.20 b	67.97 ab	67.92 b	66.63 b
70 kg N/fad	A	AB	B	B	B
	70.35 ab	69.33 b	68.68 ab	68.68 ab	68.49 a
105 kg N/fad	A	A	B	B	B
	71.62 a	72.27 a	69.69 a	69.69 a	68.47 a

Capital and small letters were used to denote significant differences among columns and rows means, respectively.

Table 6. Protein and carbohydrate yield as affected by nitrogen fertilizer level, wheat cultivar and their interaction during two seasons (2019/2020 and 2020/2021) and their combined

Main effects and interaction	Protein yield (kg/fad.)			Carbohydrate yield (kg/fad.)		
	2019/2020	2020/2021	Comb.	2019/2020	2020/2021	Comb.
Nitrogen levels (N):						
Check	165.08 d	194.01 c	179.55 d	1407 d	1552 d	1480 d
35 kg N/fad.	202.84 c	261.96 b	232.40 c	1674 c	2085 c	1880 c
70 kg N/fad.	238.23 b	292.77 a	265.50 b	1916 b	2336 b	2126 b
105 kg N/fad.	259.05 a	314.29 a	286.67 a	2082 a	2523 a	2303 a
F-test	**	**	**	**	**	**
Cultivar (C):						
Giza 171	217.03 b	282.71 a	249.87 b	1797 b	2294 a	2046 a
Gemmieza 12	244.71 a	291.99 a	268.35 a	1970 a	2340 a	2155 a
Sids 14	199.12 c	248.21 bc	223.67 c	1587 c	1984 bc	1786 c
Misr 1	214.81 b	270.24 ab	242.53 b	1783 b	2150 ab	1967 b
Shandweel 1	205.83 bc	235.64 c	220.74 c	1713 b	1851 c	1782 c
F-test	**	**	**	**	**	**
Interactions:						
N x C	N. S	N. S	N. S	N. S	N. S	N. S

*, ** and N.S. indicate significance at 0.05 and 0.01 levels and insignificancy of differences, in respective order.

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تأثير مستوى السماد النيتروجينى على نمو وجودة بعض أصناف قمح الخبز

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أقيمت تجربتان حقليتان فى مركز الحسينية - محافظة الشرقية - منطقة شمال الدلتا - مصر خلال الموسمين الشتويين 2020/2019، 2021/2020، لدراسة تاثير أربع مستويات من السماد النيتروجينى (بدون إضافة، 35، 70، 105 كجم نيتروجين/فدان) على خمسة أصناف من قمح الخبز (جيزه 171، جميزه 12، سدس 14، مصر 1، شندويل 1). تضمنت كل تجربة 20 معاملة عبارة عن التوافيق بين اربعة مستويات للنيتروجين وخمسة أصناف فى تصميم القطع المنشقة مرة واحدة في ثلاث مكررات. أوضحت النتائج أن زيادة مستوى السماد النيتروجينى حتى 105 كجم ن/الفدان أدى إلى زيادة معنوية في عدد الأشطاء/م^2 عند 15 و 30 و 45 يوم من الزراعة، ومساحة ورقة العلم، ومحتوى ورقة العلم من الكلوروفيل، ومحتوى حبوب القمح من البروتين والكربوهيدات، ومحصول البروتين والكربوهيدرات للفدان ، بينما لم يؤثر مستوى السماد النيتروجينى في صفة عدد الأيام حتى طرد 50% من السنابل. من ناحية آخرى، تفوق الصنفان جيزة 171 وجميزة 12 معنوياً على باقى الأصناف في صفات ارتفاع النبات، وعدد الأشطاء/م عند 15 و 30 و 45 يوم من الزراعة، ومساحة ورقة العلم ومحصول البروتين والكربوهيدات للفدان. وتأخر الصنف سدس 14 في الطرد مقارنة بباقى الأصناف تحت الدراسة، وحقق الصنف جميزة 12 أعلى محتوى من الكربوهيدرات والبروتين بالحبوب، بينما سجل الصنف شندويل 1 أقل القيم في محتوى الحبوب من البروتين والكربوهيدرات. وبصفة عامة كانت هناك استجابة معنوية للتسميد النيتروجينى في صنفى القمح جيزة 171 وجميزة 12.

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