Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www.jpp.journals.ekb.eg

Studies on Morphophysiological Traits and their Relationships to Grain Yield and its Components of Six Bread Wheat Genotypes under Four Nitrogen Fertilization Levels

Cross Mark

Shehab-Eldeen, M. T. [1*]; Rania A. Khedr[2] and M. S. Genedy[1]

[1]Wheat Research Department, Field crops research Institute, ARC, Egypt.
[2]Physiology Department, Field crops research Institute, ARC, Egypt.

ABSTRACT

In 2015/2016 and 2017/2018 Two experiments were carried out at Sakha Agricultural Research Station, to investigate the response of wheat crop to nitrogen fertilization levels(0, 25, 50 and 75 kg N/fed)on growth, chemical composition and productivity of six wheat genotypes(Misr 1, Sakha 95, Giza 171, Shandaweel 1, Misr 2 and promising line developed from Sakha breeding program(SPL2015).This research conducted using the split-plot design with four replications. In which, the main-plots and sub-plots assigned to levels of nitrogen fertilization and wheat genotypes, respectively. Results showed that high levels of nitrogen levels(75 kg N/fed)gave the highest values of crop growth rate, flag leaf area, photosynthetic pigments and Nitrogen percentage in grains. Moreover, increasing nitrogen fertilizer increased yield and its components significantly. Sakha 95 cultivar produced the highest values of all studied characteristics in both growing seasons. Meanwhile, the cultivar Misr 2 showed the highest number of spikelets/spike, additionally recorded the second best results after Sakha 95.On the other hand, Shandaweel 1 cultivar gave the longest spikes; Giza 171 cultivar recorded the highest values of 1000-grain weight,Misr1 gave the highest N% content for the grain. However, Sakha 95 under 50 kg N/fed ranked secondly in most treatments without significant differences between Sakha 95 under 75 kg N level /fed for both seasons. It can be concluded that Sakha 95 had the highest nitrogen use efficiency and this reflecting in reduction of production costs and environmental pollution by saving 25 kg N/fed under such environmental conditions of Sakha district, Kafr El-Sheikh Governorate, Egypt.

Keywords: Wheat, genotypes, yield components, nitrogen fertilization levels, morphophysiological.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop in Egypt and many countries. However, wheat covers about 20 percent of the food needing for human consumption. Also, wheat straw very important source for animal feedings In Egypt, the total annual cultivated area to wheat lies between 3.1 and 3.2 million feddans in 2019/2020 season and the total production exceeded 8.8 million tons (FAO, 2020). Moreover, our local Wheat production is less than the local consumption. Thus, too much attention has been made for increasing the local production through increasing the area cultivated to wheat (horizontal expansion) and/or increasing the yield of unit area (vertical expansion) to reach the self-sufficient of wheat. The agronomical processes such as applying high yielding wheat promising genotypes as well as applying economic optimum nitrogen fertilization levels have the most important effects on earliness, growth, yield and yield components of wheat crop.

From all needed metabolic elements from the soil, nitrogen needs are the largest; it is stimulating a lot of vital processes in plants and plays the most important role in various physiological processes. (Tucker, 2004). Chlorophyll a and b biosynthesis showed significant increase due to increasing N fertilization (Tranavičienė *et al.* 2007). Meanwhile, deficiency of nitrogen leads to a great lose in green color in the leaves, consequently decrease leaf area and intensity of photosynthesis, also chlorophyll content is approximately proportional to leaf nitrogen content (Bojović and Marković 2009). Grain nitrogen content (N %), is a major determinant for wheat quality, it is very influenced by the available soil N, and a complex interaction between grain N% and grain yield exists (Triboi and Triboi-Blondel, 2002). Nitrogen application improved grain nitrogen % percentage. Nitrogen fertilizer has great effect on leaf area sense it increases the leaf growth, and hence; it affects the photosynthesis process (Bojović and Marković 2009). Increasing N fertilizer up to 160 kg/ha significantly increased all physiological characters (Alam, 2014). Many authors found close positive correlation between grain yield and plant chlorophyll content and average nitrogen concentration on the grains in wheat (Skudra and Ruza 2017).

Nitrogen (N) is the most important limiting factor of plant nutrients, which influences the plant cell components and subsequently the main growth characters specially protein content, chlorophyll and protoplasm. It is well known that, wheat is highly sensitive to nitrogen applied (David *et al.*, 2005). In addition, Marschner (1995) reported that N increases the leaf area and photosynthetic

[*] **Corresponding author.**
E-mail address: drmostafa_tag@yahoo.com
DOI: 10.21608/jpp.2021.152011

activity. Moreover, nitrogen is very important for the all metabolic processes of plants, where it is the main component and major constituent especially in living tissues formation of plants. Nitrogen is also, an integral part of proteins, phytochromes compounds, coenzymes, chlorophyll and nucleic acids, consequently enhancing earliness elements as well as yields and its components (Genaidy 2001 and 2011). Furthermore, many researchers in many parts of the world have indicated that adding adequate nitrogen fertilizer amount could enhance wheat growth, yield and its components as well as wheat quality. Seadh *et al.* (2017); Imdad Ullah *et al.* (2018); Ali *et al.* (2019) and Liu *et al.* (2019).

Choosing the high yielding ability genotypes is very important to raise wheat productivity per unit area. Hence, this research is aimed to evaluate some new promising genotypes with some common cultivars to detect the best wheat genotypes for the prevailing environmental conditions. Moreover, many researchers indicated that cultivars are different in their response to N-levels, such as; El-Metwally *et al.* (2012); Harb *et al.* (2012); Atia and Ragab (2013); Seleem and Abd El–Dayem (2013); Mehasen *et al.* (2014); Seadh (2014); Abdelsalam and Kandil (2016); Kandil *et al.* (2016); Baqir and Al-Naqeeb (2018); El-Sayed *et al.* (2018); Gomaa *et al.* (2018); Hassanein *et al.* (2018) and Khan *et al.* (2019).

Therefore, this research aimed to study the nitrogen fertilization levels effect on productivity of some recent wheat genotypes to reach the highest yield with the lower levels of nitrogen fertilizer than the recommended rate under the conditions of Sakha district, Kafr El-Sheikh Governorate, Egypt.

MATERIALS AND METHODS

The two experimental field work of this study was carried out at Sakha Agricultural Research Station of the Agricultural Research Center (ARC) during 2015/16 and 2017/18 growth seasons, to evaluate the response of some wheat genotypes productivity to nitrogen fertilization levels.

This research was conducted in a split-plot design with four replicates; the main-plots were assigned to four levels of nitrogen fertilization i.e. N_1- without nitrogen fertilization (0 kg N/fed, N_2-25 kg N/fed, N_3-50 kg N/fed and N_4-75 kg N/fed), and six wheat genotypes namely; Misr 1, Sakha 95, Giza 171, Shandaweel 1, Misr 2 and new promising line developed from Sakha Breeding Program (SPL2015) are assigned to the subplots (Table1).

Table 1. Name, pedigree and Selection history of six bread wheat genotypes.

Name	Pedigree	Selection history
Misr 1	OASIS/SKAUZ//4*BCN/3/2*PASTOR	CMSS00Y01881T-050M-030Y-030M-030WGY-33M-0Y-0S.
Sakha 95	PASTOR//SITE/MO/3/CHEN/AEGILOPS SQUARROSA (TAUS)//BCN/4/WBLL1.	CMA01Y00158S-040POY-040M-030ZTM-040SY-26M-0Y-0SY-0S.
Giza 171	SAKHA 93/GEMMEIZA 9	S.6-1GZ-4GZ-1GZ-2GZ-0S.
Shandweel 1	SITE/MO/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC	CMSS93B00567S-72Y-010M-010Y-010M-3Y-0M-0HTY-0SH.
Misr 2	SKAUZ/BAV92	CMSS96M03611S-1M-010SY-010M-010SY-8M-0Y-0S.
(SPL2015)	CHEN/AEGILOPS SQUARROSA(TAUS) //BCN/3/2*KAUZ/4/GEN*2//BUC/FLK/3/BUCHIN.	S.16280-020S-015S-4S-0S.

From soil surface of the experimental field site Different samples were randomly taken in the two seasons at a depth of 0-30 cm according to (Black, 1965 and Jackson, 1972) to estimate physical and chemical analysis soil (Table 2).

Table 2. Physical and chemical analysis of the experimental field in seasons 2015/2016 and 2017/2018.

Soil fertility analyses		Site 1 (2015/2016)	Site 2 (2017/2018)
A: Mechanical analysis:			
Coarse sand (%)		4.5	4.6
Fine sand (%)		19.6	19.8
Silt (%)		40.0	39.6
Clay (%)		35.9	36.1
Texture class		Clay loam	Clay loam
B: Chemical analysis:			
E.C. dS m^{-1} (1 : 5)		2.00	2.40
pH (1 : 2.5)		8.00	8.20
Organic matter (%)		1.68	1.51
$CaCO_3$ (%)		2.40	2.10
Soil CEC (c mol/kg)		32.37	31.65
Available (ppm)	N	48.18	50.90
	P	10.00	11.10
	K	432.00	498.00
	Zn	0.89	0.98

The ammonium nitrate (33.5% N) fertilizer was applied in two equal doses right before the first and the second irrigations; respectively. The previous crop was cotton (*Gossypium barbadense* L.) In the first season and maize (*Zea mays* L.) in the second one. All cultural practices were applied as recommended by Wheat Research Department. The wheat genotypes were obtained from Wheat Research Department, Agricultural Research Center (ARC). The plot area was 4.2 m^2 (1.2×3.5). The preceding summer crop was cotton (in the first seasons and maize in the second one. The sowing date was (25^{th} November 2015/16 and 25^{th} December 2017/18) at the first and second seasons, respectively.

On the other way, the data of 2016/17 season did not taken on consideration because of some factors affected the results, so we did grow the second season in 2017/2018.

Studied characters:

A- Physiological characters:

1- Crop growth rate: in g/day/m^2: samples were taken from each plot at the three dates (55, 70 and 85 days after sowing) (DAS) according to Hunt (1990) formulas, (CGR) = $(W_2\text{-}W_1) / (t_2\text{-}t_1)$; where, $W_2\text{-}W_1$= differences in dry matter accumulation of m^2 between the two samples in (g) and $t_2\text{-}t_1$= Number of days between the two samples (day).

2- Flag leaf area (FLA): from each plot at heading stage, flag leaves of ten plants were taken randomly to estimate: flag leaf area which measured by Portable Area Meter (Model LI-3000A),

3- Chlorophyll a and b as well as the total chlorophyll were estimated by using the spectro-photometric method according to (Moran 1982).

B-Grain chemical analysis: Nitrogen% in grains was determined according to Chapman and Pratt (1978).

C- Morphological characters:

1- Days to heading (DH): Number of days from sowing date to the date at which 50% of main spikes/ plot have completely emerged from the flag leaves.

2. Days to maturity (DM): Number of days from sowing date to the date at which 50% of main peduncles / plot have turned to yellow color

3- Plant height (PH): Was measured as plant length from the soil surface to the top of the main spike excluding awns as average of ten plants.

4- Spike length (SL): average of ten main spikes were taken to determine the length of spike from the base to the top excluding owns.

5- Spikelets/spike (S/S): Was counted and expressed as average of ten spikes.

D-Yield and yield components: at harvesting, a square meter was selected at random from each sub-plot to report the following characters:

1- spikes/m^2 (S/M^2). Number of fertile spikes per square meter.

2- grains/spike (G/S). Number of grains per spike for ten randomly selected spikes and their average was reported.

3- 1000-grain weight (1000-GW): Was measured as weight of the grains of each individual plant randomly taken.

4- Biological yield (BY): Was measured by harvesting whole plants in the plot and air dried before weighted in kg and then converted to tons per feddan.

5- Grain yield (GY): was estimated by weighing the grains obtained from the whole plot right after harvesting and then converted to ardab per feddan (one ardab=150 kg).

6- Straw yield (t/fed), (SY): The straw yield was calculated by the deference between biological and grain yields in kg/plot; then it was converted to tons per feddan.

The results were analyzed made the analysis of variance (ANOVA) for the split-plot design according to Gomez and Gomez (1984). By means of “MSTAT-C” Computer software package. Moreover, Duncan's multiple range was applied to compare means of treatments and tests at 5% level of probability as described by Duncan (1955).

RESULTS AND DISCUSSION

A- Physiological characters:

Data of physiological characteristics of the six wheat genotypes as affected by N levels and their interactions in the two seasons are illustrated in Tables 3 and 4.

1- Effect of nitrogen levels

From Table 3 it can be noticed that CGR in the first season is higher than that in the second one under all nitrogen levels in the two stages of sampling (55-70 days and 70- 80 days). Significant differences were existed among nitrogen levels in the first period in both seasons, and highly significant in the second period in both seasons, where the recommended dose (75 kg N /fed) gave the highest values at the two periods, but there were insignificant differences between 75kg N/ fed and 50kg N/fed only in the first period in both seasons.

Results of flag leaf area in Table 3 showed significant differences existed among the four nitrogen levels in the first season and highly significant among them in the second one. Although 75 kg N/fed recorded the highest area of flag leaf there were insignificant differences among 75, 50 and 25 kg N/fed in both seasons.

Table 4 show results of photosynthetic pigments (chlorophyll a, chlorophyll b and total chlorophyll). Highly significant differences were observed among nitrogen fertilizer levels in both seasons. Insignificant differences were found between 75 and 50 kg N /fed in chlorophyll b in both seasons.

Table 3. Overall mean values of growth characteristics (crop growth rate (g/d/m^2) and flag leaf area (cm^2) as affected by nitrogen fertilizer levels and wheat genotypes and their interaction in 2015/2016 and 2017/2018 seasons.

Factors	Treatments	Crop growth rate (g/d/m^2)				Flag leaf area (cm^2)	
		(55-70) days		(70-85) days			
		2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018
A. Nitrogen fertilization levels	N_1-0 kg N/fed	12.36b	6.16c	34.65d	23.14d	28.00b	22.15b
	N_2- 25 kg N/fed	24.15ab	13.87bc	45.00c	36.29c	33.09ab	28.56ab
	N_3- 50 kg N/fed	35.40a	22.98ab	52.33b	44.89b	34.62a	32.33a
	N_4- 75 kg N/fed	40.57a	31.50a	61.92a	55.75a	36.80a	33.91a
	F. test	*	*	**	**	*	**
B. Genotypes	Misr 1	23.11c	18.57b	41.96d	34.63d	32.30bc	30.34ab
	Sakha 95	34.18a	23.20a	62.59a	51.29a	35.04a	31.83a
	Giza 171	28.53b	18.20b	48.03c	39.62c	34.59ab	28.30bc
	Shandaweel 1	28.35b	14.78c	44.12cd	35.62d	32.56bc	26.78c
	Misr 2	32.64a	22.87a	55.44b	45.69b	34.93a	30.82a
	(SPL2015)	21.91c	14.17c	38.72d	33.25d	29.89c	27.29c
	F. test	**	**	**	**	**	**
C. Interaction (F. test)	A × B	NS	NS	**	NS	NS	*

Also increasing nitrogen fertilizer levels up to 75 kg N/fed significantly increased percentage of N content in grains in both seasons but there were insignificant differences between (75 and 50 kg N/fed) in the second one.

Maybe these results due to that nitrogen plays an important role in plant metabolism. Where nitrogen is a vital structural component of proteins, nucleic acids, chlorophyll, phytochromes compounds, coenzymes as well as some hormones (Ata-Ul-Karim *et al.*, 2016) and nitrogen fertilizer has large effect on flag leaf area through increasing leaf growth of plants and hence it affects the photosynthesis capacity (Bojović and Marković 2009). Meanwhile, many authors reported that Deficiency of nitrogen leads to loss green color in the leaves, decrease leaf area and intensity of photosynthesis and many authors found close positive correlation between and plant chlorophyll content and grain yield in wheat (Skudra and Ruza, 2017) increasing nitrogen levels led to significant increase in N percentage in grain and that led to increasing quality of grains (El-Agrodi *et al.* 2011).

Table 4. Overall mean values of photosynthetic pigments (chlorophyll a, b and total) and % N in grains as affected by nitrogen fertilizer levels and wheat genotypes and their interaction in 2015/2016 and 2017/2018 seasons.

Factors	Treatments	Chlorophyll a (µ/ml)		Chlorophyll b (µ/ml)		Total chlorophyll (µ/ml)		% N in grain	
		2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018
A. Nitrogen fertilization levels:	N_1-0 kg N/fed	11.88d	9.17d	4.51c	3.63c	16.57d	11.81d	1.841b	1.641d
	N2- 25 kg N/fed	13.99c	12.48c	5.97b	5.07b	19.75c	17.56c	1.914b	1.834c
	N3- 50 kg N/fed	16.68b	15.00b	7.45a	6.71a	23.97b	22.65b	2.215a	2.167b
	N4- 75 kg N/fed	17.70a	16.81a	7.87a	6.97a	25.49a	23.88a	2.277a	2.227a
	F. test	**	**	**	**	**	**	**	**
B. Genotypes:	Misr 1	14.45bc	12.72cd	6.04b	5.35c	20.25c	18.07cd	2.131a	2.041a
	Sakha 95	16.74a	15.05a	7.19a	6.27a	23.68a	21.32a	2.06b	1.959b
	Giza 171	15.01bc	13.16bc	6.42ab	5.51bc	21.26bc	18.67c	2.029bc	1.93c
	Shandaweel 1	14.56bc	12.90c	6.20b	5.26c	20.85bc	18.16cd	2.021c	1.926c
	Misr 2	15.65ab	14.17b	6.74ab	5.97ab	22.50ab	20.15b	2.131a	2.036a
	(SPL2015)	14.06c	12.27d	6.10b	5.22c	20.11c	17.49d	2.01c	1.914c
	F. test	**	**	**	**	**	**	*	**
C. Interaction (F. test):	A × B	NS	*	NS	NS	NS	NS	NS	NS

2- Wheat genotypes performance:

Results in Table 3 showed highly significant differences existed among the studied genotypes where Sakha 95 had the highest Crop Growth Rate CGR in the two periods (55-70 and 70-85) in both seasons and Misr 2 only in the first period in both seasons, while (SPL2015) had the lowest CGR in both seasons.

Also Sakha 95 and Misr 2 recorded the highest area of flag leaf in both seasons while (SPL2015) gave the lowest area of flag leaf in both seasons (Table 3).

Table 4 showed highly significant differences existed among the studied genotypes where Sakha 95 was the highest in all photosynthetic pigments in both seasons followed by Misr 2 with insignificant differences between them only in the first season. Misr 1 and Misr 2 gave the highest percentage of nitrogen in grains and ranked the first in both seasons, while (SPL2015) gave the lowest one and ranked last in both seasons.

3-The interaction effect:

Figure 1. presented the interaction effect in CGR between nitrogen levels and wheat genotypes in the second period (70-85) in the first season, where the highest CGR were obtained from Sakha 95 either at 75 kg N/fed or 50 kg N/fed and Misr 2 at 75 kg N/fed. Fig. 2 shows the interaction effect between nitrogen levels and wheat genotypes in (FLA). Sakha 95 at 75 and 50 kg N/fed gave the highest (FLA). Fig. 3 The interaction effect in chlorophyll a between nitrogen levels and wheat genotypes are Sakha 95 at 75 and 50 kg N/fed and Misr 2 at 75 kg N / fed gave the highest content of chlorophyll a in the second seasons.

B-Chemical analysis:

Data in Table (4) showed that increasing nitrogen level significantly increased percentage of nitrogen in grains in both seasons. Nitrogen application improved grain nitrogen % percentage; high grain nitrogen levels may have adverse effects on human health, because of anti-nutrient phytate which is the major storage form of nitrogen in wheat (Warraich *et al.* 2002).

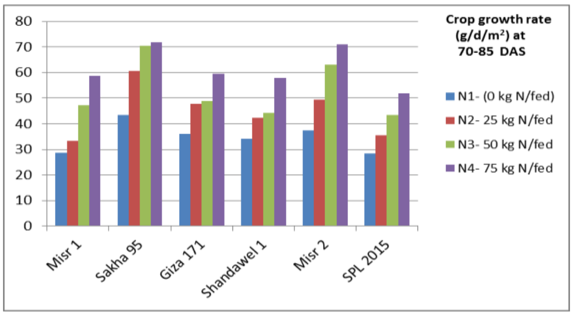

Fig.1. Crop growth rate (CGR) as influenced by the interaction between six wheat genotypes and four nitrogen fertilizer levels during 2015/2016 season.

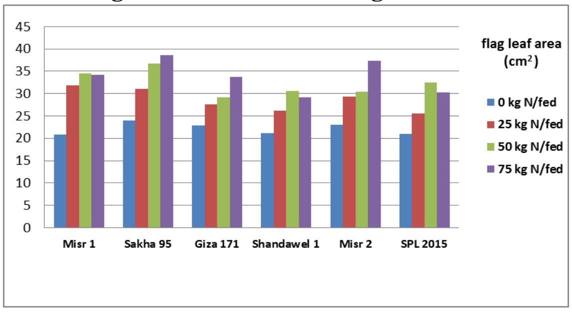

Fig.2. Flag leaf area as influenced by the interactions among six wheat genotypes and four N levels during 2017/2018 season.

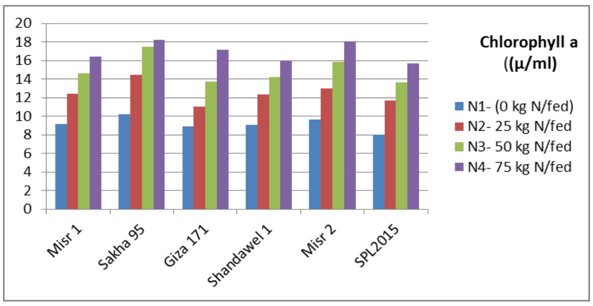

Fig.3. Chlorophyll a as influenced by the interactions among six wheat genotypes and four N levels during 2017/2018 season.

C. Morphological characters:

1- Nitrogen fertilization levels effects:

With respect to the effects of nitrogen fertilization levels (0, 25, 50 and 75 kg N/fed) on earliness character, DH and DM, PH, SL, and S/S, as shown in Table (5). The obtained results indicated that increasing N levels up to 75 kg N/fed led to significant increases in all values of studied characters, with exception of DH in the two seasons. However, nitrogen fertilizing for some wheat genotypes with 50 kg N/fed ranked secondly after the recommended level of nitrogen fertilization; but without significant differences between them on DM as well the highest means of PH, SL, S/S, G/S, in the first and the second seasons.

Whereas, applying 25kg N/fed for such wheat genotypes ranked thirdly concerning its effect on all studied characters in the first and the second seasons. On the other way, growing wheat plants without nitrogen fertilization (0 kg N/fed) produced the lowest values in the two seasons for all studied wheat characters. The improve in most characters was caused of leaf area increasing with nitrogen which gave high rate of photosynthesis, more production of assimilates and plant dry matter. These obtained results matched with those of Seadh *et al.* (2017), ImdadUllah *et al.* (2018), Ali *et al.* (2019) and Liu *et al.* (2019).

Table 5. Wheat growth characters; days to heading, days to maturity, plant height, spike length and number of spikelets/spike as influenced by nitrogen fertilizer levels and wheat genotypes and their interaction in 2015/2016 and 2017/2018 seasons.

Factors	Treatments	Days to heading (days)		Days to maturity (days)		Plant height (cm)		Spike length (cm)		Number of spikelets/spike	
		2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018
A. Nitrogen fertilization levels	N_1-0 kg N/fed	92.38	84.16	137.44b	128.29c	94.16c	76.45d	10.58c	9.95d	19.66d	19.41d
	N_2-25 kg N/fed	92.55	84.16	138.44b	128.58bc	100.55b	80.00c	10.85bc	10.26c	20.11c	19.95c
	N_3-50 kg N/fed	93.11	84.41	138.88ab	129.70ab	106.66a	84.37ab	11.33ab	10.71ab	21.08ab	20.73ab
	N4-75 kg N/fed	93.27	84.79	140.44a	130.12a	110.18a	88.33a	11.74a	11.04a	21.77a	21.42a
	F. test	NS	NS	*	*	**	**	**	**	**	**
B. Genotypes:	Misr 1	91.66b	83.03c	135.41c	126.75c	98.75bc	77.50c	10.39c	9.80d	20.27c	19.95b
	Sakha 95	94.33a	86.25a	141.75a	130.81a	108.75a	94.68a	10.71c	10.21c	21.17b	21.31a
	Giza 171	92.08b	83.75bc	141.58a	130.25a	105.41a	81.56b	11.64ab	11.02ab	20.45c	20.20b
	Shandaweel 1	93.33ab	85.56ab	137.91b	130.62a	101.25b	81.56b	11.88a	11.12a	21.55ab	21.42a
	Misr 2	94.16a	86.06a	141.75a	128.25b	107.50a	81.56b	10.72c	9.95d	21.98a	21.51a
	(SPL2015)	91.41b	81.62c	134.41b	128.37b	95.41c	76.87c	11.39b	10.85b	18.50d	17.87c
	F. test	*	**	**	**	**	**	**	**	**	**
C. Interaction (F. test):	A × B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

2- Genotypes performance:

Sakha 95 cultivar surpassed other studied genotypes in DH, DM and PH. Misr2 cultivar ranked the second results after Sakha 95 cultivar without significant differences between them in the two growing seasons. Even as, (SPL2015) genotype was the earlier genotype as comparing the other studied genotypes, where recorded the lowest DH and DM as well as shortest plants and lowest number of spikelets/spike and grains/spike in both seasons. These variations among the genotypes might reflect, partially, their differences in the genetic backgrounds. These findings agree with the findings of many researchers among whom, Seadh (2014), Abdelsalam and Kandil (2016), Kandil *et al.* (2016), Baqir and Al-Naqeeb (2018), El-Sayed *et al.* (2018), Gomaa *et al.* (2018) and Hassanein *et al.* (2018).

D. Yield and its components:

1- Nitrogen fertilizer levels effects:

The results in Table 6 showed the effect of four nitrogen fertilization levels on studied traits of wheat genotype during the two growing seasons. Moreover, increasing N level from 0 up to 75 kg N/fed resulted in significant increases in all values of studied characters; S/M2, G/S, 1000-GW, BY, GY and SY in the two seasons. The highest GY can be attributed the highest number of (S/M2 and G/S). Analogous resulted were revealed by Seadh (2014), Abdelsalam and Kandil (2016) and Gomaa *et al.* (2018).

Table 6. Yield characters (spikes/m^2, grains/spike, 1000-grain weight, biological yield, grain yield and straw yield) as affected by six wheat genotypes, four nitrogen fertilization levels and their interactions during 2015/2016 and 2017/2018 growth seasons.

Factors	Treatments	Number of spikes/m^2		Number of grains/spike		1000-grain weight (g)		Biological yield (t/fed)		Grain yield (ardab/fed)		Straw yield (t/fed)	
		2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018	2015/2016	2017/2018
A. Nitrogen fertilization levels:	N_1-0 kg N/fed	221.51d	208.47d	58.06b	50.58b	45.21b	38.46d	5.97d	4.52d	16.94d	12.20d	3.43d	2.61d
	N_2- 25 kg N/fed	262.74c	251.66c	59.51b	50.67b	46.10b	39.49c	7.98c	5.14c	21.69c	13.86c	4.63c	3.06c
	N_3- 50 kg N/fed	312.96b	302.54b	62.81ab	52.99a	47.97a	41.47ab	8.99ab	6.20b	25.37b	16.45ab	5.23ab	3.57ab
	N_4- 75 kg N/fed	337.30a	320.63a	64.81a	64.18a	48.87a	42.69a	9.62a	6.89a	26.91a	17.48a	5.59a	3.90a
	F. test	**	**	*	*	**	**	**	**	**	**	**	**
B. Genotypes:	Misr 1	294.25b	283.01b	56.46c	49.01b	45.65c	40.10c	8.02c	5.97b	23.08bc	14.22c	4.79a	2.67d
	Sakha 95	334.66a	324.66a	67.58a	56.46a	48.48b	48.48c	8.86a	6.52a	24.91a	16.38a	5.29a	4.25a
	Giza 171	298.80b	198.84d	62.15b	49.91b	52.30a	43.70a	8.49ab	5.22c	22.78c	15.72ab	4.86a	3.61b
	Shandaweel 1	219.40d	288.80b	63.21b	54.96a	42.01d	39.64c	8.23bc	6.01b	21.57d	14.99bc	4.80a	2.99c
	Misr 2	301.43b	291.42b	63.90ab	55.56a	52.29a	42.01b	8.64ab	5.44c	23.81b	15.80ab	4.86a	3.75b
	(SPL2015)	253.21c	238.21c	54.46c	46.71b	41.51d	37.24d	6.61	4.97d	20.24e	12.90d	3.74b	2.44e
	F. test	**	**	**	**	**	**	**	**	**	**	*	**
C. Interaction (F. test):	A × B	NS	NS	NS	NS	NS	NS	NS	**	*	NS	NS	NS

2- Genotypes performance:

Significant variation among the tested genotypes i.e. Misr 1, Sakha 95, Giza 171, Shandaweel 1, Misr 2 and (SPL2015) were detected in S/M2, G/S, 1000-GW, BY, GY and SY during the two seasons, as shown from data in Table 6. In addition, the values of cultivar Sakha 95 surpassed other genotypes in S/M2, G/S, BY, GY and SY in the two seasons. Misr 2 cultivar showed the second best results after Sakha95 cultivar without significant differences in both seasons; Whereas, Giza 171 cultivar recorded the highest values of 1000-GW in both seasons of this research. Even as, (SPL2015) genotype was recorded the lowest number of G/S, lowest means of BY, GY and SY in two seasons. These detected variation could be a resulted from the differences in their genetic constitution. The obtained results is in harmony with the results of Kandil *et al.* (2016); Baqir and Al-Naqeeb (2018); El-Sayed *et al.* (2018); Gomaa *et al.* (2018) and Hassanein *et al.* (2018).

3- Interaction effects:

Regarding the significant interactions BY (in the second season), GY (in the first one) as shown from data obtainable in figures 4 and 5. From the obtained results of this investigation, it could be concluded that nitrogen fertilization for the wheat cultivar Sakha95 with 75 kg N/fed resulted in the highest values of BY/fed. The second interaction treatment in the second season for aforesaid characters was nitrogen fertilizations for wheat Sakha95 cultivar with 75 kg N/fed in the highest values of GY/fed. However response of genotypes to nitrogen levels and other environmental factors had the same trend for traits under study.

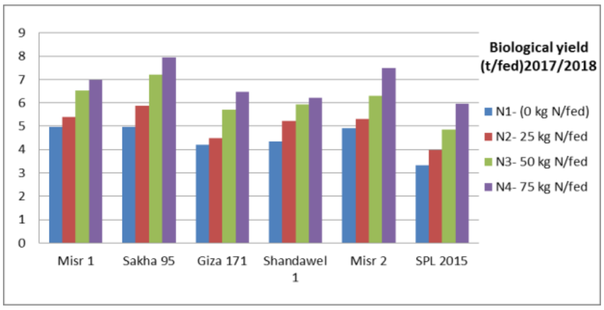

Fig. 4. Biological yield as influenced by the interactions among six wheat genotypes and four N levels during first season 2017/2018 season.

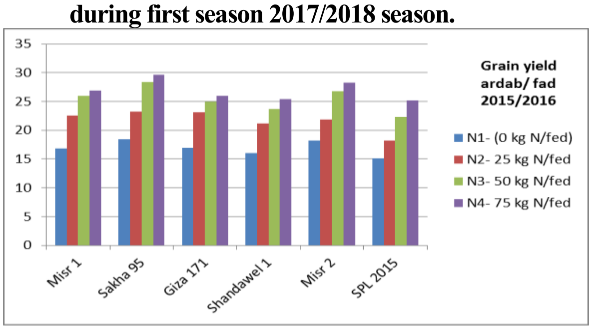

Fig. 5. Grain yield as affected by the interaction between six wheat genotypes and four N levels during 2015/2016 season.

CONCLUSIONS

According to the previous results, it could be concluded that:

1- For the North Delta region, all the recent wheat genotypes have been varied among themselves in responding to N-fertilization. This may be related to the genetic make-up of the genotypes. In terms of wheat growth character and yield and yield components, the higher values have been realized according to the following order; (Sakha 95> Misr 2> Giza 171> Shandaweel 1> Misr 1> SPL 2015).

2- For such alluvial soils of that region; where they are low nitrogen availability, all wheat genotypes have been responded to nitrogen fertilization up to 75 Kg N/fed., Sakha 95 cultivar gave the highest values either at 75 kg N/fed or 50 kg N/fed, at the same time reduce production costs and environmental pollution by saving about 25 kg N/fed under the environmental conditions of Sakha district, Kafr El-Sheikh Governorate, Egypt.

REFERENCES

Abdelsalam, N.R. and E.E. Kandil (2016). Assessment of genetic variations and growth/yield performance of some Egyptian and Yemeni wheat cultivars under saline condition. Egypt. Acad. J. Bio. Sci., 7(1): 9-26.

Alam, M. S. (2014). Physiological traits of wheat as affected by nitrogen fertilization and pattern of planting. International Journal of Agriculture and Forestry; 4(2): 100-105.

Ali, S.A.; L. Tedone; L. Verdini; E. Cazzato and G. De-Mastro (2019).Wheat response to no-tillage and nitrogen fertilization in a long-term faba bean-based rotation. Agro. 9, 50; doi: 10.3390/agronomy 9020050.

Ata-Ul-Karim S. T., X. Liu, Z. Lu, Z. Yuan, Y. Zhu and W. Cao (2016). In-season estimation of rice grain yield using critical nitrogen dilution curve. Field Crops Res.195C, 1-8. 10.1016/j.fcr. 04.027.

Atia, R.H. and Kh.E.Ragab (2013). Response of some wheat varieties to nitrogen fertilization. J. Soil Sci. and Agric. Eng., Mansoura Univ., 4(3): 309-319.

Baqir, H.A. and M.A.S. Al-Naqeeb (2018). Response of growth and yield of the three bread wheat cultivars to applying yeast powder methods in different concentrations. Intern. J. Agric. Stat. Sci., 14(Sup. 1): 327-336.

Black, C.A. (1965). "Methods of Soils Analysis" Amer. Soc. Agron. Inc. Pub. Madsen, Wisconsin, USA.

Bojovič, B. and M. Markivič (2009). Correlation between nitrogen and chlorophyll content in wheat (*Triticum aestivum L.).*Kragujevac Journal of Science,31:69-74.

Chapman, H.D. and P.E. Pratt (1978). Methods of Analysis for Soils, Plants and Waters. Univ. of Calif., Div. Agric. Sci. Priced Pub., 4034. pp: 50-169.

David, C.; M.H. Jeuffroy and J.M. Meynard (2005). Nitrogen management of organic winter wheat Decision-making through model-based explorations. Res. Sust. Sys., Intern. Sci. Conf. on Organic Agric., Adelaide, Australia, Sept. 21-23.

Duncan, D.B. (1955). Multiple ranges and multiple F test. Biometrics, 11: 1-42.

El-Agrodi, M. W., A. M. EL-Ghamry and H. H. Ibrahim (2011). Effect of nitrogen fertilizer rates, timing and splitting application on wheat plant grown on reclaimed soils. J. Soil Sci. and Agric. Eng., Mansoura Univ., 2 (9): 915 – 924.

El-Metwally, A.El-M.; N.A. Khalil; M.M. El-FoulyandM.F. El-Dahshouri (2012). Growth, nutrients uptake and grain yield of some wheat cultivars as affected by zinc application under sandy soil conditions. J. Plant Production, Mansoura Univ., 3(5): 773-783.

El-Sayed, A.A.; A.M. Omar; S.A. Elsaied and Basma, E. El-Samahey (2018). Yield, yield traits and grain properties of some bread wheat cultivars as influenced by planting dates under Egyptian conditions. J. Plant Production, Mansoura Univ., 9(3): 233-239.

FAO (2020). Food and Agriculture Organization.Faostat, FAO Statistics Division, March, 2020. http://www. fao. org/ faostat/en/#data/QC.

Genaidy, S. (2001). "Research and Application Facts in Plant Nutrition" in Arabic. Al-Dar Al-Arabia Lil-NasherWa Al-Tawzeia, Nsr City, Cairo, Egypt.

Genaidy, S. (2011). "Research and Application Bases in Soil Chemistry and Fertility" in Arabic. Al-Dar Al-Arabia Lil-NasherWa Al-Tawzeia, Nsr City, Cairo, Egypt.

Gomaa, M.A.; F.I. Radwan; E.E. Kandil and M.A.F. Al-Msari (2018). Response of some Egyptian and Iraqi wheat cultivars to mineral and nanofertilization. Egypt. Acad. J. Bio. Sci., 9(1): 19-26.

Gomez,K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. 2nd Ed., Jhon Wiley and Sons Inc., New York, pp: 95-109.

Harb,O.M.S.; G.H. Abd El-Hay; M.A. Hager; M.K.Hassanien and M.M. Abou El-Enin (2012). Effect of water irrigation quantity and compost rates on some wheat varieties under sandy soil conditions of West Delta region conditions. J. Plant Production, Mansoura Univ., 3(5): 847-855.

Hassanein, M.S.; Amal, G. Ahmed and Nabila, M. Zaki (2018). Effect of nitrogen fertilizer and bio-fertilizer on yield and yield components of two wheat cultivars under sandy soil.Middle East J.of App.Sci.8(1): 37-42.

Hunt, R. (1990). Basic growth analysis. Published by the Academic Division of Unwin Hyman Ltd., London. pp.55-72.

ImdadUllah, A.; N. Ali; S. Durrani; M.A. Shabaz; A. Hafeez; H. Ameer; M. Ishfaq; M.R. Fayyaz; A. Rehman and A. Waheed (2018). Effect of different nitrogen levels on growth, yield and yield contributing attributes of wheat. Intern. J. of Sci. & Eng. Res., 9(9): 595-602.

Jacson, M.L. (1972). Soil Chemical Analysis" Printic-Hall of India, New Delhia, India.

Kandil, A.A.; A.E.M. Sharief; S.E. Seadh and D.S.K. Altai (2016). Role of humic acid and amino acids in limiting loss of nitrogen fertilizer and increasing productivity of some wheat cultivars grown under newly reclaimed sandy soil. Int. J. Adv. Res. Biol. Sci., 3(4): 123-136.

Khan, F.U.; M. Khan; S.G. Khattak; Z. Iqbal; J. Iqbal and Z. Saleem (2019). Performance of some improved bread wheat varieties grown in Khyber Pakhtunkhwa, Pakistan. Adv. Plants Agric. Res., (1): 191-193.

Liu, Z.; F. Gao; Y. Liu; J. Yang; X. Zhen; X. Li; Y. Li; J. Zhao; J. Li; B. Qian; D. Yang and X. Li (2019). Timing and splitting of nitrogen fertilizer supply to increase crop yield and efficiency of nitrogen utilization in a wheat–peanut relay intercropping system in China. The Crop J., 7: 101-112.

Marschner, H. (1995). Functions of Mineral Nutrients: Micronutrients. In: Mineral Nutrition of Higher Plants, 2nd Edition, Academic Press, London,313-404.

Mehasen, S.A.S.; N.Kh. El-Gizawy; A.M. Sharoba; S.A. Soliman and T.R.M. Khalil (2014). Yield and chemical composition of bread wheat cultivars as affected by some skipping irrigation.Minufiya J. Agric., 39 (3):1-6.

Moran, R. (1982). Formulae for determination of chlorophyll pigments with N-N-dimethyl formamid. Plant Physiol., 69: 1376-1381.

Seadh, A.K.E.G. (2014). Improvement of some wheat varieties productivity under organic and minerals fertilization. Ph. D. Thesis, Fac. of Agric. Mansoura Univ., Egypt.

Seadh, S.E.; W.A. E. Abido and Samar, E.A. Ghazy (2017). Impact of foliar and npk fertilization treatments on bread wheat productivity and quality. J. Plant Production, Mansoura Univ., 8(1): 65-69.

Seleem, S.A. and S.M. Abd El-Dayem (2013). Response of some wheat cultivars to nitrogen fertilizer levels. J. Plant Production, Mansoura Univ., 4(5): 721-731.

Skudra, I. and A. Ruza (2017). Effect of nitrogen and sulphur fertilization on chlorophyll content in winter wheat.Rural Sustainability Research 37(332), 29-37.

Tranavičienė, T.; J.B. Šikšnianienė, A. Urbonavičiūtė, I. Vagusevičienė, Samuolienė, P. Duchovskis and A. Sliesaravičius (2007). Effects of nitrogen fertilizers on G.wheat photosynthetic pigment and carbohydrate contents.Biologija, 53 (4) 80-84.

Triboi, E. and A. M. Triboi-Blondel, (2002). Productivity and grain or seed compositAion: a new approach to an old problem–invited paper. Eur. J. Agron. 16: 163-186.

Tucker, M. (2004). Primary Nutrients and Plant Growth.-In:Essential Plant Nutrients (SCRIBD, Ed.). North Carolina Department of Agriculture.

Warraich, E., S.M.A. Basra, N. Ahmad, R. Ahmed and A. Muhammad (2002). Effect of Nitrogen on Grain Quality and Vigour in Wheat (*Triticum aestivum L.*) Int. J. Agri. Biol., 4 (4): 517-520.

دراسة بعض الصفات المورفوفسيولوجية وعلاقتها بمحصول الحبوب ومكوناته لبعض التراكيب الوراثية من قمح الخبز تحت أربعة مستويات من التسميد النيتروجيني

مصطفى تاج الدين شهاب الدين [1] ، رانيا أنور خضر [2] ومحمد سعيد جنيدي[1]

[1]قسم بحوث القمح – معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية

[2]قسم بحوث فسيولوجيا المحاصيل- مركز البحوث الزراعية

أجريت تجربتان حقليتان بالمزرعة البحثية بمحطة البحوث الزراعية بسخا، مصر، خلال موسمي 2016/2015 و 2018/2017 لدراسة إستجابة بعض التراكيب الوراثية من محصول قمح الخبز (مصر1، سخا95، جيزة171، شندويل1، مصر2 وسلالة مبشرة) وذلك لمستويات السماد النيتروجيني (صفر، 25، 50، 75 كجم نيتروجين/فدان). و لقد أستخدم في هذه الدراسة تصميم القطع المنشقة مره واحده في أربعة مكررات. حيث تم تخصيص القطع الرئيسية لمستويات السماد النيتروجيني, والقطع الشقية لستة تراكيب وراثيه من قمح الخبز. أدى التسميد النيتروجيني للقمح بـ 75 كجم نيتروجين/فدان للحصول على أكبر عدد أيام من الزراعة حتى طرد السنابل، عدد الأيام حتى النضج الفسيولوجي، مساحة ورقة العلم ونسبة النيتروجين في الحبوب وكذلك أعلى القيم لصفات إرتفاع النبات (سم)، عدد السنابل/م2، طول السنبلة (سم)، عدد السنيبلات/ السنبلة، عدد الحبوب/سنبلة، وزن ال 1000 حبه (جرام)، المحصول البيولوجي (طن/فدان)، محصول الحبوب (أردب/فدان) ومحصول القش (طن/فدان) في كلا الموسمين. كما أوضحت النتائج أن صنف سخا 95 سجل أعلى القيم لصفات عدد الأيام حتى الطرد، عدد الأيام حتى النضج الفسيولوجي، إرتفاع النبات، عدد السنابل/م2، عدد الحبوب/السنبلة، المحصول البيولوجي، محصول الحبوب ومحصول القش/فدان وذلك خلال موسمي النمو وذلك عند التسميد ب 50 كجم نيتروجين/فدان او 75 كجم نيتروجين/فدان. كما سجل الصنف مصر2 أكبر عدد من السنيبلات/السنبلة وثاني أفضل النتائج بعد الصنف سخا 95. كما تفوق كل من الأصناف شاندويل 1 في طول السنابل، وجيزة 171 في وزن الألف حبة ومصر 1 في نسبة النيتروجين. كما أوضحت النتائج أن معاملة سخا 95 ب 50 كجم سجلت الترتيب الثاني في القيم في أغلب الصفات مع عدم وجود فروق معنوية لمعاملة 75 كجم نيتروجين / فدان لذات الصنف (سخا 95). وبناءا على هذه الدراسة يمكن التوصية بتسميد القمح صنف سخا 95 بـإضافة 50 كجم نيتروجين/فدان للحفاظ على أعلى إنتاجية و في نفس الوقت تقليل تكاليف الإنتاج والتلوث البيئي من خلال توفير حوالي 25 كجم نيتروجين/فدان تحت الظروف البيئية بمنطقة سخا، محافظة كفر الشيخ، مصر.