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Flax yield potential as affected by irrigation intervals and nitrogen fertilizer rates

Khaled S. S. EL-Shimy **; Gaber. Y. M. Hammam*; Salah A. H. Allam*; Saber H. A. Mostafa and El-Saeed M. M. El-Gedwy***
***Agronomy Department, Faculty of Agriculture, Benha University**
**** Fiber Crops Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt.**

Abstract

Two field experiments were carried out at El-Gemmeiza Research Station, Gharbia Governorate, Agricultural Research Center, Egypt, during the two successive winter seasons of 2015/2016 and 2016/2017. The objective of this work was to evaluate the effect of irrigation intervals (every 21, 28 and 35 days) and nitrogen fertilizer rates [control (0), 30, 45 and 60 kg N/fad] on quantity and quality of straw and seed characters of flax (Variety Giza 10). The experimental design was split plot with three replications.

The obtained results can be summarized as follows:-

Obtained results indicate that significant differences in all studied traits among irrigation intervals in both seasons and combined analysis. Irrigated flax plants every 21 days gave the maximum values for plant height, technical length, straw yield/fad, fiber yield/fad, number of capsules/plant, number of seeds/capsule, seed yield/fad and oil yield/fad as well as gave the minimum values of fiber fineness (Nm). In contrast, irrigation every 35 days gave the minimum values for all studied characters under this study except, fiber fineness (Nm). Irrigated flax every 28 days gain intermediate estimates in all studied traits without significance with irrigation every 21days. All traits of flax under study, *i.e.* plant height, technical length, straw yield/fad, fiber yield/fad, number of capsules/plant, number of seeds/capsule, seed yield/fad and oil yield/fad showed significantly increased by increasing nitrogen fertilizer rates from 0 up to 60 kg N/fad, except fiber fineness (Nm) which decreased with increasing nitrogen rates in the both seasons and combined analysis. Results showed that irrigated flax plants every 21 days and soil fertilized with 60 kg N/fad gave the maximum values of plant height and straw yield/fad only in the second season as well as seed and oil yields/fad in the two seasons and the combined. In addition to great reduction in fiber fineness had happened in this case. It could be summarized that irrigated flax plants (Giza 10) every 21 or 28 days and soil fertilized with 60 kg N/fad to maximized quantity and quality of straw and seed yield characters.

Keywords: Flax, irrigation intervals, nitrogen fertilizer rates.

Introduction

Flax is now unknown in the wild but originally it may have been a native of Asia. It has been cultivated since at least 5000 BC, probably first by the ancient Mesopotamians and later by the Egyptians who wrapped their mummies in linen cloth. The Romans spread flax cultivation to Northern Europe and now the plant is grown all over the world for the oil extracted from the seeds and for its fibers, which are made into linen and other cloths. Various parts of the plant have been used to make fabric, dye, paper, medicines, fishing nets, hair gels, and soap. It is also grown as an ornamental plant in gardens. The seeds are widely used medicinally. Their constituents include 30-40% of fatty oil (linseed oil) with esters of linoleic acid, linolenic acid, stearic acid and oleic acid; also mucilage, proteins, a cyanogenic glycoside (linamarin) and enzymes. Whole of crushed, the seeds are a reliable means of relieving constipation. Externally, crushed seeds mixed to a paste with water are used to make hot poultices to relieve pain and to heal septic wounds, skin rashes and ulcers. The extracted oil is used in the pharmaceutical industry to make liniments for burns and rheumatic pain. The oil is also important in the manufacture of paints, soap and printer's ink. In Egypt, flax (*Linum usitatissimum*, L.) is cultivated as a dual purpose (seeds for oil and stems for fibre). The cultivated area through the last 20 years was decreased from 60.000 to 30.000 faddans due to the great competition of other economic winter crops resulting in a gap between production and consumption. Therefore, it is necessary to increase flax productivity per unit area which could be achieved by using high yielding varieties and improving different agriculture treatments to gain highest yield characterize by best quality.

Alessi and Power (1970), Bauer and Frederick (1997) and Lisson and Mendham (2000) found that, irrigation increased flax straw and seed yield when precipitation was low and with poor distribution. **Chorumale *et al*., (2001), Gabiana (2005), Gabiana *et al*., (2005) and Yenpreddiwar *et al*., (2007)** mentioned that, two irrigations applied at flowering and capsule filling stages significantly increased the yield attributes, yield, oil content and

oil yield of flax compared with no irrigation and irrigation at flowering stage only. In addition, **Barky *et al.*, (2012), Chavarria and Dos Santos (2012) Mirshekari *et al.*, (2012) and Sharma *et al.*, (2012)** indicated that, irrigation at both 30 and 60 days after sowing (DAS) produced the highest values of growth characters compared with irrigation at 30 DAS only. **Bauer *et al.*, (2015) and Rashwan *et al.*, (2016)** illustrated that belonging irrigation interval on flax plants until 45 days gave minimum values for total plant height, seed yield/ha, oil yield/ha, straw yield /ha, fiber fineness, fiber yield/ha.

Determination of the required rate of nitrogen fertilizer of flax plants is the main important practices of great contribution for the highest production of better quality, as well as nitrogen is a key element for flax productivity as well as in many other field crops. Several investigations reported that increasing nitrogen fertilizer rates caused significant increase in all straw and seed characters of flax, **Moawed and Abd El-Hamid (1999), El-Gazzar (2000), El-Shimy and Moawed (2000), Chorumale *et al.*, (2001), Gabiana (2005), Gabiana *et al.*, (2005), Moawed *et al.*, (2008), Salim *et al.*, (2008), Mousa *et al.*, (2010), Sakandar *et al.*, (2011), Khajani *et al.*, (2012), Soethe *et al.*, (2013), Kariuki *et al.*, (2014), Rahimi (2014), El-Refaey *et al.*, (2015) and El-Seidy *et al.*, (2015).**

Therefore, in the recent years many efforts were devoted to increase the productivity of the flax through improving genetic traits and use of improved cultivars which have high yields and high water use efficiency. The irrigation intervals and nitrogen fertilizer were considered two of the main factors that affecting directly the growth and productivity of flax plants. With keeping the above points in view, the objective of this research were to evaluate the performance and response of flax.

The main target of this investigation is to determine the suitable irrigation interval and optimum nitrogen fertilizer rate which achieve highest yield production from flax fiber and seeds in addition to their quality in farm of El-Gemmeiza Research Station, Gharbia Governorate.

Materials and Methods

Two field experiments were carried out at the Farm of El-Gemmeiza Research Station, Gharbia Governorate, Agricultural Research Center, Egypt, during the two successive winter seasons of 2015/2016 and 2016/2017. The aim of this study was to investigate the effect of irrigation intervals and nitrogen fertilizer rates on quantity and quality of straw and seed characters of flax (Variety Giza 10). Soil texture of the experimental site was clay-loam with pH nearly of 7.8. The physical and chemical properties of the experimental soil were determined according to the standard procedures described by **Black (1965)** and represented in Table, 1 in each of the two growing seasons.

Table 1. Chemical and mechanical properties of the experimental soil in the two growing seasons (2015/2016 and 2016/2017 seasons).

Properties	Seasons	
	2015/2016	2016/2017
Chemical analysis		
E.C.	**3.42**	**3.40**
pH (1 :2.5)	**7.9**	**7.7**
$CaCo_3$ %	**1.9**	**2.1**
O.M %	**1.92**	**1.98**
Total N (%)	**0.10**	**0.12**
Available N (ppm)	**27.08**	**31.93**
Particle size distribution (mechanical analysis)		
Course sand %	**9.2**	**8.1**
Find sand %	**18.4**	**19.2**
Silt %	**28.1**	**26.5**
Clay %	**44.3**	**46.2**
Texture grade	**Clay-Loam**	**Clay-Loam**

Each experiment included 12 treatments which were the combination of three irrigation interval and four nitrogen fertilizer rates.

Factors under study were as follows:

1. Three irrigation interval treatments, *i.e.* every 21, 28 and 35 days.
2. Four nitrogen fertilizer rates, *i.e.* control (0), 30, 45 and 60 kg N/fad, nitrogen fertilizer was applied in form of urea (46 % N), and divided into two equal parts and applied before the first and second irrigation in each season.

Seeds of flax cv. Giza 10 (a fiber type) were obtained from Fiber Crops Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt. The experimental design was split plot in three replications. The three irrigation intervals treatments were distributed in the main

plots, whereas the four nitrogen fertilizer rates were arranged at random in sub plots. The preceding summer crop in the two seasons was rice crop. The sub plot area was 21 m^2 (4 X 5.25 m). Experiments were planted on November 1th and 7th in the first and the second seasons, respectively. Seeds were broadcasting at the rate of 60 kg seeds / fad. Phosphorous fertilizer was applied in form of Calcium super phosphate (12.5 % P_2O_5) at a rate of 100 kg /fad during soil preparation in each season. The other recommended agronomic practices of growing flax were applied in the manner prevailing in the region were practiced.

Data recorded:

At maturity, about 150 days from sowing date, ten guarded plants were taken randomly from each sub plot for recording the following plant traits, in addition to straw, fiber and seed yields/fad (estimated according to yield from one meter square of each sub plot). After harvesting and removing the capsules from plants of each subplot, retting process took place at Fiber Crops Research Section, El-Gemmeiza Agriculture Research Station. Straw of each sub plot was arranged in bundles and put in retting basins and soaked in water for about 12 hours. After soaking, the water was changed to leach out all the soluble materials. Retting period was about one week in summer season. The degree of water temperature during retting process ranged from 28 to 32ºC and the acidity was pH 6-7. The retted straw was washed with water and finally dried in open air. Thus, the fibers were easily extracted from above the woody part of the stem. The recorded characters included:

A- Straw yield and related characters:

1- Plant height (cm). From the cotyledonary node till the top of the plant.

2- Technical length of the main stem (cm). From the cotyledonary node till the beginning of apical branching zone of the main stem.

3- Straw yield (ton/fad). It was estimated according to weight of air dried straw yield/1 m^2 of each sub-plot.

4- Fiber yield (kg /fad). It was estimated according to fiber yield/1 m2 of each sub-plot.

Fiber yield = Straw yield X Fiber %.

Fiber % = Fiber yield after retting/ Straw yield after retting for each sub plot X 100.

5- Fiber fineness (Nm). It was calculated according to **Radwan and Momtaz (1966)**,

Fiber fineness = (No. of 20 fibers X Length of fibers / weight of fibers in mg).

B- Seed yield and related characters:

6- Number of capsules/plant.

7- Number of seeds/capsule. Which recorded on 5 random capsules from each sub-plot

8- Seed yield (kg/fad). It was estimated according to seed yield/1 m^2 of each sub plot.

9- Oil yield (kg/fad). It was calculated by multiplying seed oil % X seed yield/fad. Oil percentage (%). It was determined as described by the **(A.O.A.C., 1990)** methods, using petroleum ether (40-60 °C) in Soxhlet apparatus.

Statistical analysis:

The analysis of variance was carried out according to the procedure described by **Gomez and Gomez (1984).** Data were statistically analyzed for each season and the homogeneity of experimental error, in both seasons, was tested. Then, the combined analysis of the two seasons was done according to using the MSTAT-C Statistical Software Package (**Michigan State University, 1983).** L. S. D. test at 0.05 level was used to compare among treatments.

Results and Discussion

A- Straw yield and related characters:

Mean values of straw characters for flax variety Giza 10 as affected by irrigation intervals and nitrogen fertilizer rates in 2015/2016, 2016/2017 and combined analysis are presented in Table 2.

Data obtained revealed that all five straw traits significantly differed in the first and second seasons as well as the combined over them concerning the two studied factors *i.e.*, irrigation intervals and nitrogen rates. Regarding irrigation intervals effect in the combine results, irrigated flax plants at the shortest intervals (21 days) achieved maximum estimates in plant height, technical length, straw yield/fad and fiber yield/fad. In the same time, fiber fineness character was in the opposite direction. By means that more amount of water which added to plants at the shortest interval caused more coarse fiber and decrease fiber fineness (Nm) in comparison with the longest irrigation one. This behavior may be due to deposit more cellulosic layers on the primary wall inside to make secondary cell wall as resulting to more solvent nutrients from the soil. The differences between irrigation at 21 days and 28 days did not reach the level of significance in all straw characters. The results obtained from the combined over both seasons, the superiority ratios between irrigation at 21 days and either 28 or 35 days were 6.18 and 11.69 % for plant height; 5.84 and 11.70 % for technical length; 8.36 and 17.75 % for straw yield ton/fad in addition to 5.55 and 11.39 % for fiber yield kg/fad. Meanwhile, the superiority percentage between fiber fineness estimates which irrigated every 35 days and each of 28 and 21 days were 6.06 and 7.01 %, respectively. Many investigators came out with similar results as **Alessi and Power (1970), Bauer and Frederick (1997) and Lisson and Mendham (2000)**, **Chorumale *et al*., (2001), Gabiana (2005), Gabiana *et al*., (2005) and Yenpreddiwar *et al*., (2007), Barky *et al*., (2012), Chavarria and Dos Santos (2012), Mirshekari *et al*., (2012), Sharma *et al*., (2012), Bauer *et al*., (2015) and Rashwan *et al*., (2016).**

Table 2. Mean values of some straw characters for the flax variety Giza 10 as affected by irrigation intervals and nitrogen fertilizer rates in 2015/2016, 2016/2017 seasons and combined analysis.

Treatments		Plant height (cm)			Technical length (cm)			Straw yield (ton/fad)			Fiber yield (kg/fad)			Fiber fineness (Nm)		
		2015/2016	2016/2017	Comb.	2015/2016	2016/2017	Comb.	2015/2016	2016/2017	Comb.	2015/2016	2016/2017	Comb.	2015/2016	2016/2017	Comb.
Irrigation intervals																
21 days		120.71	121.83	121.27	109.02	108.48	108.75	4.788	4.807	4.797	707.585	722.090	714.838	179.237	182.605	180.921
28 days		113.43	115.00	114.21	103.02	102.46	102.75	4.395	4.457	4.427	663.718	690.778	677.245	181.283	183.798	182.541
35 days		106.88	110.28	108.58	96.20	98.52	97.36	3.891	4.258	4.074	631.055	652.398	641.725	192.397	194.801	193.598
L.S.D. at 5%		7.46	7.13	9.76	6.38	6.72	9.11	0.640	0.300	0.440	45.880	37.320	40.520	4.6	2.7	5.2
Nitrogen fertilizer rates																
Control (0)		107.21	108.80	108.01	99.06	98.60	98.83	3.983	4.065	4.024	594.290	643.893	619.092	193.178	196.202	194.690
30 kg N/fad		109.29	112.50	110.90	100.88	100.91	100.90	4.310	4.311	4.310	640.470	646.097	643.283	188.191	190.118	189.154
45 kg N/fad		117.21	118.84	118.03	104.22	105.56	104.89	4.518	4.728	4.623	700.893	712.127	706.510	182.230	184.808	183.519
60 kg N/fad		120.97	122.66	121.82	106.82	107.54	107.18	4.620	4.926	4.773	734.157	751.570	742.863	173.623	177.145	175.384
L.S.D. at 5%		4.21	4.09	4.12	2.99	2.14	2.85	0.300	0.300	0.440	36.260	42.450	39.240	4.6	4.2	4.8
The interaction effect between irrigation intervals and nitrogen fertilizer rates																
21 days	0	111.97	112.78	112.38	103.94	101.67	102.81	4.189	4.264	4.227	630.340	650.650	640.495	189.783	192.580	191.182
	30	114.53	116.72	115.63	105.35	105.58	105.47	4.669	4.562	4.616	669.690	682.830	676.260	183.155	186.133	184.644
	45	126.50	126.78	126.64	111.84	112.03	111.94	5.131	5.123	5.127	748.420	765.400	756.910	180.368	183.845	182.107
	60	129.85	131.02	130.44	114.96	114.63	114.80	5.161	5.277	5.219	781.890	789.480	785.685	163.643	167.862	165.753
28 days	0	107.33	108.65	107.99	99.01	98.93	98.97	4.057	4.071	4.064	586.940	621.750	604.345	192.858	197.178	195.018
	30	109.42	112.54	110.98	102.80	100.76	101.78	4.429	4.228	4.329	640.780	655.930	648.355	187.528	188.162	187.845
	45	115.92	117.39	116.66	103.53	104.40	103.97	4.561	4.677	4.619	691.850	719.900	705.875	175.090	176.903	175.997
	60	121.03	121.42	121.23	106.73	105.75	106.24	4.534	4.853	4.694	735.300	765.530	750.415	169.657	172.950	171.304
35 days	0	102.32	104.98	103.65	94.23	95.20	94.72	3.702	3.859	3.781	565.590	659.280	612.435	196.893	198.848	197.871
	30	103.93	108.23	106.08	94.50	96.40	95.45	3.831	4.142	3.987	610.940	599.530	605.235	193.890	196.058	194.974
	45	109.22	112.36	110.79	97.30	100.26	98.78	3.863	4.384	4.124	662.410	651.080	656.745	191.233	193.675	192.454
	60	112.03	115.55	113.79	98.78	102.23	100.51	4.166	4.648	4.407	685.280	699.700	692.490	187.570	190.622	189.096
L.S.D. at 5%		N.S.	N.S.	N.S.	N.S.	3.71	N.S.	N.S.	0.520	N.S.	N.S.	N.S.	N.S.	8.0	7.3	8.3

Results indicated that increasing nitrogen fertilizer rates from the untreated control (0) up to 60 kg N/fad caused remarkable increments in the four straw characters *i.e.*, plant height, technical length, straw yield ton/fad and fiber yield kg/fad in the first and second seasons as well as in the combined over them. The superiority rations in the combined analysis between the highest nitrogen rate (60 kg N/fad) and each of 45, 30 and 0 kg N/fad were 3.21, 9.85 and 12.79 % for plant height; 2.18, 6.22 and 8.45 % for technical length; 3.24, 10.74 and 18.61 % for straw yield/fad in addition to 5.15, 15.48 and 19.99 % for fiber yield ton/fad, respectively. Meanwhile, increase nitrogen rate caused more coarse fiber, by means that more fine fiber obtained from the untreated control (0 kg N/fad). The estimates of fiber fineness from the combined were 195 Nm for the control, 189 Nm for added 30 kg N/fad, 184 Nm from the nitrogen rate 45 kg/fad and 175 Nm for applying 60 kg N/fad. The superiority ratios between the control (0) and each of added 30, 45 and 60 kg N/fad were 2.93, 6.09 and 11.01 %, respectively. Similar results were also obtained by **Moawed and Abd El-Hamid (1999), El-Gazzar (2000), El-Shimy and Moawed (2000), Chorumale *et al*., (2001), Gabiana (2005), Gabiana *et al*., (2005), Moawed *et al*., (2008), Salim *et al*., (2008), Mousa *et al*., (2010), Sakandar *et al*., (2011), Khajani *et al*., (2012), Soethe *et al*., (2013), Kariuki *et al*., (2014), Rahimi (2014), El-Refaey *et al*., (2015) and El-Seidy *et al*., (2015).**

The interaction effect between irrigation intervals and nitrogen fertilizer rates had significant effect on technical length and straw yield ton/fad only in the second season, while it was significant in both seasons and the combined in fiber fineness character. Similar results were also obtained by **Chorumale *et al*., (2001), Gabiana (2005), Gabiana *et al*., (2005) and Ibrahim (2009).**

B- Seed yield and related characters:

From Table 3, results showed significant differences between each of either irrigation intervals or nitrogen fertilizer rates in seed characters *i.e.*, number of capsules/plant, number of seeds/capsule, seed yield/fad and oil yield/fad in the both seasons and combined analysis.

Irrigated flax plants every 21 days achieved an increment in all four seed characters under study. The superiority ratios between irrigation at 21 days and each of 28 and 35 days in combined analysis were 9.87 and 22.13 % for No. of capsules/plant; 3.43 and 3.22 % for No. of seeds/capsule; 5.72 and 9.40 % for seed yield/fad in addition to 9.70 and 18.99 % for oil yield/fad. Similar results were also obtained by **Alessi and Power (1970), Bauer and Frederick (1997) and Lisson and Mendham (2000)**, **Chorumale *et al*., (2001), Gabiana (2005), Gabiana *et al*., (2005) and Yenpreddiwar *et al*., (2007), Barky *et al*., (2012), Chavarria and Dos Santos (2012), Mirshekari *et al*., (2012), Sharma *et al*., (2012), Bauer *et al*., (2015) and Rashwan *et al*., (2016)**.

In relation to nitrogen fertilizer rates effect, the seed traits illustrated clear increments in these characters with increasing nitrogen rate up to 60 kg/fad without significance with applying 45 kg N/fad in both seasons and combined analysis. The superiority percentages between added the highest dose (60 kg N/fad) and each of 45, 30 kg N/fad and 0 (control) in combined analysis were 6.35, 25.34 and 44.76 % for No. of capsules/plant; 1.01, 2.83 and 7.55 % for No. of seeds/capsule; 6.74, 10.78 and 14.43 % % for seed yield/fad in addition to 10.69, 19.48 and 27.41 % for oil yield/fad. Many investigators came out with similar results as **Moawed and Abd El-Hamid (1999), El-Gazzar (2000), El-Shimy and Moawed (2000), Chorumale *et al*., (2001), Gabiana (2005), Gabiana *et al*., (2005), Moawed *et al*., (2008), Salim *et al*., (2008), Mousa *et al*., (2010), Sakandar *et al*., (2011), Khajani *et al*., (2012), Soethe *et al*., (2013), Kariuki *et al*., (2014), Rahimi (2014), El-Refaey *et al*., (2015) and El-Seidy *et al*., (2015).**

The interaction between irrigation intervals and nitrogen fertilizer rates had significant effect on seed and oil yields/fad in the two seasons and the combined, by means that dependent effect was found concerning the two studied factors in this case. Similar results were also obtained by **Chorumale *et al*., (2001), Gabiana (2005), Gabiana *et al*., (2005) and Ibrahim (2009).**

Table 3. Mean values of some seed characters for the flax variety Giza 10 as affected by irrigation intervals and nitrogen fertilizer rates in 2015/2016, 2016/2017 seasons and combined analysis.

Treatments		Number of capsules/plant			Number of seeds/ capsule			Seed yield (kg/fad)			Oil yield (kg/fad)		
		2015/2016	2016/2017	Comb.	2015/2016	2016/2017	Comb.	2015/2016	2016/2017	Comb.	2015/2016	2016/2017	Comb.
Irrigation intervals													
21 days		**10.413**	**10.855**	**10.635**	**7.363**	**7.595**	**7.478**	**500.468**	**478.016**	**489.242**	**169.192**	**167.329**	**169.261**
28 days		**9.198**	**10.165**	**9.680**	**7.303**	**7.158**	**7.230**	**465.592**	**459.921**	**462.757**	**151.604**	**156.978**	**154.291**
35 days		**8.173**	**9.250**	**8.708**	**7.148**	**7.340**	**7.245**	**447.157**	**447.279**	**447.218**	**140.091**	**144.405**	**142.248**
L.S.D. at 5%		**1.74**	**1.48**	**1.65**	**0.16**	**0.19**	**0.17**	**37.500**	**28.640**	**29.700**	**22.110**	**17.620**	**23.810**
Nitrogen fertilizer rates													
Control (0)		**7.880**	**7.713**	**7.797**	**7.050**	**6.933**	**6.992**	**439.344**	**438.756**	**439.050**	**134.509**	**141.448**	**137.978**
30 kg N/fad		**8.390**	**9.620**	**9.005**	**7.197**	**7.430**	**7.313**	**457.716**	**449.294**	**453.505**	**145.218**	**149.046**	**147.132**
45 kg N/fad		**9.910**	**11.317**	**10.613**	**7.397**	**7.493**	**7.445**	**471.700**	**469.625**	**470.663**	**156.797**	**160.851**	**158.824**
60 kg N/fad		**10.863**	**11.710**	**11.287**	**7.440**	**7.600**	**7.520**	**515.530**	**489.278**	**502.404**	**177.992**	**173.604**	**175.798**
		1.86	**1.67**	**1.83**	**0.18**	**0.14**	**0.18**	**52.180**	**32.020**	**36.650**	**31.490**	**24.150**	**29.720**
The interaction effect between irrigation intervals and nitrogen fertilizer rates													
21 days	**0**	**8.830**	**8.440**	**8.635**	**7.120**	**7.350**	**7.235**	**456.228**	**449.178**	**452.703**	**146.542**	**151.285**	**148.914**
	30	**9.230**	**10.350**	**9.790**	**7.280**	**7.590**	**7.435**	**466.960**	**464.920**	**465.940**	**156.582**	**159.003**	**157.793**
	45	**11.380**	**12.040**	**11.710**	**7.570**	**7.640**	**7.605**	**482.688**	**492.000**	**487.344**	**161.005**	**175.250**	**168.128**
	60	**12.210**	**12.590**	**12.400**	**7.480**	**7.800**	**7.640**	**595.997**	**505.965**	**550.981**	**212.640**	**183.777**	**198.209**
28 days	**0**	**7.810**	**7.500**	**7.655**	**7.110**	**6.250**	**6.680**	**436.152**	**436.697**	**436.425**	**131.347**	**142.165**	**136.756**
	30	**8.290**	**9.900**	**9.095**	**7.240**	**7.430**	**7.335**	**462.702**	**450.868**	**456.785**	**143.100**	**152.397**	**147.749**
	45	**9.990**	**11.570**	**10.780**	**7.390**	**7.450**	**7.420**	**478.588**	**459.063**	**468.826**	**162.597**	**158.563**	**160.580**
	60	**10.700**	**11.690**	**11.195**	**7.470**	**7.500**	**7.485**	**484.927**	**493.055**	**488.991**	**169.370**	**174.787**	**172.079**
35 days	**0**	**7.000**	**7.200**	**7.100**	**6.920**	**7.200**	**7.060**	**425.652**	**430.393**	**428.023**	**125.637**	**130.893**	**128.265**
	30	**7.650**	**8.610**	**8.130**	**7.070**	**7.270**	**7.170**	**443.487**	**432.095**	**437.791**	**135.972**	**135.737**	**135.855**
	45	**8.360**	**10.340**	**9.350**	**7.230**	**7.390**	**7.310**	**453.823**	**457.813**	**455.818**	**146.790**	**148.740**	**147.765**
	60	**9.680**	**10.850**	**10.265**	**7.370**	**7.500**	**7.435**	**465.667**	**468.813**	**467.240**	**151.965**	**162.248**	**157.107**
L.S.D. at 5%		**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**90.376**	**55.459**	**63.478**	**54.541**	**41.828**	**51.475**

Conclusion

Generally, it could be concluded that flax plants need the water for cell division, elongation, photosynthesis, bio processes in cytoplasm, transfer and distribution of carbohydrate, hormones and minerals salts. Moreover, flax plants at short irrigation interval (every 21 days) achieved an increment in majority characters, except fiber fineness of flax which take the opposite trend and consequently coarse fiber. In the same time, increasing nitrogen rates encourage vegetative plant growth, which return back for increasing plant yield, look for also exception in fiber fineness that more nitrogen amount caused more coarse fiber. It could be summarized that irrigated flax plants (Giza 10) every 21 days and soil fertilized with 60 kg N/fad to maximized quantity and quality of straw and seed yield characters.

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الكفاءة الإنتاجية لمحصول الكتان تحت تأثير فترات الري ومستويات السماد النيتروجيني

خالد شعبان سيد الشيمي - جابر يحيى محمد همام * - صلاح عباس حسن علام* - صابر حسين أحمد مصطفى** - السعيد محمد محمود الجدوي***

***قسم المحاصيل - كلية الزراعة - جامعة بنها**
****** قسم بحوث الألياف – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية- جيزة - القاهرة**

أجريت تجربتان حقليتان في محطة البحوث الزراعية بالجميزة، محافظة الغربية، مركز البحوث الزراعية، مصر. خلال الموسمين الشتوين 2016/2015 و 2017/2016. لدراسة تأثير ثلاثة فترات للري (كل 21 ، 28 و 35 يوم) وأربع معدلات من السماد النيتروجيني [كنترول (0) - 30 - 45 و 60 كجم نيتروجين/فدان] على كمية ونوعية القش والبذور لصنف الكتان جيزة 10. وكان التصميم التجريبي المستخدم هو قطع منشقة مرة واحدة لثلاث مكررات.

ويمكن تلخيص أهم النتائج فيما يلي:-

أشارت النتائج أن الإختلافات بين فترات الري تحت الدراسة كانت معنوية في جميع الصفات المدروسة خلال موسمي الزراعة والتحليل التجميعي. ري نباتات الكتان كل 21 يوم حقق معنويا أعلى القيم من صفات إرتفاع النبات، الطول الفعال، محصول القش/فدان، محصول الإلياف/فدان، عدد الكبسولات/نبات، عدد البذور/كبسولة، محصول البذور/فدان و محصول الزيت/فدان بينما أعطت أقل القيم في نعومة الألياف. وعلي النقيض الري كل 35 يوم حقق أقل القيم في الصفات المدروسة ما عدا نعومة الألياف. ري الكتان كل 28 يوم أعطيت قيم متوسطة في كل الصفات المدروسة بدون معنوية مع الري كل 21 يوم.

تأثرت جميع الصفات المدروسة (إرتفاع النبات، الطول الفعال، محصول القش/فدان، محصول الألياف/فدان، عدد الكبسولات/نبات، عدد البذور/كبسولة، محصول البذور/فدان و محصول الزيت/فدان في كلا الموسمين والتحليل التجميعي) معنوياً بزيادة معدل السماد النيتروجيني من كنترول حتى 60 كجم نيتروجين/فدان ما عدا صفة نعومة الألياف التي نقصت مع زيادة معدل السماد النيتروجيني في كلا الموسمين والتحليل التجميعي.

أشارت النتائج إلى أن ري الكتان كل 21 يوم مع التسميد النيتروجيني بمعدل 60 كجم نيتروجين/فدان أعطت معنوياً أفضل القيم في الطول الفعال ومحصول القش/فدان في الموسم الثاني فقط كما زادت قيم صفات محصول البذور والزيت للفدان في كلاً موسمي الدراسة والتحليل التجميعي. على العكس من ذلك أعطت ألياف أقل نعومة خلال موسمي الدراسة والتحليل التجميعي .

توصي النتائج بري الكتان صنف جيزة 10 كل 21 يوم والتسميد النيتروجيني بمعدل 60 كجم نيتروجين/فدان حيث زاد محصول القش والبذور بوحدة المساحة والصفات المرتبطة بها كماً ونوعاً.