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EFFECT OF NITROGEN FERTILIZATION REGIMES ON SEED YIELD AND OIL PERCENTAGE OF SOME CANOLA CULTIVARS

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ABSTRACT

A field experiment was carried out at the Experimental Farm, Faculty of Environmental Agricultural Sciences, Rafah, North Sinai Governorate, Suez Canal University, during two successive winter seasons 2011/2012 and 2012/2013; to study the response of 5 canola cultivars to nitrogen bio-chemical fertilization regimes in respect to yield and yield components under North Sinai conditions. Application of nitrogen fertilizer T_1 (100% mineral) significantly increased yield/plant, seed yield kg/fed. and oil yield, while, (75% mineral) and (50% mineral) gave the highest 1000-seed weight at both seasons. $Serw_4$ with 100% mineral nitrogen fertilization regimes gave the highest seed yield per plot and high oil percentage. Generally, it could be concluded that the canola cultivar $Serw_4$ and 100% mineral nitrogen fertilization regime gave the heighst yield and can be recommended under North Sinai conditions.

Key words: Canola, *Brassica napus*, canola cultivars, nitrogen fertilizations, Biofertilizer, *Azotobacter*, N -fixing bacteria.

INTRODUCTION

Canola (*Brassica napus* L.) is one of the main oil crops in many countries especially in Canada, European Union and USA, but in Egypt it is still uncommon as oil crop. Canola has a relatively high requirement of nitrogen, where the content of this nutrient in seeds and plant tissues is greater than in most grain crops. Addition of 60kg N/fed under Egyptian conditions increased its yield **(Kandil, 1984)**. **Elewa *et al*. (2014)** showed that Wan 25 variety was superiorin seed yield and yield components than the other. **Bagheri *et al.* (2011) Moghadam*et al.* (2011).**

Many investigators reported that increasing nitrogen fertilizer levels significantly increased most of yield components and seed oil percent **(Afridi*et al.*, 2002; Ali and Hassan, 2002 and Khan *et al.*, 2002: Abd El-Motaleb and Gomma, 2004 and Al-Barrak (2006)**. They concluded that seed oil content decreased with increasing nitrogen level.

MATREALS AND METHODS

A field experiment was carried out at the Farm of the Faculty of Environmental Agricultural Sciences, Rafah, Suez Canal University, North Sinai Governorate on canola (*Brassica napus* L.) during 2011/ 2012 and the 2012/2013 winter seasons. The experiment was laid out in split-plot randomized complete block design with three replications.

The main plots were devoted to the five canola cultivars ($Serw_4$, Pactol, $Sakha_1$, $Sakha_2$ and $Sakha_3$). While, the sub - plots

were devoted to 5 nitrogen bio-chemical fertilization regimes (T_1, T_2, T_3, T_4 and T_5) calculated from plant needs of nitrogen N/fed. from (Urea 46%) and commercial fertilizer (Biogen viz. *Azotobacter*) which give 25% nitrogen needs as a biofertilizer source.

Plot area was 12 m^2 (1/350 fed.) rows 20 m length and 0.6 m width with 30 cm within row. Cultivars were sown on 30th and 17th October in the first and second seasons. The plants were thinned twice, the 1stat 30 days after planting (DAP), where, 3-4 plants per hill was left and the 2nd at 45 DAP, where, one plant per hill was left. Drip irrigation system (4.0 L/hr for each dripper) with underground saline water (3500 ppm) pumped from a well was used. The experimental site was irrigated immediately after planting, then irrigation every 2 days till 45 days from sowing.

Thereafter, irrigation every 7 days was applied. The physical and chemical analyses of experimental soil site were determined according to **Richard (1954)** as shown in Table 2. The organic fertilization was applied at the rate of 20 m^3/fed., while phosphorus fertilizer was applied in the form of single superphosphate (15.5 % P_2O_5) at the rate of 200 kg/fed., during land preparation.

At harvesting time (10thand 20thApril at the first and second seasons), ten plants were taken from each sub-plot to determine the yield attributes, while, plants of one square meter from each treatment were taken for determining the seed yield (kg/fed.):

1. Seed yield per plant (g/plant).
2. Seed yield (kg/fed.) was computed according to seed yield (plot/g).
3. Seed oil yield (kg/fed.) was computed according to seed yield (kg/fed.) and oil percentage.

Five grams from fresh seeds were taken at harvesting time from each plot. Each sample was dried in an electric oven (70 ºC) till a constant weight, then milled to a fine powder. Seed oil content was estimated according to **A.O.A.C. (1990)** using Soxhelt apparatus and petroleum ether as a solvent, and then oil percentage was calculated on dry weight basis. Data of the two seasons were subjected to proper statistical analysis of variance (**Snedecor and Cochran, 1990)** using M-STATC program. Mean values were compared at $P<0.05$ using the multiple range test **(Duncan, 1955).**

RESULTS AND DISCUSSION

1. Effect of canola cultivars

As shown in Table 3, seed yield/plant was significantly affected due to varietal differences cultivars in the both seasons.$Serw_4$, produced the highest seed yield per plant in both seasons (12.84 and 21.45g), while low seed yield/plant was observed in each of $Sakha_2$ and $Sakha_3$ in first season as well as $Sakha_1$, $Sakha_2$ and $Sakha_3$ in second season. The increase in seed yield per plant in $Serw_4$ may be attributed to the increase in plant height, number of racemes and also number of siliqua than the other cultivars. Similar results were reported by **Mekki (2007 and 2013)**.

Seed yield kg/fed., was significantly affected by canola cultivars, whereas the differences among the five cultivars under study were significant. $Serw_4$ produced higher seed yield kg/fed., compared to the other cultivars. Such increases amounted 27.41% and 36.36% compared with $Sakha_3$ at both seasons (Table 3). However, canola cultivars $Sakha_1$, $Sakha_2$ and $Sakha_3$ gave the minimum seed yield kg/fed., in comparison with the other two cultivars.

This increase may be due to the increase in number of racemes, number of siliqua per plant, seed yield per plant, l000-seed weight of $Serw_4$ cultivar which reflected to increase the seed yield. Similar results were reported by **Elewa *et al.* (2014).** Regarding

Table (1): Nitrogen fertilization types, rates and time of adding.

Treatments	Types	Rate and time of adding
	Mineral	
T_1	100% 1.39 kg	Equal amounts after thinning + at beginning of flowering on all nitrogen fertilization regimes.
T_2	75% 1.04 kg	One amount before seeding.
T_3	50% 0.659 kg	2 amounts, before seeding + at thinning.
T_4	25% 0.347 kg	3 amounts, before seeding + at thinning + at beginning of flowering.
T_5	0%	

Table (2): Physical and chemical properties of the experimental soil site during the two seasons.

Soil Properties	Clay (%)	Loam (%)	Sand (%)	Texture	Organic matter%	pH	EC (ds/m 1:5)
Value	0.40	3.50	96.10	Sand	1.15	7.03	3.84
Cations (meq/l)	Ca^{++}	Mg^{++}	Na^{+}	K^{+}			
	10.00	11.00	21.00	2.00			
Anions (meq/l)	HCO_3^{-}	Cl^{-}	SO_4^{--}				
	6.60	26.40	11.00				

to the oil yield it was scientifically different in the performance of cultivars. Therefore, $Sakha_3$ had the lowest oil yield/fed. The reduction on oil yield of $Sakha_3$ mainly due to the decreased on their seed yield kg/fed. (Table 3). Performance of $Serw_4$ had the highest oil yield due to the increase in their seed yield kg/fed.

These results may refer to genetically difference between cultivars. These results are similar with those obtained by **Moghadam *et al.* (2011).**

Seed oil percentage

Data in Table (3) shows the significant effect at $p<0.01$ of performance of canola cultivars on seed oil percentage at the both seasons. $Serw_4$ cultivar surpassed the other cultivars regarding seed oil (%), Pactol ,$Sakha_1$, $Sakha_2$ and $Sakha_3$ canola cultivars had insignificant differences seed oil (%) among each other. These results depending on climatic conditions under grown *B. napus*. But there are slightly differences on performance of cultivars in oil seed (%) at the second season. Whease $Serw_4$ cultivar ranked first and Pactol ranked second, then followed by $Sakha_1$, $Sakha_2$ and $Sakha_3$ without significant differences among Sakha cultivars.

This may refer to the fact that accumulation of fat take place during the development of storage tissue. Fat increase in quality and in concentration is probably due to transformation of sugar to fat in the seed from leaves.

On the other hand $Serw_4$ and Pactol gave the highest value of plant height, number of racemes which may reflected on the increase of carbohydrates at such plants which consequently may encourage the transformation of carbohydrates to fat.

This due to the stability of oil percentage in canola cultivars. These results go in harmony with those obtained by **Zarei *et al.* (2010), Ali *et al.* (2011), Sayed *et al.* (2011).**

2. Effect of nitrogen fertilization regimes

Nitrogen fertilizer is the most important element for crop growth and high yield with good quality. Seed yield and yield attributes were increased by increasing nitrogen levels.

The excessive use of nitrogen fertilizer has generated several environmental problems. Some of these problems can be solved by using bio-fertilizers which have natural benefits and safely to environment. The bio-fertilizers provide nutrients to the plants and maintain soil structure. It has been revealed that the effect of nitrogen fixation induced by nitrogen fixers is not only significant for legumes, but also non-legumes.

The canola nitrogen requirement is the amount of nitrogen needed to produce high seed yield. Because of soils, weather conditions and agronomic practices that can influence nitrogen uptake, the nitrogen requirement determination is essential for maximum seed and oil yield of canola crop, especially under unfavorable growth conditions such as arid and semi-arid lands.

Results in Table 4 show that there were highly significant effects for nitrogen fertilization regimes on seeds yield/plant in the both studied seasons. Application of T_1 increased seed yield per plant up to 15.33 and 25.00 g at the 1^{st} and 2^{nd} seasons. Applying T_1 surpassed the other nitrogen regimes by 47.87% and 54.12% as compared with T_5 at the both seasons.

This increase may be due to nitrogen general function in plant. Similar results were reported by **Shahin *et al.* (2000)** and **Al-Barrak (2006).**

Response of seed yield kg/fed., to nitrogen bio-chemical fertilization regimes was highly significant in canola crop (Table 4).

A gradual increase in seed yield kg/fed. was noticed with applying of T_1 (100% mineral). The increase in seed yield kg/fed.

Table (3): Seed yield/plant (g), seed yield (kg/fed.), oil yield (kg/fed.) and seed oil percentage for the five studied cultivars at the two seasons.

Canola cultivars	Seed yield/plant (g)		Seed yield (kg/fed.)		Oil yield (kg/fed.)		Seed oil percentage	
	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013
$Serw_4$	12.84[a]	21.45[a]	292.11[a]	487.98[a]	127.59[a]	207.24[a]	43.68[a]	42.47[a]
Pactol	12.63[a]	17.65[b]	287.33[a]	401.53[b]	119.58[a]	153.90[b]	41.62[b]	38.33[c]
$Sakha_1$	11.54[a]	14.39[c]	262.53[b]	327.37[c]	110.55[b]	131.55[c]	42.11[b]	40.12[b]
$Sakha_2$	9.862[b]	14.36[c]	224.36[c]	326.69[c]	92.59[c]	131.34[c]	41.27[b]	40.27[b]
$Sakha_3$	9.329[b]	13.65[c]	212.03[c]	310.53[c]	86.88[c]	125.17[c]	40.98[b]	40.31[b]
Significant	**	**	**	**	**	**	**	**

Table (4): Effect of nitrogen fertilization regimes on seed yield/plant (g), Seed yield (kg/fed.), Oil yield (kg/fed.)and seed oil percentage at the two seasons.

Nitrogen fertilization regimes	Seed yield/plant (g)		Seed yield (kg/fed.)		Oil yield (kg/fed.)		Seed oil percentage	
	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013
T_1	15.33[a]	25.00[a]	348.75[a]	568.75[a]	152.33[a]	241.54[a]	44.52[a]	40.40[ab]
T_2	13.15[b]	17.73[b]	299.16[b]	403.35[b]	124.51[b]	154.60[b]	43.96[a]	40.55[ab]
T_3	11.36[c]	14.58[c]	258.44[c]	331.69[c]	108.82[c]	133.07[c]	41.49[b]	40.80[a]
T_4	8.37[d]	12.72[d]	190.19[d]	289.38[d]	80.96[d]	116.53[d]	41.33[b]	40.06[ab]
T_5	7.99[d]	11.47[d]	181.77[d]	260.94[e]	74.48[d]	105.18[e]	38.37[c]	39.69[b]
Significant	**	**	**	**	**	**	**	**

was estimated by 47.78% and 54.12% for T_1 regime compared to T_5 (0% chemical + biofertilizer) regime at the two seasons.

These increases in seed yield may be due to increase in vegetative growth stage, which reflected to the adequate supply of photosynthesis for formation of plant height at harvest, number of racemes/plant at harvest, number of siliqua/plant, seed yield/ plant, 1000 seed weight and seed yield per plot and development at seeds then it increased seed yield kg/fed.

So, biofertilizer leads to major negative affection between vegetative growth and yield production.

Similar finding have been reported by **Afridi*et al*. (2000), Kappen*et al*. (2000), Sharief and Keshta (2000), Pennock*et al.* (2001), Ali and Hassan (2002), Khan *et al*. (2002), Abd El-Motaleb and Gomaa (2004) and El- Demrdash and Ali (2005)**.

Concerning, the oil yield (kg/fed.), results in Table 4 shows that T_1 fertilization regime had high significant effect on oil yield kg/fed.

The increase in oil yield estimated by 51.10% and 56.45% in plants fertilized by T_1 as a compared with T_5 such increase in oil yield was mainly due to the increase of seed yield kg/fed. and also due to oil (%).

These results are in line with those obtained by other studies **Ahmed 2001** and **Al-Barrak 2006.**

Seed oil percentage

Data in Table 4 shows that there were significant effect of nitrogen fertilization regime on canola seed oil percentage at the 1st and 2nd seasons. The highest seed oil % (44.58 and 43.96%) were obtained when canola was fertilized by T_1 as mineral fertilizer and T_2 at the 1st season. However, T_3 gave maximum seed oil percentage at the 2nd season.

These results may due to the negative correlation between nitrogen fertilization, as a reason to increase protein content in seeds.

So, biofertilizer leads to major negative correlation between vegetative growth and yield attributes which resulted to decrease yield and oil (%) in seeds. **Khan *et al.* (2002)** and **Asghar *et al.* (2002)** revealed that the seed oil content was decreased with increasing nitrogen rates

Interaction

The highest seed yield per plant (34.55 g) was produced by canola cv. $Serw_4$ with 100% mineral while, there is no significant differences in the first season (Table 5). The highest seed yield per feddan (395.16 and 786.01 kg/fed.) and oil yield (177.07 and 329.41 kg/fed.) were obtained by $serw_4$ cultivar with 100% mineral (Table 5).

Results in Table 6 cleared that the effect of interaction between canola cultivars and nitrogen fertilization treatments was significant on seed oil percentage.

The highest seed oil percentage was obtained by Pactol cultivar and T_2 in first season and $sakha_3$ and T_1 in 2nd season.

Generally, it could be recommended that fertilizing canola ($Serw_4$ cultivar) with (100% mineral) increased the yield production, oil yield and oil percentage under North Sinai conditions.

Table (5): Effect of canola cultivars and nitrogen fertilization regimes on yield and yield attributes (Seed yield/plant (g), Seed yield (kg/fed) and Oil yield (kg/fed) at the two seasons (2011/2012&2012/2013).

Cv.	N-fertilization regimes	Seed yield/plant(g)		Seed yield (kg/fed)		Oil yield (kg/fed)	
		2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Serw$_4$	T_1	17.37	34.55^{a}	395.16^{a}	786.01^{a}	177.07^{a}	329.41^{a}
	T_2	13.87	25.66^{b}	315.54^{bcd}	315.54^{b}	136.77^{bcd}	234.96^{b}
	T_3	11.90	14.67^{e-h}	270.72^{def}	583.76^{c}	123.17^{def}	126.25^{c}
	T_4	10.82	13.33^{e-j}	246.15^{d-g}	333.74^{efg}	112.53^{d-g}	122.87^{efg}
	T_5	10.25	9.05^{cd}	233.18^{fg}	205.88^{fgh}	101.03^{fg}	85.44^{fgh}
Pactol	T_1	15.30	28.44^{b}	348.07^{b}	647.01^{b}	153.01^{b}	273.87^{b}
	T_2	14.00	16.67^{cde}	318.50^{bc}	379.24^{e}	152.46^{bc}	148.41^{e}
	T_3	12.40	15.72^{def}	314.63^{bcd}	357.63^{e}	132.58^{bcd}	143.16^{e}
	T_4	13.83	14.61^{e-h}	282.10^{efg}	332.37^{ef}	126.89^{efg}	134.04^{ef}
	T_5	10. 97	12.83^{e-k}	249.56^{fg}	291.88^{hi}	101.39^{fg}	119.17^{hi}
Sakha$_1$	T_1	14.10	28.00^{b}	341.25^{bc}	637.00^{b}	139.98^{bc}	273.91^{b}
	T_2	13.30	15.00^{d-h}	320.77^{bcd}	341.25^{efg}	136.74^{bcd}	133.87^{efg}
	T_3	9.25	10.33^{ijk}	302.57^{bcd}	227.50^{jk}	125.83^{bcd}	91.56^{jk}
	T_4	7.22	9.61^{jk}	210.00^{hi}	218.62^{k}	91.52^{hi}	89.65^{k}
	T_5	7.00	9.00^{k}	164.25^{ij}	204.75^{k}	67.62^{ij}	82.92^{k}
Sakha$_2$	T_1	11.80	20.00^{c}	268.45^{bc}	455.00d	123.48^{bc}	191.10^{d}
	T_2	8.95	15.44^{d-g}	203.^{61cde}	351.26^{e}	81.95^{cde}	141.10^{e}
	T_3	8.55	13.44^{e-j}	194.51^{gh}	305.76^{gh}	81.05^{gh}	117.71^{gh}
	T_4	8.00	12.11^{f-k}	182.00^{ij}	275.50^{hi}	69.34^{ij}	105.37^{hi}
	T_5	7.13	10.83^{h-k}	162.20^{j}	246.38^{jk}	65.52^{j}	101.92^{jk}
Sakha$_3$	T_1	12.00	15.89^{def}	273.00^{bc}	361.49^{d}	111.93^{bc}	155.80^{d}
	T_2	10.26	14.37^{e-i}	233.41^{def}	326.91^{ef}	87.52^{def}	135.36^{ef}
	T_3	5.25	14.00^{e-i}	119.43^{fg}	318.50^{fgh}	39.41^{fg}	118.42^{fgh}
	T_4	4.00	12.62^{e-k}	91.00^{j}	287.10^{hi}	39.13^{j}	111.96^{hi}
	T_5	4.00	11.37^{g-k}	91.00^{j}	258.66^{ij}	33.97^{j}	96.55^{ij}
Significant		NS	**	**	**	**	**

Table (6): Effect of canola cultivars and nitrogen fertilization regimes on Seed oil (%) at the two seasons.

Cv.	N-fertilization regimes	Seed oil percentage	
		2011/2012	2012/2013
Serw$_4$	T_1	44.81^{b-f}	41.91^{a-d}
	T_2	43.25^{d-h}	40.25^{def}
	T_3	45.50^{a-e}	37.83^{gh}
	T_4	45.72^{a-d}	40.52^{cde}
	T_5	43.33^{d-h}	41.50^{a-d}
Pactol	T_1	43.96^{c-g}	42.33^{abc}
	T_2	47.87^{a}	37.75^{gh}
	T_3	47.00^{ab}	41.50^{a-d}
	T_4	40.63^{i-k}	40.33^{de}
	T_5	40.33^{jk}	40.83^{b-e}
Sakha$_1$	T_1	42.63^{f-j}	43.00^{a}
	T_2	39.23^{kl}	39.23^{efg}
	T_3	43.40^{d-h}	40.25^{def}
	T_4	41.02^{h}-^{k}	41.01^{b-e}
	T_5	41.17^{h-k}	40.50^{cde}
Sakha$_2$	T_1	46.00^{abc}	42.00^{a-d}
	T_2	40.25^{jk}	40.17^{def}
	T_3	41.67^{g-k}	38.50^{fgh}
	T_4	36.00^{m}	38.25^{gh}
	T_5	42.75^{f-j}	41.37^{a-d}
Sakha$_3$	T_1	41.00^{h-k}	43.10^{a}
	T_2	37.50^{lm}	34.25^{i}
	T_3	33.00^{n}	42.50^{ab}
	T_4	43.00^{e-i}	41.25^{a-d}
	T_5	37.33^{lm}	37.33h
Significant		**	**

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الملخص العربى

تأثير نظم التسميد النيتروجيني علي محصول البذور ونسبة الزيت لبعض أصناف الكانولا

مها سليمان عبد الرحمن المالح، عبد الفتاح حلمي بلال، إيمان إسماعيل السراج

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نفذت الدراسة من خلال تجربة حقلية بمزرعة كلية العلوم البيئية الزراعية بمركز رفح في الموسمين الشتويين ٢٠١١/ ٢٠١٢ و٢٠١٢/٢٠١٣م، حيث كان الهدف من هذه الدراسة هو معرفة تاثير المعاملات الزراعية (خمسة أصناف من الكانولا وخمس معاملات مختلفة من التسميد النيتروجينى) على المحصول ومكوناتة ونسبة الزيت للحصول على أحسن إنتاجيه لهذا المحصول تحت ظروف محافظة شمال سيناء. وقد اوضحت النتائج أن الصنف سرو ٤ تفوق في معظم الصفات عن باقي الاصناف حيث أعطي أعلي كمية لمحصول القطعة التجريبية وأعلي نسبة من الزيت في البذور. وكانت معاملة التسميد المعدني فقط هي افضل المعاملات حيث أعطت أعلي قيمة في معظم الصفات (وزن بذور النبات، وزن بذور الفدان، محصول الزيت للفدان وبنسبة الزيت بالبذور) ومن نتائج هذة الدراسة يمكن التوصية بزراعة الصنف سرو ٤ مع تسميده بالتسميد المعدني فقط للحصول على افضل النتائج.

الكلمات الإسترشادية: الكانولا، التسميد النيتروجيني، التسميد الحيوي، اصناف الكانولا، البكتريا المثبتة للنيتروجين، بكتريا الازتوبكتر.

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