

## Effect of Nitrogen Fertilizer on some Flax Varieties under Two different Location Conditions

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### ABSTRACT

Two field experiments were carried out at El-Gemmeiza and Sakha Agriculture Research Stations, Gharbia and Kafr El-Sheikh Governorates, Egypt in 2016/2017 and 2017/2018 seasons to study the effect of three nitrogen fertilizer rates (30, 45 and 60 kg/feddan) on four flax varieties (Giza 11, Giza 12, Sakha 5 and Sakha 6). Results indicated that, fertilized flax Giza 12 variety with nitrogen fertilizer at the rate of 45 kg N /feddan at El-Gemmeiza location yielded the highest values of seed index, seed yield per plant, seed yield per feddan, and oil yield per feddan, on the same line fertilized flax Giza 12 variety with nitrogen fertilizer at the rate of 60 kg N /feddan at El-Gemmeiza location produced the highest values of plant height, fiber length, straw yield per plant, straw yield per feddan and fiber yield per feddan. On the other hand, flax Sakha 6 variety with nitrogen fertilizer at a rate of 60 kg N /feddan at El-Gemmeiza location gave the highest values of number of capsules per plant but flax Sakha 5 variety with nitrogen fertilizer at a rate of 45 kg N /feddan at Sakha location gave the highest values of oil percentage only as compared with all other this interaction treatments in 2016/2017 and 2017/2018 seasons, respectively.

### INTRODUCTION

In Egypt, flax (*Linum usitatissimum* L.) is an ancient crop, which is grown as dual purpose for its fiber and seed or oil, flax ranks second to cotton, as fiber crop, where it plays an important role in the national economy due to local industry and contribute in increasing flax exports. The cultivated area in Egypt is very limited, therefore, increasing flax yield from expanding new cultivated area and per unit area is very important. This could be achieved through improving the agronomic practices such as nitrogen fertilizer rates and sowing new cultivars highly yielding, therefore, Casa *et al.* (1999) noted that the environmental factors exert a major role in determining yield potential it is important to understand environmental effects on flax yield. Inga *et al.* (2015) apart from the changing conditions highest seed yield were produced from a varieties 'Lirina' (2.54 h -1t), high seed oil content from variety 'Amon' (53.03%).

Nitrogen fertilizer is the major important for plant growth and raising productivity of all crops. In this connection, El-Gazzar and Kineber (2002) found that increasing nitrogen level from 30 to 60 kg/fed significantly increased seed yield per plant as well as per feddan. El-Nagdy *et al.* (2010) reported that 45 kg N/fed have highest seed and straw yields. Geovan *et al.* (2013) reported that nitrogen rates influenced some production components. Dervisevic *et al.* (2014) reported that the optimal nitrogen rate for fiber flax to the obtained results was 30 kg N/ha. Sowing the suitable cultivars is an important factor to give higher yields. In this connections by many investigators indicating that there are significant differences due to flax genotypes in growth and yield. El-Borhamy (2016) increasing nitrogen level from 30 to 60 kg/fed significantly increased straw yield/plant, straw yield/fed, fiber length, fruiting zone length and number of capsules/plant. Adding 45kg N/fed resulted in the highest values of seed yield and its components.

The increase of unit area could be achieved by sowing high yielding cultivars. In this concern, Bakry *et al.* (2012) show that significant differences among flax varieties in all studied characteristics. Giza-8 variety surpassed all other tested flax varieties in seed and oil yields/fed., number of capsules/plant, number of branches/plant, seed yield/plant, and oil seed %. However,

Vaiking variety significantly exceeded the other cultivars in straw and fiber yields/fed., plant height, fruiting zone length fiber%. Hussein (2012) showed that flax crop genotypes significantly differed for all studied yield and its components. Gholamhosein *et al.* (2013) found that flax genotypes differed in plant height, capsule number, seed yield and biological yield. El-Borhamy *et al.* (2015) showed that significant differences among the flax genotypes in straw and seed yield/feddan and its components. Kineber *et al.* (2015) found that new flax varieties Sakha 5 and Sakha 6 were significantly higher in straw, seed, fiber, and oil yields. El-Borhamy (2016) revealed that Giza12 cv., was superior than Giza 11 cv., due to straw yield /plant, straw yield/fed., fiber length, fiber yield/plant and fiber yield/fed. While Giza 11 cv. was superior than Giza 11 cv., in fruiting zone length, number of capsules/plant, number of seeds /plant, seed yield/plant and seed index.

Therefore, this investigation was carried out to study the effect of three nitrogen fertilizer rates on growth and yield of four flax varieties at two locations El-Gemmeiza, Gharbia and Sakha Kafr El-Sheikh Governorates, Egypt.

### MATERIALS AND METHODS

The present investigation was carried out at El-Gemmeiza and Sakha Agriculture Research Stations, Gharbia, and Kafr El-Sheikh Governorates, Egypt during the two successive winter seasons of 2016/2017 and 2017/2018 to study the effect of three nitrogen fertilizer rates on yield and quality of four flax varieties under two locations condition.

**The experiment treatments were as follows:**

#### A-Nitrogen fertilizer

Three rates of nitrogen fertilizer (30, 45 and 60 Kg / feddan) were used. Nitrogen fertilizer at the above mentioned rates in the form of urea (46.5% N) was applied in two equal doses the first dose (50%) was applied before the first irrigation and the second dose (50%) before the second irrigation.

#### B- Flax varieties

**The studied four flax varieties were:**

1 – Giza 11 2- Giza 12 3- Sakha 5 4- Sakha6

Seeds of studied varieties were obtained from El-Gemmeiza Agriculture Research Stations, El-Gharbia

Governorate , Egypt. Planting flax varieties i.e. Giza 11 and Giza 12 with seeding rates of 70 kg/feddan while flax varieties i.e. Sakha 5 and Sakha6 were planting at seeding rate of 60 kg/feddan.

The experiments were laid out in split plot design with three replications in each location. The main plots were devoted to nitrogen fertilizer rates and sub plots were allocated to flax varieties . the sub plot area was 10.5 m<sup>2</sup> (3mlong x 3.5m wide).

Seed of the four flax cultivars were sowing on Nov. 15<sup>th</sup> and 20<sup>th</sup> in 2016/2017and 2017/2018 seasons, respectively. Super phosphate fertilizer was added at the rate of 100 kg / feddan ( 15.5 % P<sub>2</sub>O<sub>5</sub> ) during soil preparation.

The Mechanical and Chemical analysis of the soil at the experimental site according to standard methods of Page ( 1982) and Arnold (1986 ) during 2016 / 2017 and 2017 / 2018 seasons are shown in Table 1 and Table 2.

**Table 1. Mechanical and Chemical analysis of the experimental-soil in the two growing seasons at El-Gemmeiza Research Station.**

Characters	seasons	
	2015/2016	2016/2017
A-Mechanical characters:		
Clay %	46.86	48.75
Silt %	38.68	37.53
Sand %	14.46	13.72
Texture class	clay	clay
B-Chemical characters:		
PH	7.83	7.32
Total N%	0.07	0.08
Available N (ppm)	65.12	75.17
Available P (ppm)	9.56	12.21
Available K (ppm)	454.85	538.45

**Table 2. Mechanical and Chemical analysis of the experimental-soil in the two growing seasons at Sakha Research Station.**

Characters	seasons	
	2015/2016	2016/2017
A-Mechanical characters:		
Clay %	37.86	39.32
Silt %	55.62	56.09
Sand %	6.52	4.59
Texture class	clay	clay
B-Chemical characters:		
PH	8.12	7.89
Total N%	0.06	0.05
Available P (ppm)	18.3	22.4
Available N (ppm)	24.4	27.9
Available K (ppm)	432.0	485.0

**The studied characters:**

Ten plants were chosen randomly at harvesting time after 145 days from sowing to estimate the following characters:

- 1- **Plant height (cm):** from the cotyledonary node to apical bud of each plant.
- 2- **Fiber length (cm).**
- 3- **Number of capsules per plant.**
- 4- **Seed index (g):** It was determined as the average weight of 1000 seeds obtained from each plot.
- 5- **Oil percentage %.**
- 6- **Straw yield per plant (g).**
- 7- **Seed yield per plant (g).**

8- **Straw yield per feddan (ton):** It was estimated from the sub plots and converted to recorded straw yield per feddan after removing the capsules.

9- **Seed yield per feddan (kg).**

10- **Fiber yield per feddan (kg).**

11- **Oil yield per feddan:** Was calculated from oil percentage multiplying by Oil percentage and seed yield per feddan.

**Statistical Analysis:**

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split – plot design and made compaiend analysis among locations by means of “ MSTAT-C” computer software package and least significant difference (LSD) method was used to test the differences between treatment means at 5% levels of probability, as published by Gomes and Gomes (1984).

**RESULTS AND DISCUSSION**

Results presented in Table 3-13 indicated that locations significantly affected all studied characters in both seasons . Flax plants grown in El-Gemmeiza location gave the highest values of plant height 90.10 and 92.25 cm, fiber length 80.92 and 82.71 cm, number of capsules per plant 21.33 and 22.50, seed index 9.19 and 9.48 g, straw yield per plant 1.20 and 1.28 g, seed yield per plant 0.393 and 0.411 g, straw yield per feddan 2.95 and 3.23 ton, seed yield per feddan 526.31 and 537.70 kg, Fiber yield per feddan 718.59 and 770.57 kg as well as oil yield per feddan 177.46 and 184.99 kg. While, flax plants grown in Sakha gave the highest values of oil percentage only which was 35.82 and 36.34 % in both 2016/2017 and 2017/2018 seasons, respectively.

The increase in straw yield per feddan ,seed yield per feddan and oil yield per feddan at El-Gemmeiza location may be attributed to the environmental factors was suitable for plant growth such as plant height (table 3)which led to raising plant straw yield (table 8) therefore increasing straw yield per feddan. Also, this region of El-Gemmeiza was adequate for growing plant flax to gave the tallest plants which gave the tallest fiber (table 4) hence the fiber yield per feddan increased . In this connection, the highest seed yield per plant (table 11) increased seed yield per feddan which caused increment of oil yield per feddan. These results are in the same line with those obtained by Casa *et al.* (1999) and Inga *et al.* (2015).

Results presented in Table 3-13 indicated that nitrogen fertilizer rates significantly affected all studied characters in both seasons . Fertilized flax plants by nitrogen fertilizer at the rate of 45 kg/feddan gave the highest values of seed index 9.56 and 9.79 g, oil percentage 37.08 and 37.83 % , seed yield per plant 0.414 and 0.431 g, seed yield per feddan 546.37 and 557.72 kg, as well as oil yield per feddan 201.14 and 208.56 kg as compared with all other fertilizer rates in 2016/2017 and 2017 /2018 seasons, respectively. In this connection , flax plants treated with fertilizer nitrogen at the rate of 60 kg/feddan gave the highest values of plant height 95.31 and 95.97 cm, fiber length 81.21 and 82.63 cm, number of capsules per plant 21.12 and 22.50, straw yield per plant 1.29 and 1.35 g, straw yield per feddan 3.16 and 3.41 ton and fiber yield per feddan 769.22 and 803.47 kg compared to other fertilization treatments in 2015/2016 and 2016/2017 seasons ,respectively.

**Table 3. Effect of nitrogen fertilizer rates on plant height (cm) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)					Flax varieties (V)				
		Giza 11	Giza 12	Sakha 5	Sakha 6	mean	Giza 11	Giza 12	Sakha5	Sakha 6	mean
EL-Gemmeiza	30	79.20	82.50	61.40	70.40	73.37	81.60	87.30	62.50	71.80	75.80
	45	101.20	102.30	87.50	97.50	97.12	103.40	105.70	91.20	98.20	99.62
	60	103.70	105.10	91.20	99.30	99.82	104.50	105.90	93.40	101.60	101.35
mean		94.70	96.63	80.03	89.06	90.10	96.50	99.63	82.36	90.53	92.25
Sakha	30	73.40	76.20	58.60	61.80	67.50	75.30	78.20	63.10	65.70	70.57
	45	96.30	98.40	77.30	83.20	88.80	97.50	103.20	79.40	86.40	91.62
	60	97.20	100.50	79.70	85.80	90.80	88.30	103.90	81.70	88.50	90.60
mean		88.96	91.70	71.86	76.93	82.36	87.03	95.10	74.73	80.20	84.26
General mean of N-rates	30	76.30	79.35	60.00	66.10	70.43	78.45	82.75	62.80	68.75	73.18
	45	98.75	100.35	82.40	90.35	92.96	100.45	104.45	85.30	92.30	95.62
	60	100.45	102.80	85.45	92.55	95.31	96.40	104.90	87.55	95.05	95.97
means of flax varieties		91.83	94.16	75.94	82.99	86.23	91.76	97.36	78.54	85.36	88.25
L.S.D at 5% for: L				*				*			
	N			0.95				1.02			
	L x N			1.36				1.54			
	V			1.80				1.92			
	L x V			2.68				2.79			
	N x V			3.23				3.52			
	L x N x V			4.45				4.64			

**Table 4. Effect of nitrogen fertilizer rates on fiber length (cm) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)					Flax varieties (V)				
		Giza 11	Giza 12	Sakha 5	Sakha 6	mean	Giza 11	Giza 12	Sakha 5	Sakha 6	mean
EL-Gemmeiza	30	75.30	82.30	69.30	71.40	74.57	77.40	83.40	71.70	73.40	76.47
	45	84.15	91.30	78.15	81.30	83.72	85.70	92.40	81.70	82.80	85.65
	60	84.90	92.10	79.10	81.80	84.47	85.80	93.10	82.10	83.10	86.02
mean		81.45	88.56	75.51	78.16	80.92	82.96	89.63	78.50	79.76	82.71
Sakha	30	71.20	77.40	65.20	68.40	70.55	72.40	79.30	66.70	69.80	72.05
	45	80.7	86.10	69.40	73.20	77.35	81.30	87.50	70.80	75.70	78.82
	60	81.10	87.20	69.80	73.70	77.95	81.70	87.90	71.30	76.10	79.25
mean		77.66	81.56	68.13	71.76	75.28	78.46	84.90	69.60	73.86	76.70
General mean of N-rates	30	73.25	79.85	67.25	69.90	72.56	74.90	81.35	69.20	71.60	74.26
	45	82.42	88.70	73.77	77.25	80.53	83.50	89.95	76.25	79.25	82.23
	60	83.00	89.65	74.45	77.75	81.21	83.75	90.50	76.70	79.60	82.63
means of flax varieties		79.55	85.06	71.82	74.96	78.10	80.71	87.26	74.05	76.81	79.70
L.S.D at 5% for: L				*				*			
	N			1.23				1.33			
	L x N			1.64				1.72			
	V			1.90				2.02			
	L x V			2.35				2.47			
	N x V			2.96				3.10			
	L x N x V			3.05				3.12			

The increase in seed yield per feddan owing to nitrogen fertilizer at the rate of 45 kg N/ feddan might be attributed to increasing seed yield per plant (table 9) and seed index ( table 6) which led to raising seed yield per feddan. Also, the increase in oil yield per feddan caused by adding 45 kg N /feddan may be due to increasing seed yield per feddan ( table 11) and oil % ( table 7) thus oil yield per feddan was increased. In this connection the highest fiber yield per feddan caused by applying nitrogen fertilizer at the rate of 60 kg N/feddan may be attributed to the higher plant height (table 3), fiber length (table 4) therefore gave the highest fiber yield per feddan , also straw yield per feddan was obtained with 60 kg N/feddan because it gave the highest plant height (table 3) and straw yield per plant, hence straw yield per feddan was highest. These results are in harmony with those of El-Gazzar and

Kineber (2002), El-Nagdy *et al.* (2010), Geovan *et al.* (2013), Dervisevic *et al.* (2014) and El-Borhamy (2016).

Data recorded in Tables 3-13 show clearly that flax varieties were significantly differed in both 2016/2017 and 2017/2018 seasons . Flax Giza 12 variety exceeded other flax varieties and gave the highest values of plant height 94.16 and 97.36 cm, fiber length 85.06 and 87.26 cm, seed index 9.86 and 10.16 g, straw yield per plant 1.33 and 1.42 g, seed yield per plant 0.475 and 0.489 g, straw yield per feddan 3.38 and 3.59 ton, seed yield per feddan 639.13 and 648.88 kg, fiber yield per feddan 832.34 and 867.86 kg and oil yield per feddan 222.15 and 228.78 kg. While flax variety Sakha 6 surpassed other varieties due to number of capsules per plant 22.16 and 23.33, but flax variety Sakha 5 gave the highest values of oil percentage 36.81 and 37.56 % as compared with other flax varieties tested in 2016/2017 and 2017/2018 seasons, respectively.

**Table 5. Effect of nitrogen fertilizer rates on number of capsules per plant of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	17.00	20.00	17.00	19.00	18.25	18.00	21.00	18.00	20.00	19.25
	45	19.00	21.00	24.00	26.00	22.50	20.00	23.00	25.00	27.00	23.75
	60	20.00	21.00	25.00	27.00	23.25	21.00	24.00	26.00	27.00	24.50
mean		18.66	20.66	22.00	24.00	21.33	19.66	22.66	23.00	24.66	22.50
Sakha	30	13.00	15.00	16.00	18.00	15.50	15.00	16.00	16.00	19.00	16.50
	45	15.00	16.00	19.00	21.00	17.75	16.00	18.00	20.00	23.00	19.25
	60	17.00	18.00	19.00	22.00	19.00	18.00	19.00	21.00	24.00	20.50
mean		15.00	16.33	18.00	20.33	17.41	16.33	17.66	19.00	22.00	18.75
General mean of N-rates	30	15.00	17.50	16.50	18.50	16.87	16.50	18.50	17.00	19.50	17.87
	45	17.00	18.50	22.50	23.50	20.12	18.00	20.50	22.50	25.00	21.50
	60	18.50	19.50	22.00	24.50	21.12	24.50	21.50	23.50	25.50	22.50
means of flax varieties		16.83	18.49	20.00	22.16	19.37	17.99	20.16	21.00	23.33	20.62
<b>L.S.D at 5% for: L</b>				*				*			
	N			1.10				1.21			
	L x N			1.20				1.26			
	V			1.36				1.39			
	L x V			1.45				1.49			
	N x V			1.75				1.80			
	L x N x V			1.83				1.90			

**Table 6. Effect of nitrogen fertilizer rates on seed index (g) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	7.90	8.30	7.50	7.70	7.85	8.10	8.60	7.80	7.90	8.10
	45	10.20	11.50	8.70	9.30	9.92	10.80	11.90	8.90	9.50	10.27
	60	10.20	11.30	8.50	9.20	9.80	10.50	11.70	8.80	9.30	10.07
mean		9.43	10.36	8.23	8.73	9.19	9.80	10.73	8.50	8.90	9.48
Sakha	30	7.60	7.90	7.10	7.30	7.47	7.70	8.10	7.20	7.50	7.62
	45	9.70	10.30	8.20	8.60	9.20	9.70	10.50	8.30	8.80	9.32
	60	9.40	9.90	8.10	8.40	8.95	9.50	10.20	8.10	8.50	9.07
mean		8.90	9.36	7.80	8.10	8.54	8.96	9.60	7.86	8.26	8.67
General mean of N-rates	30	7.75	8.10	7.35	7.50	7.66	7.90	8.35	7.50	7.70	7.86
	45	9.95	10.90	8.45	8.95	9.56	10.25	11.20	8.60	9.15	9.79
	60	9.80	10.60	8.30	8.80	9.37	10.00	10.95	8.45	8.90	9.57
means of flax varieties		9.16	9.86	8.01	8.41	8.86	9.38	10.16	8.18	8.58	9.07
<b>L.S.D at 5% for: L</b>				*				*			
	N			0.06				0.07			
	L x N			0.09				0.11			
	V			0.12				0.13			
	L x V			0.15				0.17			
	N x V			0.18				0.24			
	L x N x V			0.21				0.29			

The superiority of flax Giza 12 variety in oil yield per feddan might be attributed to it gave the highest seed yield per plant (table 9) which led to raising seed yield per feddan (table 11) and consequently gave the higher oil yield per feddan than other varieties studied. Also this variety gave the highest fiber yield per feddan because of it had the highest plant height (table 3) and fiber length (table 12). These results are in the same line with obtain by Bakry *et al.* (2012), Hussein (2012), Gholamhosein *et al.* (2013), El-Borhamy *et al.* (2015), Kineber *et al.* (2015) and El-Borhamy (2016).

The obtained results showed that the interaction effect between location and nitrogen fertilizer was significant on all studied traits in both seasons. At EL-Gemmeiza location, fertilized flax plant with nitrogen

fertilizer at the rate of 45 kg N / feddan and gave the highest values of seed index 9.92 and 10.27 g, seed yield per plant 0.426 and 0.448 g, seed yield per feddan 562.42 and 576.00 kg and oil yield per feddan 198.88 and 208.42, while, fertilized plants with nitrogen at the rate of 60 kg N / feddan under the same location gave the highest values of plant height 99.82 and 101.35 cm, fiber length 84.47 and 86.02 cm, number of capsules per plant 23.25 and 24.50, straw yield per plant 1.52 and 1.57g, straw yield per feddan 3.53 and 3.86 ton and fiber yield per feddan 859.70 and 909.10 kg. While, at Sakha location, fertilized flax plant with nitrogen fertilizer at the rate of 45 kg N / feddan gave the highest values of oil percentage 38.65 and 39.32 % only as compared with all other treatments in 2016/2017 and 2017/2018 seasons, respectively.

**Table 7. Effect of nitrogen fertilizer rates on oil percentage of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	29.70	31.30	34.30	32.70	32.00	30.60	31.70	34.80	33.60	32.67
	45	33.20	36.10	38.10	34.70	35.52	33.60	37.20	39.20	35.40	36.35
	60	32.10	33.70	35.30	34.60	33.92	32.80	34.20	35.80	34.80	34.40
mean		31.66	33.70	35.90	34.00	33.81	32.33	34.36	36.60	34.60	34.47
Sakha	30	31.80	33.60	35.70	33.80	33.72	31.60	33.80	36.20	35.10	34.17
	45	35.70	38.20	41.20	39.50	38.65	36.30	38.80	41.90	40.30	39.32
	60	33.40	34.80	36.30	35.90	35.10	34.20	34.90	37.50	35.60	35.55
mean		33.63	35.53	37.73	36.40	35.82	34.03	35.83	38.53	37.00	36.34
General mean of N-rates	30	30.75	32.45	35.00	33.25	32.86	31.10	32.75	35.50	34.35	33.42
	45	34.45	37.15	39.65	37.10	37.08	34.95	38.00	40.55	37.85	37.83
	60	32.75	34.25	35.80	35.25	34.51	33.50	34.55	36.65	35.20	34.97
means of flax varieties		32.64	34.61	36.81	35.20	34.81	33.18	35.09	37.56	35.80	35.40
<b>L.S.D at 5% for: L</b>				*				*			
	N			1.15				1.12			
	L x N			1.36				1.30			
	V			1.58				1.46			
	L x V			1.83				1.76			
	N x V			1.89				1.81			
	L x N x V			1.99				1.90			

**Table 8. Effect of nitrogen fertilizer rates on straw yield per plant (g) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	0.92	0.98	0.78	0.83	0.87	0.94	1.15	0.82	0.92	0.95
	45	1.35	1.66	0.89	0.95	1.21	1.45	1.75	0.91	1.20	1.32
	60	1.78	1.95	1.10	1.25	1.52	1.83	1.98	1.20	1.30	1.57
mean		1.35	1.53	0.92	1.01	1.20	1.40	1.62	0.97	1.14	1.28
Sakha	30	0.75	0.86	0.71	0.73	0.75	0.78	0.91	0.72	0.76	0.79
	45	0.98	1.15	0.77	0.89	0.94	1.12	1.25	0.81	0.92	1.02
	60	1.20	1.40	0.82	0.85	1.06	1.25	1.50	0.86	0.95	1.14
mean		0.97	1.13	0.76	0.82	0.91	1.05	1.22	0.79	0.87	0.98
General mean of N-rates	30	0.83	0.92	0.74	0.78	0.81	0.86	1.03	0.77	0.84	0.87
	45	1.16	1.40	0.83	0.92	1.07	1.28	1.50	0.86	1.06	1.17
	60	1.49	1.67	0.96	1.05	1.29	1.54	1.74	1.03	1.12	1.35
means of flax varieties		1.16	1.33	0.84	0.91	1.05	1.22	1.42	0.88	1.01	1.13
<b>L.S.D at 5% for: L</b>				*				*			
	N			0.09				0.07			
	L x N			0.15				0.13			
	V			0.45				0.42			
	L x V			0.50				0.47			
	N x V			0.56				0.52			
	L x N x V			0.65				0.62			

The obtained results showed that the interaction effect between location and flax varieties was significant on all studied traits in both seasons. At EL-Gemmeiza location, flax Giza 12 variety gave the highest values of plant height 96.63 and 99.63 cm, fiber length 88.56 and 89.63 cm, seed index 10.36 and 10.73 g, straw yield per plant 1.53 and 1.62 g, seed yield per plant 0.488 and 0.505 g, straw yield per feddan 3.69 and 3.88 ton, seed yield per feddan 656.66 and 665.36 kg and oil yield per feddan 222.53 and 230.01 kg, for 2016/2017 and 2017/20118 seasons, respectively. While, flax Sakha 6 variety gave the highest values of number of capsules per plant 24.00 and 24.66, for both seasons, respectively. But at Sakha location flax Sakha 5 variety gave the highest values of oil percentage 37.73 and 38.53 % only as compared with all other treatments in 2016/2017 and 2017/20118 seasons, respectively.

Data recorded in Table 3-13 showed clearly that all traits studied were significantly affected by the interaction effect among flax varieties and nitrogen rates in both seasons. Fertilized flax variety Giza 12 with nitrogen fertilizer at a rate of 45 kg N /feddan gave the highest values of seed yield per plant 0.525 and 0.545 g, seed yield per feddan 694.65 and 704.50 kg, seed index 10.90 and 11.20 g, as well as oil yield per feddan 257.83 and 267.54 kg In this connection, fertilized flax variety Giza 12 with nitrogen fertilizer rate 60 kg/feddan gave the highest values of plant height 102.80 and 104.90 cm, straw yield per plant 1.67 and 1.74 g, straw yield per feddan 4.12 and 4.31 ton as well as fiber length 89.65 and 90.50 cm while fertilized flax Sakha 6 variety with nitrogen fertilizer rate 60 kg/feddan gave the highest values of number of capsules per plant 24.5 and 25.5 as compared with all other this interaction treatments in 2016/2017 and 2017/2018 seasons, respectively.

**Table 9. Effect of nitrogen fertilizer rates on seed yield per plant (g) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	0.385	0.410	0.275	0.295	0.341	0.397	0.425	0.295	0.325	0.360
	45	0.430	0.540	0.350	0.385	0.426	0.455	0.565	0.375	0.400	0.448
	60	0.420	0.515	0.345	0.375	0.413	0.435	0.525	0.350	0.392	0.425
mean		0.411	0.488	0.323	0.351	0.393	0.429	0.505	0.340	0.372	0.411
Sakha	30	0.370	0.390	0.250	0.270	0.320	0.375	0.405	0.260	0.290	0.239
	45	0.405	0.510	0.330	0.370	0.403	0.415	0.525	0.345	0.375	0.415
	60	0.395	0.490	0.310	0.360	0.388	0.405	0.493	0.318	0.375	0.397
mean		0.390	0.463	0.296	0.333	0.370	0.398	0.474	0.307	0.346	0.350
General mean of N-rates	30	0.377	0.400	0.262	0.282	0.330	0.386	0.415	0.277	0.307	0.299
	45	0.417	0.525	0.340	0.377	0.414	0.435	0.545	0.360	0.387	0.431
	60	0.407	0.502	0.327	0.367	0.400	0.420	0.509	0.334	0.383	0.411
means of flax varieties		0.400	0.475	0.309	0.342	0.381	0.413	0.489	0.323	0.359	0.380
L.S.D at 5% for: L				*				*			
	N			0.08				0.07			
	L x N			0.10				0.10			
	V			0.13				0.12			
	L x V			0.16				0.15			
	N x V			0.20				0.18			
	L x N x V			0.26				0.24			

**Table 10. Effect of nitrogen fertilizer rates on straw yield per feddan (ton) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	1.86	2.34	1.68	1.72	1.90	2.11	2.57	1.95	2.05	2.17
	45	3.45	4.35	2.85	3.10	3.43	3.65	4.45	3.10	3.47	3.66
	60	3.55	4.40	2.95	3.25	3.53	3.78	4.62	3.25	3.80	3.86
mean		2.95	3.69	2.49	2.69	2.95	3.18	3.88	2.76	3.10	3.23
Sakha	30	1.68	1.71	1.51	1.56	1.61	1.80	1.95	1.65	1.78	1.79
	45	2.75	3.70	1.97	2.25	2.66	2.80	3.95	2.10	2.35	2.80
	60	2.83	3.85	2.15	2.35	2.79	2.95	4.00	2.35	2.60	2.97
mean		2.42	3.08	1.87	2.05	2.35	2.51	3.30	2.03	2.24	2.52
General mean of N-rates	30	1.77	2.02	1.59	1.64	1.75	1.95	2.26	1.80	1.91	1.98
	45	3.10	4.02	2.41	2.67	3.04	3.22	4.20	2.60	2.91	3.23
	60	3.19	4.12	2.55	2.80	3.16	3.36	4.31	2.80	3.20	3.41
means of flax varieties		2.68	3.38	2.18	2.37	2.65	2.84	3.59	2.39	2.67	2.87
L.S.D at 5% for: L				*				*			
	N			0.85				0.88			
	L x N			0.98				0.99			
	V			1.12				1.15			
	L x V			1.23				1.27			
	N x V			1.33				1.36			
	L x N x V			1.52				1.54			

Data recorded in Table 3-12 showed clearly that all traits studied were significantly affected by the interaction effect among locations, flax varieties and nitrogen rates in both seasons. Fertilized flax variety Giza 12 with nitrogen fertilizer at a rate of 45 kg N /feddan under the condition of El-Gemmeiza location gave the highest values of seed index 11.50 and 11.90 g, seed yield per plant 0.540 and 0.565 g, seed yield per feddan 715.90 and 725.30 kg, and oil yield per feddan 258.43 and 269.81 kg, while Fertilized flax Giza 12 variety with nitrogen fertilizer at a rate of 60 kg N /feddan at the same El-Gemmeiza location gave the highest values of plant height 105.10 and 105.90 cm, fiber length 92.10 and 93.10 cm, straw yield per plant 1.95 and 1.98 g, straw yield per feddan 4.40 and 4.62 ton and fiber

yield per feddan 1071.10 and 1112.30 kg. On the other hand, flax Sakha 6 variety with nitrogen fertilizer at a rate of 60 kg N /feddan at El-Gemmeiza location gave the highest values of number of capsules per plant 27.00 and 27.00, but flax Sakha 5 variety with nitrogen fertilizer at a rate of 45 kg N /feddan at Sakha location gave the highest values of oil percentage 41.20 and 41.90 only as compared with all other this interaction treatments in 2016/2017 and 2017/2018 seasons, respectively .

Generally it could be concluded that fertilized flax Giza 12 variety by 45 kg/feddan gave the raising oil yield per feddan at El-Gemmeiza and Sakha ,Gharbia, and Kaf El-Sheikh Governorates, Egypt locations.

**Table 11. Effect of nitrogen fertilizer rates on seed yield per feddan (kg) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	530.20	560.30	375.20	395.50	465.30	540.30	575.40	395.70	408.30	479.92
	45	608.10	715.90	412.50	513.20	562.42	618.20	725.30	425.30	535.20	576.00
	60	607.20	693.80	398.70	505.20	551.22	597.70	695.40	415.20	520.70	557.25
mean		581.83	656.66	395.46	471.30	526.31	585.40	665.36	412.06	488.06	537.70
Sakha	30	490.20	540.20	345.40	372.70	437.12	497.30	553.40	357.20	385.20	448.27
	45	585.30	673.40	397.20	465.40	530.32	593.20	683.70	405.70	475.20	539.45
	60	575.40	651.20	385.30	453.70	516.40	580.40	660.10	395.20	465.30	525.25
mean		550.26	621.60	442.63	430.60	507.94	556.96	632.40	386.03	441.90	504.32
General mean of N-rates	30	510.20	550.25	630.30	384.10	451.21	518.60	564.44	376.45	396.75	464.09
	45	596.70	694.65	404.85	489.30	546.37	605.70	704.50	415.50	505.20	557.72
	60	591.30	672.50	391.95	479.45	533.81	589.05	677.75	405.20	393.00	541.25
means of flax varieties		566.04	639.13	419.04	450.95	517.12	571.18	648.88	399.04	464.98	521.01
L.S.D at 5% for: L											
	N										
	L x N										
	V										
	L x V										
	N x V										
	L x N x V										

**Table 12. Effect of nitrogen fertilizer rates on fiber yield per feddan (kg) of some flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	451.60	568.20	407.90	417.60	461.32	512.40	624.20	473.50	497.80	526.97
	45	837.80	1056.30	692.10	752.80	834.75	886.30	1080.60	693.10	842.60	875.65
	60	862.10	1071.10	716.40	789.20	859.70	913.60	1112.30	743.20	867.30	909.10
mean		717.16	898.53	605.46	653.20	718.59	770.76	939.03	636.60	735.90	770.57
Sakha	30	408.00	465.10	366.70	378.80	404.65	482.10	501.30	423.40	453.20	465.00
	45	667.80	898.50	478.40	546.40	647.77	692.10	930.10	503.40	573.20	674.70
	60	687.20	934.90	522.30	570.60	678.75	713.60	958.70	537.30	581.80	697.85
mean		587.66	766.16	455.80	498.60	577.05	629.26	796.70	488.03	536.06	612.51
General mean of N-rates	30	429.80	516.65	387.30	398.20	432.98	497.25	562.75	448.45	475.50	495.98
	45	752.80	977.40	585.25	649.60	741.26	789.20	1005.35	598.25	707.90	775.17
	60	774.65	1003.00	619.35	679.90	769.22	813.60	1035.50	640.25	724.55	803.47
means of flax varieties		652.41	832.34	530.63	575.90	651.15	700.01	867.86	562.31	635.98	691.54
L.S.D at 5% for: L											
	N										
	L x N										
	V										
	L x V										
	N x V										
	L x N x V										

**Table 13. Effect of nitrogen fertilizer rates on oil yield per feddan (kg) of some new flax varieties under two locations condition during 2016/2017 and 2017/2018 seasons.**

locations (L)	N rates (N)	2016/2017 season					2017/2018 season				
		Flax varieties (V)				mean	Flax varieties (V)				mean
		Giza 11	Giza 12	Sakha 5	Sakha 6		Giza 11	Giza 12	Sakha 5	Sakha 6	
EL-Gemmeiza	30	157.46	175.37	128.69	129.32	147.71	165.33	182.40	137.70	137.18	155.65
	45	201.88	258.43	157.16	178.08	198.88	207.71	269.81	166.71	189.46	208.42
	60	194.91	233.81	140.74	173.76	185.80	196.04	237.82	148.64	181.20	190.92
mean		184.75	222.53	142.19	160.38	177.46	189.69	230.01	151.01	169.28	184.99
Sakha	30	155.88	181.50	123.30	125.97	146.66	157.14	187.04	129.30	135.20	152.17
	45	208.95	257.23	163.64	183.83	203.41	215.33	265.27	169.98	184.25	208.70
	60	192.18	226.61	144.18	162.87	181.46	198.49	230.37	141.08	165.64	183.89
mean		185.67	221.78	143.70	157.55	177.17	190.32	227.56	146.78	161.69	181.58
General mean of N-rates	30	156.67	178.43	125.99	127.64	147.18	161.23	184.72	133.50	136.19	153.91
	45	205.41	257.83	160.40	180.95	201.14	211.52	267.54	168.34	186.85	208.56
	60	193.54	230.21	142.46	168.31	183.63	197.26	234.09	144.86	173.42	187.40
means of flax varieties		185.21	222.15	142.94	158.96	177.31	190.00	228.78	148.89	165.48	183.28
L.S.D at 5% for: L											
	N										
	L x N										
	V										
	L x V										
	N x V										
	L x N x V										

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### تأثير التسميد النيتروجيني على بعض أصناف الكتان تحت ظروف منطقتين مختلفتين المتولي محمد علي عبدالقادر<sup>١</sup> و أحمد محمد أحمد موسى<sup>٢</sup> <sup>١</sup> قسم المحاصيل - كلية الزراعة - جامعة الأزهر - القاهرة - مصر. <sup>٢</sup> قسم بحوث الألياف - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية - الجيزة - مصر.

أجريت تجربتان حقليتان في الجميزة محافظة الغربية وسخا محافظة كفر الشيخ خلال موسمي ٢٠١٦/٢٠١٧ و ٢٠١٧/٢٠١٨م وذلك لدراسة تأثير ثلاث معدلات من التسميد الأزوتي ( ٣٠، ٤٥، ٦٠ كجم نيتروجين / فدان) أضيفت على دفعتين متساويتين الأولى قبل أول ريه والثانية قبل الري الثانية وذلك على أربعة أصناف من الكتان (جيزه ١١، جيزه ١٢، سخا ٥، سخا ٦) وقد صممت التجربة في كل منطقتين على حده في الموقعين بتصميم القطع المنشقة مره واحده. أوضحت النتائج أن زراعة نباتات الكتان في منطقة الجميزة صنف جيزه ١٢ مع التسميد بمعدل ٤٥ كجم نيتروجين / فدان قد أعطى أعلى القيم في كلا من وزن الألف بذره ومحصول البذور للنبات ومحصول البذور للنبات ومحصول الزيت للنبات. كما أوضحت النتائج أن زراعة نباتات الكتان في منطقة الجميزة صنف جيزه ١٢ مع التسميد بمعدل ٦٠ كجم نيتروجين / فدان قد أعطى أعلى القيم في كلا من طول النبات وطول الليفه ومحصول القش للنبات ومحصول القش للنبات ومحصول الألياف للنبات بينما أدت زراعة الصنف سخا ٦ مع التسميد بمعدل ٦٠ كجم نيتروجين / فدان في محطة بحوث الجميزة قد أعطى أكثر عدد من الكيسولات للنبات بينما زراعة نباتات الكتان في منطقة سخا صنف سخا ٥ مع التسميد بمعدل ٤٥ كجم نيتروجين / فدان قد أعطى أعلى نسبة مئوية للزيت في البذور.