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RESPONSE OF SOME SUNFLOWER GENOTYPES TO NITROGEN FERTILIZER LEVELS

Amal M. Metwaly[1*], Fawqia M.A. Salem[2], S.M.S. El-Yamani[1] and Eman I. El-Sarag[2]

1. Dept. Oil crops, Inst. Field Crops, A.R.C., Egypt.

2. Dept. Plant Prod., Fac. Environ. Agric. Sci., Arish Univ., Egypt.

ABSTRACT

Sunflower (*Helianthus annuus,* L.) is an important oil seed crop, which ranks a fourth next to groundnut, soybean and rapeseed which contributes as edible oils over the world. Due to the importance of this crop, this study was conducted to investigate the effect of three levels of nitrogen fertilizer (30, 45 and 60 kg fad.$^{-1}$) and eight genotypes of sunflower *i.e.* two cultivars (Giza 102 and Sakha-53) as control and six genotypes (A-120, A-34, A-44, A-45, A-47 and A-48) under North Sinai conditions through two seasons of 2015 and 2016. In this study there were 24 treatments including three nitrogen fertilizer levels and eight sunflower genotypes. Results showed that increasing nitrogen levels increased yield and it′s components and protein content, while, oil content was decreased. The interaction between Giza 102 and nitrogen level 60 kg N fad.$^{-1}$gave high value in each of 100-seed weight, head seed weight, oil yield, seed yield and protein yield in 2015 season, but, the interaction between the fertilizer level 60 kg N fad.$^{-1}$ and genotype A-48 gave significant superiority in 100 seed weight, head seed weight, oil yield, seed yield and protein yield in the 2016 season, In conclusion, sowing A-48 genotype with 60 kg N fad^{-1} was the best treatment under North Sinai conditions.

Key words: Genotypes, *Helianthus annuus* L., Nitrogen Fertilizer, Sunflower

INTRODUCTION

Sunflower (*Helianthus annuus,* L.) can play an important role to overcome the gap between demand and supply of edible oil in Egypt, where it's seeds contain high amount of oil (40 to 45%) which is an important source of the unsaturated fatty acid which (oleic, linoleic and linoleic acids) of potential health benefits. Sunflower is used in animal feed because it's considered an important protein source (30-35%). The total cultivated area of sunflower at the level of Arab Republic of Egypt for the season 2017 reaches 16139 Fadden, of which (8850 Fadden's are cultivated in the ancient lands and 7289 in new lands). The average productivity is 1.6 tons fad^{-1} in the 2017 season, The consumption ratio is 2.600 million tons while, the import reaches to 2.80 million tons in 2017 **SEAS (2017)**. Meanwhile, among the plant nutrients, nitrogen (N) element is the most significant nutrient to improve yield and quality of sunflower seeds.

Increasing nitrogen fertilizer increased each of head diameter, seed weight plant^{-1}, head weight plant^{-1},100-seed weight, seed yield plant^{-1}, seed yield ton ha^{-1} and oil yield of sunflower and *vice versa*, as respected by, some researchers studied the effect of nitrogen on yield and it′s components in sunflower, for example **El-Sarag (2007)** 60 kg N fad.$^{-1}$; **Abdel-Motagally and Osman (2010)** 142 kg N ha^{-1}**. Freitas *et al.* (2012)** 75 kg N ha^{-1}; **Namvar *et al.* (2012)** 200 kg N ha^{-1}**; Rasool *et al.* (2013)**120 kg N fad.$^{-1}$ **and Sincik *et al.* (2013)** 160 kg N ha^{-1}.

*** Corresponding author: Tel.:** +201281203465
E-mail address: amalmetwaly45@yahoo.com

Maximum seed yield ton ha^{-1} was observed due to application of N (80 and 255 kg ha^{-1}) by **Babu *et al.* (2013) and Mollashahi *et al.* (2013)**. **Bezerra *et al.* (2014)** using 100 kg N ha^{-1}. **Kazemeini *et al.* (2014)** found that high yield components were obtained at 450 kg N ha^{-1}. A moderate N application rate (135 kg ha^{-1}) resulted in the maximum photosynthetic rate and yielded as found by **Zeng *et al.* (2014)**. **Irika (2015)** recorded that application of inorganic N fertilizers at rates 20 kg N ha^{-1} and 40 kg N ha^{-1} showed no significant effect on sunflower crop yields. More and over **Awais *et al.* (2015), Hlisnikovsky *et al.* (2016), Schultz (2016), Abd El-Satar *et al.* (2017), Kandil *et al.(*2017), Ravishankar and Malligawad (2017), Bagheri *et al.*(2018), Braga *et al.* (2018) and Irika *et al.* (2018)** said that each N increment enhanced the yield and it's components at 150, 60, 180 kg N ha^{-1}, 45 kg N fad^{-1}, 168, 126, 180, 95 and 60 kg N ha^{-1}, respectively. Every additional kilogram of N taken up increased yield by 26 kg ha^{-1} by **Sheoran *et al.* (2016)**. **Khandekar *et al.* (2018) and Schultz *et al.* (2018)** showed that maximum seed yield plant^{-1} obtained at 100% N and 224 kg N ha^{-1}, respectively.

Babaiy *et al.* (2009) revealed the highest oil percent with 100 kg N ha^{-1} level but, was decreased at 200 kg N ha^{-1}. Application of N- levels declined seed oil content recorded by **Hassan (2010), El-Aref *et al.* (2011), Hussain *et al.* (2011), Nasim *et al.* (2012), Mollashahi *et al.* (2013), Rasool *et al.* (2013), Salih (2013), Shehzad and Maqsood (2015), Schultz *et al.* (2018). Sincik *et al.* (2013), Yasin *et al.* (2013) and Abd El-Satar (2017)** found that application of N-fertilizer levels at 200-240, 150 kg N ha^{-1} and 45 kg N fad.$^{-1}$ enhanced seed protein content.

Regarding to varietal differences, Sakha-53 cultivar surpassed all other the studied varieties in regard to seed, oil yields, head diameter, seed weight plant^{-1}, 100-seed weight and seed oil (%) (**El-Sarag, 2007; Abd El-Motagally and Osman, 2010; Taha *et al.,* 2010; El-Aref *et al.*, 2011; Abd El-lateef, 2012; Mahrous *et al.*, 2014**). **Mehmet (2009), Patil *et al.* (2009), Hassan (2010), Seassau *et al.* (2010), Süzer (2010), Ali *et al.* (2011) and Ibrahim (2012)** found that superiority in seed yield with its component in Shelly cultivar, hybrid KBSH-1, Giza-102 cultivar, Heliasol RM cultivar, DW-2 cultivar, Hysun-38 hybrid and hybrid Record all the studied variation, respectively. **Gul and Kara (2015)** as well as **Killi and Tekeli (2016)** mentioned that the highest 1000-seed weight, head diameter were obtained by Isera early cultivar, hybrid F708. Hybrids surpassed local varieties or cultivars in yield and it's components (**Yankov and Tahsin, 2015**). The highest mean of seed yield fad^{-1} created by grown Giza-102 cultivar, while, Sakha 53 was ranked in the first order in head diameter and 100-seed weight as found by **Abd El-Satar *et al.* (2017)**. Overall in **2017**, **Ahmed *et al.;* Kandil *et al.*; Ozturk *et al.* and Saif Ullah *et al.* (2018)** showed that maximum value in regard to head diameter and seed yield were observed in hybrid S-78**,** MS. sirena F1 genotype but, maximum weight of 1000 seed and seed yield ha^{-1} were recorded from Nsovak genotype, cultivars Sirena, Teknosol and Hybrid-14021, respectively.

Sakha-53 cultivar gave maximum seed oil (%) as recorded by **El-Sarag (2007), Taha *et al.* (2010) and Abd El-Satar *et al.* (2017)**. Giza-102 cultivar was superior in protein content (**Hassan, 2010; Abd El-Satar *et al.*, 2017**). Seed oil content in different hybrids ranged from 37–38% (PR62A91, PR63A21, DKF3875) to 41–43% (PR64H41, DKF2990, PR63M91, PR63M80) **(Zheljazjov *et al.*, 2011)**. Hysun-33 presented superior in oil content as reported by **Abd El-Lateef (2012), Nasim *et al.* (2012), Iqrasan *et al.* (2017), Kandil *et al.* (2017). Ali and Ullah (2012), Gul and Kara (2015), Hama (2015) and**

Alves *et al.* (2017) gave the highest oil content in hybrid S-278, hybrid C-70165, variety Flame and Neon genotype, respectively.

In North Sinai, low water quality, low quality soil, lands are salty and limited in irrigation water, however, sunflower grow under these conditions. In addition, sunflower is moderately sensitive to soil salinity. So, North Sinai is considered a promising region for the extension in cultivating sunflower crop. Ultimately, the aims of this study was evaluation of some sunflower genotypes under semi-arid in North Sinai, Governorate, Egypt. Studying the effect of nitrogen fertilizer levels on some sunflower genotypes to gain high production of seeds and oil and achieving the best combination of nitrogen fertilizer level to sunflower genotypes under the condition of semi arid region.

MATERIALS AND METHODS

Site Description

This study was conducted in the Experimental Farm of El-Arish Agriculture Research Station, Agriculture Research Center, North Sinai (31° 08′ 04.3″ N, 33° 49′ 37.2″E) during the two consecutive summer seasons of 2015 and 2016.

Treatments

In the study, there were 24 treatment including three nitrogen fertilizer levels (30, 45 and 60 kg N fad^{-1}) and eight genotypes of sunflower. The experimental design was (RCBD) in split–plots with three replications. The main plots were three nitrogen fertilizer levels (30, 45 and 60 kg N fad.$^{-1}$), two cultivars and six genotypes were assigned to the sub–plots. Ammonium nitrate fertilizer (33.5% N) was the source of nitrogen fertilization in both seasons (2015-2016). Nitrogen fertilizer was divided into three doses after (20, 27, 34 days) from sowing date, respectively. Organic fertilization and superphosphate (15.5% kg P_2O_5) were applied during soil preparation at the rate of 150 kg fed^{-1}. Potassium sulfates (48 % kg K_2O) at rate of 50 kg fed^{-1}, was added in two equal doses, where, the first doses was added after thinning while, the second was added after 27 days from planting with the second dose of nitrogen fertilizer. Drip irrigation system was used in this investigation work. Salinity of water ranged from 4500 to 5500 ppm. The length of irrigation lines was 20 m and distance between lines was 1/2 m apart. The plot area was 10 m^2, distance between plants was 25 cm, number of lines was 72 line and experiment area was 720 m^2. The planting dates of these experiments were on 25th and 30th May in 2015 and 2016 seasons, respectively. Harvesting date for genotypes were after 85 days.

Recorded Data

Yield components

At the end of complete flowering of heads, heads of two inner rows were bagged at early seed development for avoiding bird damages and used for estimating yield and it′s components as well as seed oil composition. At maturity stage 85 days after sowing, five guarded plants were taken randomly from each experimental unit for measuring head diameter (cm), seed weight per plant (g) and 100-seed weight (g).

Seed chemical composition

Oil content was determined according to **AOCS (2005)**, but, protein percentage was determined according to **AOAC (2012)** where, seed meals were dried at 70º C and kept for N analysis.

Yields

Seed yield ton fad.$^{-1}$

Seed yield was calculated by multiplying seed yield plot^{-1} by 420 m^2.

Protein yield ton fad.$^{-1}$

Protein yield was calculated by multiplying seed protein percent (%) by seed yield (ton fad^{-1}).

Oil yield ton fad^{-1}

Oil yield was calculated by multiplying seed oil percent (%) by seed yield (ton fad.$^{-1}$).

Statistical Analysis

The data obtained were statistically analyzed according to **Senedecor Cochran (1990)** using MSTAT computer program V.4 (1991). The mean values were compared at 0.05 level of probability using Duncan's Multiple range Test of Mean Separation **Duncan (1955).**

RESULTS AND DISCUSSION

Yield Components

Table 1 showed that nitrogen fertilizer levels had significant effect on sunflower yield components in the first and second seasons, where, increasing nitrogen levels from 30 to 60 kg N fad.$^{-1}$ increased head diameter (from 12.5 to 15.38 cm), 100-seed weight (from 5.21 to 7.13 g) and head seed weight (from 31.42 to 49.71 g) in 2015 season. Similar trend was observed at 2016 season, where, the yield components was reached to maximum values at nitrogen level application 60 kg N fad^{-1}. Head diameter is one of the most important yield components in sunflower genotypes, where nitrogen fertilizer had significant effect on head diameter. Indeed, this effect could be associated with the general enhancement of vegetative growth in response to nitrogen contribution. Regarding to100-seed weight, results refer to the activated effect of N on leaf area and number, which reflected on high photosynthetic rate and gave more accumulation to seeds (from source to sink). Results regarding head seed weight significantly increased by N fertilizer, this effect could be due to the fact that increasing nitrogen levels increased vegetative growth by stimulation photosynthetic activity in sunflower plants and consequently produced wider and heavier heads as demonstrated in Table 1. Similar studies have been reported by **Kandil *et al.* (2017), Ravishankar and Malligawad (2017) and Bagheri *et al.* (2018).** The opposite trend was obtained by **El-Aref *et al.* (2011)**.

Table 2 shows that, there were high significant differences among sunflower genotypes at most yield components. Regarding to head diameter, superiority of A-48, A-47 and A-34 genotypes (19.11, 9.89, 19.22 cm) in 2016 season was observed. There were significant differences between different genotypes. Table 2 showed also superiorities of genotypes Giza-102 and A-48 in 100- seed weight (6.89, 6.98 g) and head seed weight (47.33, 69.78 g) in 1st and 2nd seasons, respectively. Respecting to mean over two studied season, superiorities were recorded to A-48 genotypes which gave the highest value for each of 100-seed weight (6.71 g) and head seed weight (56.50 g). These results were also in conformity with other findings *i.e.* **Abd El-Satar *et al.* (2017), Iqrasan *et al.* (2017), Kandil *et al.* (2017) and Popa *et al.* (2017)**.

Figs. 1 and 2 shows the high significant interaction effect between nitrogen fertilizer levels and sunflower genotypes on yield components in the second season. Results showed that A-47 genotype produced higher head diameter (22.00 cm) than all genotypes with N3 (60 kg N fad.$^{-1}$) in 2016 season. However, the lowest head diameter (15 cm) was recorded in Sakha-53 cultivar with N1 (30 kg N fad.$^{-1}$) at the same season. However, the maximum head seed weight was reported in A-48 genotype with N3(60 kg N fad.$^{-1}$) treatments followed by A-47 and A-34 genotypes with N3 (60 kg N fad.$^{-1}$) while, minimum value of final head seed weight was observed in Giza-102 cultivar by N1(30 kg N fad.$^{-1}$) in 2016 season.

Seed Chemical Composition

Protein content

Results in Table 3 shows the effect of Nitrogen fertilizer levels on protein content

Table 1. Head diameter, 100-seed weight and head seed weight as affected by N fertilizer in 2015 and 2016 seasons.

Treatment		Head diameter (cm)			100- seed weight (g)			Head seed weight (g)		
		2015	2016	Comb.	2015	2016	Comb.	2015	2016	Comb.
Nitrogen level (kg N fad.$^{-1}$)	30	12.56 c	16.92 c	14.74	5.21 c	5.17 c	5.19	31.42 c	41.00 c	36.21
	45	13.90 b	18.29 b	16.10	6.21 b	6.34 b	6.28	39.67 b	51.88 b	45.78
	60	15.38 a	19.92 a	17.65	7.13 a	7.16 a	7.15	49.71 a	69.88 a	59.80

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

Table 2. Head diameter (cm), 100-seed weight (g) and head seed weight (g) as affected by sunflower genotypes in 2015 and 2016 seasons.

Treatment		Head diameter (cm)			100- seed weight (g)			Head seed weight (g)		
		2015	2016	Comb.	2015	2016	Comb.	2015	2016	Comb.
Genotype	Giza-102	15.00 a	16.78 b	15.89	6.89 a	6.00 c	6.45	47.33 a	49.22 c	48.28
	Sakha-53	13.78 a	17.67 ab	15.27	6.44 ab	5.83 c	6.14	35.22 d	54.22 bc	44.72
	A - 120	14.67 a	17.78 ab	16.22	5.78 b	5.72 c	5.75	39.00 bcd	48.22 c	43.61
	A - 34	13.39 a	19.22 a	16.30	5.67 b	6.07 bc	5.87	41.00 bc	54.11 bc	47.56
	A - 44	13.18 a	18.22 ab	15.70	5.89 b	6.30 bc	6.10	36.56 cd	48.78 c	42.67
	A - 45	14.00 a	18.33 ab	16.17	6.22 ab	6.22 bc	6.22	43.33 ab	51.67 c	47.50
	A – 47	13.72 a	19.89 a	16.81	6.11 ab	6.67 ab	6.39	36.00 cd	58.00 b	47.00
	A - 48	13.83 a	19.11 a	16.48	6.44 ab	6.98 a	6.71	43.22 ab	69.78 a	56.50

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

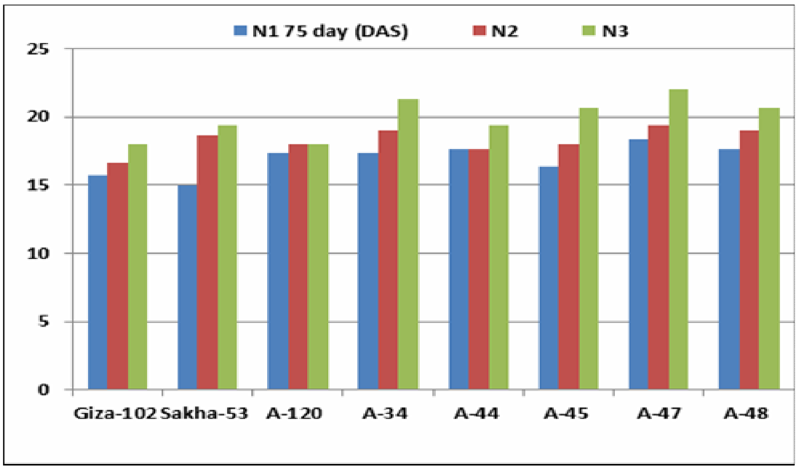

Fig. 1. Head diameter as affected by the interaction between N and sunflower genotypes at 2016 season.

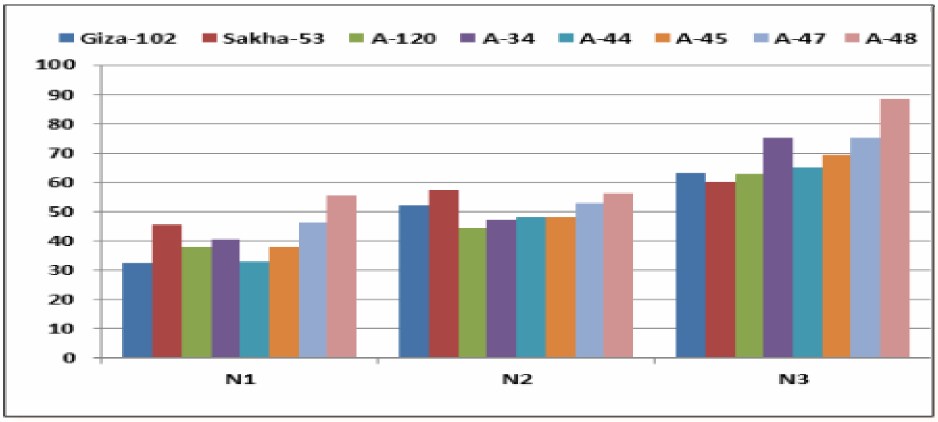

Fig. 2. Head seed weight as affected by the interaction between N fertilizer and sunflower genotypes at 2016 season.

Table 3. Protein content (%) as affected by N fertilizer levels in 2015 and 2016 seasons.

Treatment		Protein content (%) 2015	2016	Comb.
Nitrogen level	**30**	**18.43 c**	**18.60 c**	**18.52**
	45	**19.14 b**	**19.42 b**	**19.28**
(kg N fad.$^{-1}$)	**60**	**19.30 a**	**19.59 a**	**19.45**

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

in the first and second seasons. Nitrogen fertilizer levels had significant effect on protein content in both seasons (Comb.), the maximum protein content (19.45%) was observed in N3(60 kg N fad.$^{-1}$) treatment followed by N2 (45 kg N fad.$^{-1}$) treatment (19.28%) while, minimum protein content (18.52%) was observed in N1 (30 kg N fad^{-1}) treatment, at both season, respectively. The study also corroborates previous work done by **Yasin *et al.* (2013), Abd El-Satar *et al.* (2017) and Dhillon *et al.* (2017)** on the use of different N levels.

There were highly significant differences among sunflower genotypes in protein content (Table 4) in the first and second seasons, where, superiority was found to A-47 genotype (21.03 and 21.30 %) in the first and second seasons, in respectively. In addition, A-47 genotype gave the highest value (21.17 %) in protein content in the combined analysis. This is mainly due to differences in genetic makeup between cultivars. Similar results were suggested by **Gul and Kara (2015), Abd El-Satar *et al.* (2017) and Li *et al.* (2017).**

Figs. 3 and 4 shows protein content as affected by N fertilizer levels and sunflower genotypes in the first and second seasons. Results presented that the interaction treatment A-47 genotype x nitrogen fertilizer 45 kg N fed^{-1}gave the highest values of protein content (21.60 and 21.90%) in the first and second seasons, respectively. Opposite, the minimum value was recorded in A-120 genotype (14.60 and 14.30%) by (N2 45 kg N fad.$^{-1}$) in the first and second seasons.

Table 4. Protein content (%) as affected by sunflower genotypes in 2015 and 2016 seasons.

Treatment		Protein content (%) 2015 season	2016 season	Comb.
Genotype	Giza - 102	17.07 h	17.43 h	17.25
	Sakha - 53	19.60 c	19.80 c	19.70
	A - 120	17.40 g	17.47 g	17.44
	A - 34	18.97 e	19.17 e	19.07
	A - 44	19.17 d	19.40 d	19.29
	A - 45	19.78 b	20.07 b	19.93
	A – 47	21.03 a	21.30 a	21.17
	A - 48	18.63 f	19.00 f	18.82

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

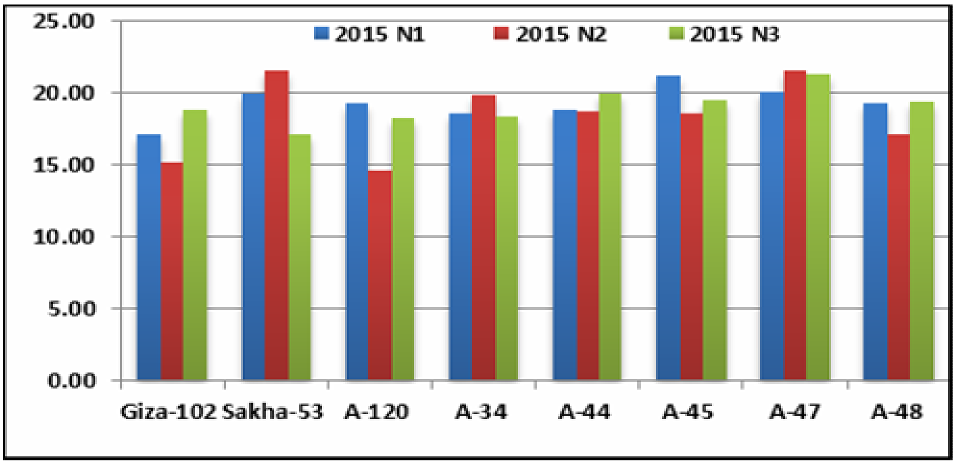

Fig. 3. Protein content as affected by the interaction between N fertilizer and sunflower genotypes at 2015 season.

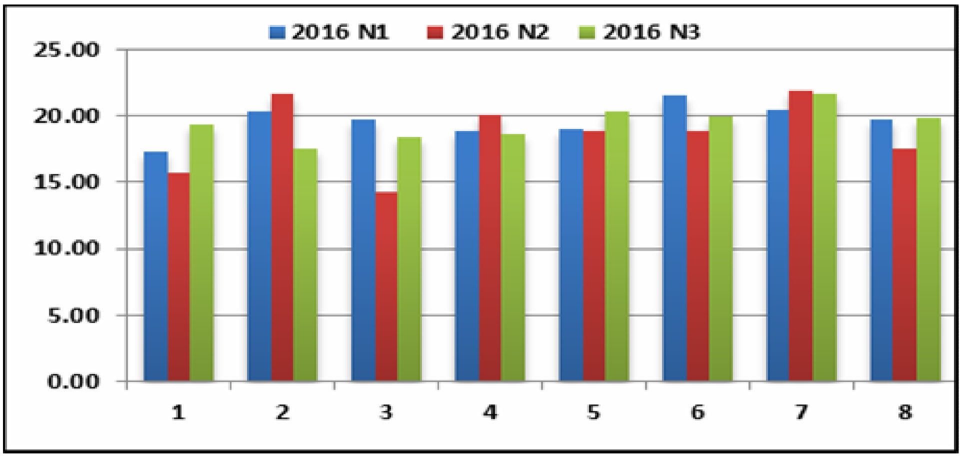

Fig. 4. Protein content as affected by the interaction between N fertilizer and sunflower genotypes at 2016 season.

Oil content

Results in Table 5 shows the effect of nitrogen fertilizer levels on oil content in first and second seasons. Nitrogen fertilizer levels had significant effect on oil content in the first and second seasons, where, oil content decreased with higher N levels, while, maximum oil content (29.73%) was observed in treatment N1 (30 kg N fad.$^{-1}$) and minimum oil content (25.83%) was observed in treatment N3 (60 kg N fad.$^{-1}$) in 2016 season, results were similar in 2015 season. Application of 60 kg N fad^{-1} gave the lowest values of oil content, while, the lowest nitrogen level (30 kg N fad.$^{-1}$) gave the highest ones for oil content in both seasons. These resulted are consistent with those of **Nasim *et al.* (2012)**, who observed decreased in seed oil percentages with increased nitrogen fertilizer application, it′s indicated that the oil content was significantly affected by N application, this could be attributed to the a diluting effect of nitrogen on seed oil content due to increased number of seeds head^{-1}. Several researches reported that, the oil content is reduced by N application **(Dhillon *et al.*, 2017; Bagheri *et al.*, 2018; Schultz *et al.*, 2018)**.

There were highly significant differences among sunflower genotypes on seed oil content (Table 6) in the first and second seasons. Sakha-53 cultivar gave the highest value of seed oil content (30.05 and 29.50%) in both respective seasons, while that, superiority of Giza -102, A-120, A-34 and A-47 gave the highest values of seed oil content (29.25, 29.61, 29.26 and 28.61%) in 2015 season, respectively. According to combined seasons Sakha-53 cultivar gave the highest value (29.78%) of oil content. Differences between sunflower cultivars in oil content were also reported by **Alves *et al.* (2017), Iqrasan *et al.* (2017) and Kandil *et al.* (2017)**.

According to oil content, Results in Figs. 5 and 6 shows that the interaction treatment of Sakha-53 cultivar x nitrogen fertilizer 45 kg N fad^{-1} gave the highest value of oil content (32.86 and 32.85 %) in the first and second seasons. Additionally, A-34 genotype gave the highest value (33.70%) under nitrogen fertilizer level 45 kg N fad.$^{-1}$ in 2015 season, while the lowest value was found by A-34 and A-44 genotypes (23.36 and 23.89%) with N1 (30 kg N fad.$^{-1}$) in the same season, but, minimum value was recorded by A-47 genotypes fertilized with 60 kg N fad.$^{-1}$ at 2016 season.

Yields

Nitrogen fertilizer levels had highly significant effect on sunflower yield (seed, oil, protein) in the first and second seasons. Tables 7 shows that increasing nitrogen levels from 30 to 60 kg fad^{-1} increased seed yield (from 0.79 to 1.25 ton fad^{-1}), protein yield (from 0.15 to 0.24 ton fad^{-1}) and oil yield (from 0.22 to 0.36 ton fad^{-1}) in 2015 season. Similar trend was observed in 2016 season, where, the highest nitrogen level application (60 kg N fad.$^{-1}$) gave the maximum values of yield. According to oil yield the increase in oil yield with the increase of nitrogen level 60 kg N fad.$^{-1}$ might be due to the role of nitrogen in activating the growth and yield components. These trend was reported by **Ravishankar and Malligawad (2017), Bagheri *et al.* (2018) and Khandekar *et al.* (2018).** The opposite trend was recorded by **Hussain *et al.* (2011)** who said that oil yield was decreased with increasing N fertilizer.

There were highly significant differences among the studied genotypes on seed, protein, and oil yield (Table 8) in the first and second seasons. According to seed yield and oil yield, superiorities were recorded to Giza-102 cultivar and A-48 genotype for seed yield (1.19 and 1.75 ton fad.$^{-1}$) and oil yield (0.36 and 0.48 ton fad^{-1}) at respective season. Superiority of A-48 genotypes in seed, protein, and oil yields ton fad.$^{-1}$ may be due to their genetic constitution and it′s capability of withstanding

Table 5. Oil content (%) as affected by N fertilizer levels in 2015 and 2016 seasons.

		Oil content (%)		
Treatment		2015 season	2016 season	Comb.
Nitrogen level (kg N fad^{-1})	30	30.66 a	29.73 a	28.02
	45	28.65 b	28.66 b	29.66
	60	26.31 c	25.83 c	27.24

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

Table 6. Oil content (%) as affected by sunflower genotypes in 2015 and 2016 seasons.

		Oil content (%)		
Treatment		2015 season	2016 season	Comb.
Genotype	Giza - 102	29.25 a	28.99 c	29.12
	Sakha - 53	30.05 a	29.50 a	29.78
	A - 120	29.61 a	28.31 d	28.96
	A - 34	29.26 a	29.26 b	29.26
	A - 44	27.41 ab	26.48 g	26.95
	A - 45	25.83 b	28.19 e	27.01
	A – 47	28.61 a	26.46 g	27.54
	A - 48	28.30 ab	27.40 f	27.85

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

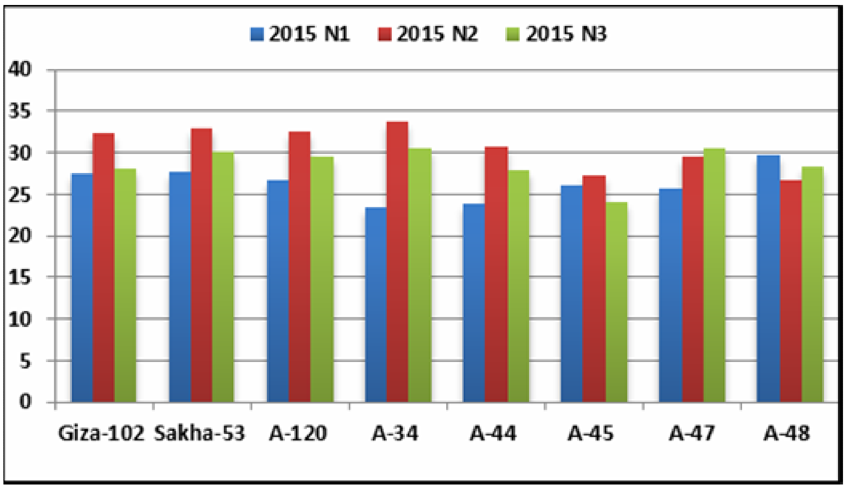

Fig. 6. Oil content as affected by the interaction between N fertilizer and sunflower genotypes at 2015 season.

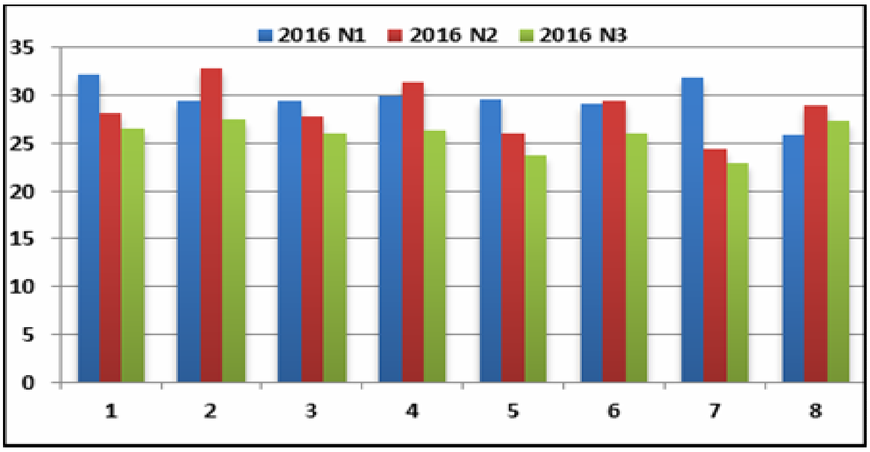

Fig. 6. Oil content as affected by the interaction between N fertilizer and sunflower genotypes at 2016 season.

Table 7. Seed, protein, oil yields ton fad^{-1} as affected by N fertilizer at 2015 and 2016 seasons.

Treatment		Seed yield ton fad.$^{-1}$			Protein yield ton fad.$^{-1}$			Oil yield ton fad.$^{-1}$		
		2015	2016	Comb.	2015	2016	Comb.	2015	2016	Comb.
Nitrogen level (kg N fad.$^{-1}$)	30	0.79 c	1.03 c	0.91	0.15 c	0.20 c	0.18	0.22 c	0.29 c	0.26
	45	1.00 b	1.32 b	1.16	0.18 b	0.25 b	0.22	0.30 b	0.38 b	0.34
	60	1.25 a	1.76 a	1.51	0.24 a	0.34 a	0.29	0.36 a	0.44 a	0.40

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

climatic fluctuation and soil conditions. The same direction was observed by **Sheoran *et al.* (2016), Abd El-Satar *et al.* (2017) and Ahmad *et al.* (2017).** As for, Table 8 presented that protein yield superiority was for A-48 and A-47 genotypes and gave the highest value (0.33, 0.32 ton fad.$^{-1}$) in 2016 season, but, A-45 genotype surpassed all genotypes and gave maximum value (0.23 ton fad.$^{-1}$) of protein yield in 2015 season. According to combined over two season, superiorities were recorded to A-48 genotype which gave the highest values for, seed yield (1.42 ton fad^{-1}), protein yield (0.27 ton fad^{-1}) and oil yield (0.40 ton fad^{-1}). Similar results were reported by **Hassan (2010), Yankov and Tahsin (2015) and Ali *et al.* (2012).**

Fig. 7 observed that maximum seed yield ton fad^{-1} was reported in A-48 genotype with N3(60 kg N fad.$^{-1}$) treatments followed by A-47 and A-34 genotypes with N3 (60 kg N fad.$^{-1}$) while, minimum value of final seed yield ton fed^{-1} was observed in Giza-102 cultivar by N1(30 kg N fad^{-1}) in 2016 season.

Fig. 8 shows that maximum protein yield ton fad^{-1} was detected in A-48 with N3(60 kg N fad.$^{-1}$) treatments followed by A-47 genotype with N3 (60 kg N fad.$^{-1}$) while, minimum value of final protein yield ton fad.$^{-1}$ was observed in Giza-102 cultivar by N1(30 kg N fad.$^{-1}$) at 2016 season.

Table 8. Seed, protein and oil yields ton fad^{-1} as affected by sunflower genotypes at 2015 and 2016 seasons.

Treatment		Seed yield ton fad.$^{-1}$			Protein yield ton fad.$^{-1}$			Oil yield ton fad.$^{-1}$		
		2015	2016	Comb.	2015	2016	Comb.	2015	2016	Comb.
Genotype	**Giza-102**	1.19 a	1.23 d	1.21	0.20 bc	0.21 d	0.21	0.36 a	0.33 de	0.35
	Sakha-53	0.89 d	1.39 c	1.14	0.18 c	0.27 b	0.23	0.27 de	0.39 bc	0.33
	A - 120	0.99 bcd	1.21 d	1.10	0.19 bc	0.20 d	0.19	0.29 cd	0.32 e	0.31
	A - 34	1.04 bc	1.36 c	1.20	0.19 bc	0.26 b	0.23	0.33 ab	0.40 b	0.37
	A - 44	0.93 cd	1.23 d	1.08	0.17 c	0.24 c	0.21	0.21 f	0.32 e	0.27
	A - 45	1.09 ab	1.30 cd	1.20	0.23 a	0.26 b	0.24	0.33 b	0.36 cd	0.35
	A – 47	0.91 cd	1.52 b	1.22	0.17 c	0.32 a	0.25	0.25 e	0.39 bc	0.32
	A - 48	1.09 ab	1.75 a	1.42	0.21 ab	0.33 a	0.27	0.31 bc	0.48 a	0.40

* Means having the same letter within each column are not significantly differed at 0.05 level, according to Duncan's multiple range test.

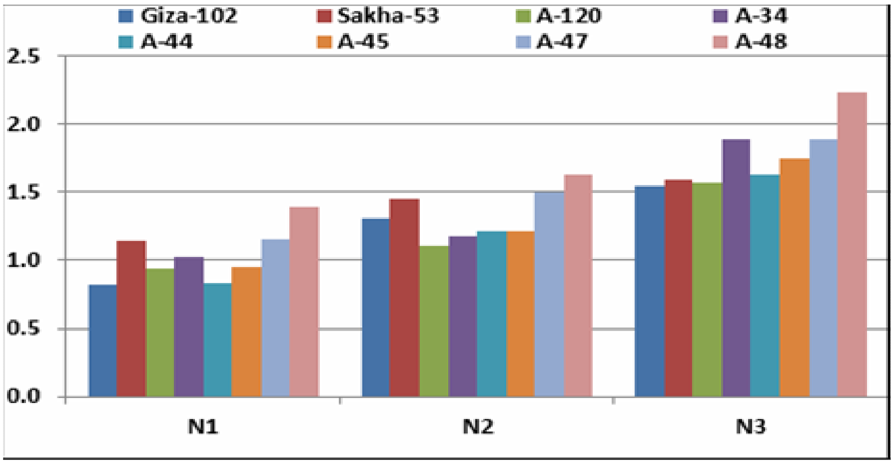

Fig. 7. Seed yield as affected by the interaction between N fertilizer and sunflower genotypes at 2016 season.

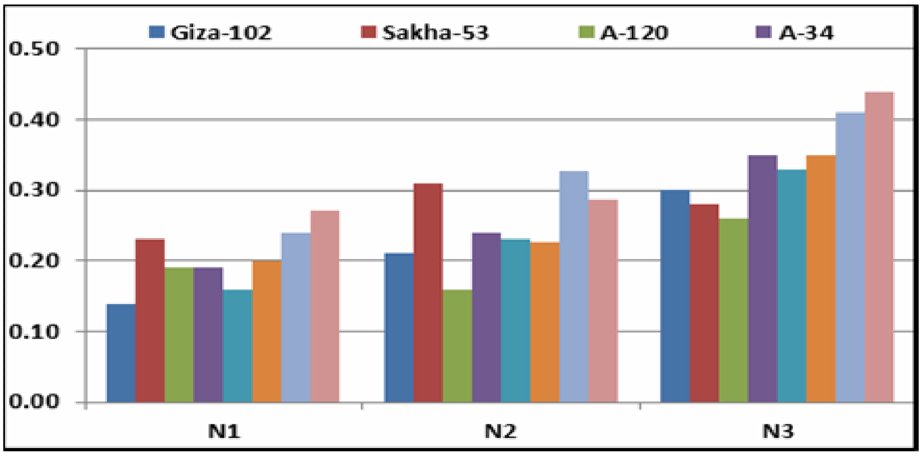

Fig. 8. Protein yield as affected by the interaction between N fertilizer and sunflower genotypes at 2016 season.

Fig. 9 presented that maximum oil yield ton fad^{-1} was reported in Giza-102 cultivar with N3 (60 kg N fad^{-1}) treatments, while, minimum value of final oil yield ton fad^{-1} was observed in A-45 genotype by N1(30 kg N fad^{-1}) at 2015 season.

Fig. 10 showed that maximum oil yield was reported in A-48 genotypes with N3(60 kg N fad^{-1}) treatments followed by A-34 with N3 (60 kg N fad^{-1}) while, minimum value of final oil yield ton fad^{-1} was observed in Giza-102 cultivar and A-120 by N1(30 kg N fad.$^{-1}$) at 2016 season.

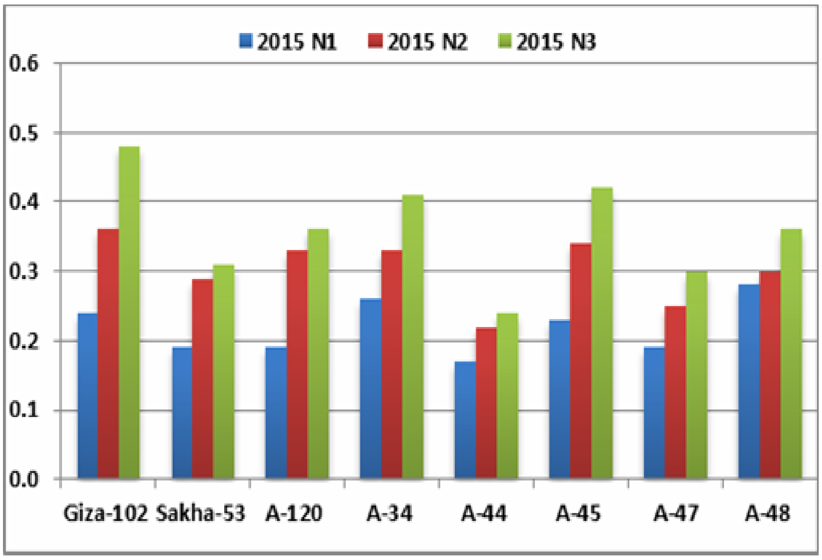

Fig. 9. Oil yield as affected by the interaction between N fertilizer and sunflower genotypes at 2015 season.

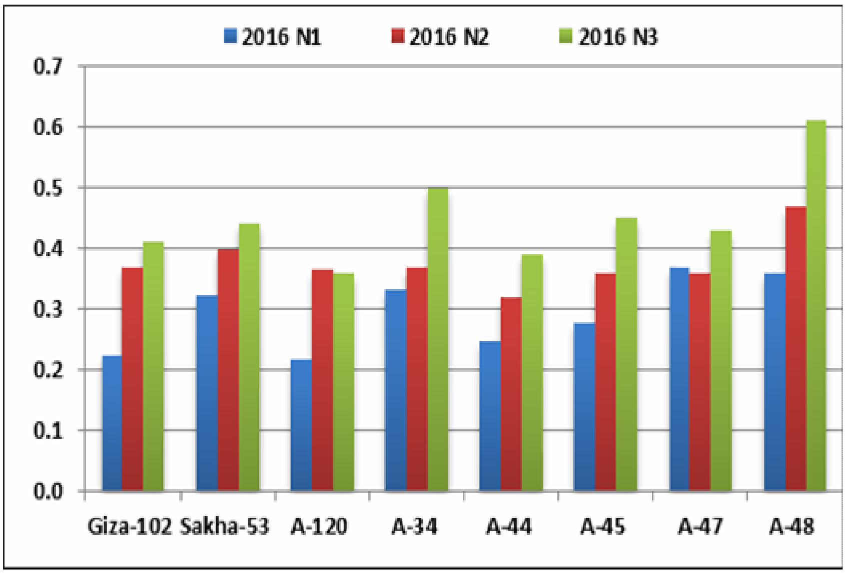

Fig. 10. Oil yield as affected by the interaction between N fertilizer and sunflower genotypes at 2016 season.

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الملخص العربى

اســتجــابة بعـض التراكيب الوراثيـــــة لزهــرة الشمـــس لمســـتويات التسميد النيتروجينـــي

أمل محمد متولي[1]، فوقية محمد أحمد سالم[2]، صبري محمود سليم اليماني[1]، إيمان إسماعيل السراج[2]

١- قسم بحوث المحاصيل الزيتية، معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية، مصر.

٢- فرع المحاصيل - قسم الإنتاج النباتي، كلية العلوم الزراعية البيئية، جامعة العريش، مصر.

يعتبر نبات زهـرة الشـمس من أهم المحاصيل الزيتية، حيث يقع ترتيبه فى المرتبة الرابعة في إنتاج الزيت بعد الفول السوداني وفول الصويا والكانولا، وانطلاقاً من أهمية هذا المحصول، فقد أجريت هذه الدراسة بهدف دراسة تأثير ثلاث مستويات من التسميد النيتروجيني (٣٠، ٤٥ و٦٠ كجم نيتروجين للفدان) علي ٨ تراكيب وراثية من بينهم صنفين من نبات زهرة الشمس (سخا ٥٣، وجيزة ١٠٢) مقارنةً مع ٦ تراكيب وراثية (ع ٣٤، ع ٤٤، ع ٤٥، ع ٤٧، ع ٤٨ وسلالة ١٢٠) من نبات زهرة الشمس وذلك تحت ظروف شمال سيناء في صيف موسمي ٢٠١٥ و٢٠١٦م/ اشتملت الدراسة علي ٢٤ معاملة عبارة عن محصلة ثلاث مستويات من التسميد النيتروجيني (٣٠، ٤٥ و٦٠ كجم نيتروجين للفدان) و٨ تراكيب وراثية من نبات زهرة الشمس، كانت أهم النتائج التى توصلت إليها الدراسة هي أن زيادة مستويات التسميد النيتروجيني تؤدي إلي زيادة المحصول ومكوناته وزيادة نسبة البروتين بالبذرة، بينما يقل محتوي الزيت بالبذور، أعطى التركيب الوراثي ع ٤٨ أعلي قيمة عند التسميد بمعدل ٦٠ كجم نيتروجين للفدان في (وزن ١٠٠ بذرة، وزن بذور القرص، محصول الزيت والبروتين والبذور في الموسم ٢٠١٦، كما تفوق صنف جيزة ١٠٢ بالتسميد بمعدل ٦٠ كجم نيتروجين للفدان في وزن ١٠٠ بذرة، وزن بذور القرص، محصول الزيت والبروتين والبذور في الموسم ٢٠١٥، وأخيراً خلصت الدراسة إلى أن تسميد التركيب الوراثي ع ٤٨ بمعدل ٦٠ كجم نيتروجين للفدان يعتبر أفضل معاملة تحت ظروف شمال سيناء.

الكلمات الإسترشادية: التراكيب الوراثية، نبات زهرة الشمس، التسميد النيتروجيني.

المحكمـــون:

١- **أ.د. عبدالستار عبدالقادر الخـــواجة** أستاذ المحاصيل، كلية الزراعة، جامعة الزقازيق، مصر.

٢- **أ.د. محمـد عبدالحميـد البرمـــاوي** أستاذ المحاصيل، كلية الزراعة، جامعة قناة السويس، مصر.