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Effect of different nitrogen sources combination with bio-fertilizers on yield and chemical composition of canola and sesame crop

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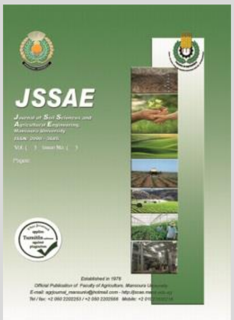

ABSTRACT

Two field experiments were carried out during winter season (2016/2017) and summer season (2017) an clay soil to evaluate the effects of bio-fertilizers (*Azospirillum and Azotobacter*) and different nitrogen fertilizer sources i.e., ammonium nitrate (AN), slow release nitrogen fertilizer ureaform aldehyde (SRF) and organic fertilizer (OF) at rate of 100% in absence of bio fertilizer and at rate of 75% nitrogen from recommend dose for both canola as winter season crop and sesame as summer season crop on the growth, chemical composition as well as concentration and yields of protein and oil in both canola and sesame crops. The results of the analyzes showed that the use of bio-fertilizer with mineral nitrogen fertilizer increased plant growth rates, (number of pods/plant, height plant, weight of 1000 Seeds (g), number of seeds/ capsule, seeds and straw yields, biological yield as well as the harvest index of both canola and sesame plants compared with mineral fertilizer AN and SRF alone. The highest values of concentration and uptake of N, P and K in both straw and seeds were obtained by application of nitrogen fertilizer with bio-fertilizer. Interaction between nitrogen fertilizer and bio-fertilizer achieved suitable protein and oil percent and could be improve canola and sesame seeds quality. On the other hand, some soil chemical properties (EC, pH and O.M) were enhanced due to application of mineral nitrogen with bio-fertilizer.

Keywords: Nitrogen fertilizers, bio-fertilizer, Canola and Sesame

INTRODUCTION

The use of nitrogen mineral fertilizers increases and as this fertilizer continues to be used in the soil, some problems can arise, and for example, some nitrogen loss can occur by washing nitrates and denitrifying seep through the groundwater, causing environmental pollution. In addition, some nitrogen can volatilize from the soil surface or volatile ammonia. (Hewedy, 1999). Usually the crop uses 30: 50% of the mineral fertilizers addition. Recently the use of bio-fertilizers is of particular interest to avoid the previously mentioned problems. Moreover, microorganisms which are used as a bio-fertilizers induce simulative effect on plant growth and production by fixing atmospheric nitrogen in a free living state, bio-fertilizers as *Azotobacter and Azospirillum* produce a product free from the residual of some chemical compounds, bio-fertilizers also are secreting growth promoting factors, e.g., gibberellin, *Cytokinine* like substances and auxin, (Saber, 1996 and El- Haddad *et al* 1993) Recently, big attention was focused on the use of organic manure as N fertilizer compared to chemical fertilizers to produce healthy and safety crops. Moreover, organic fertilizers could improve the physical, chemical and biological soil Properties; such enhanced conditions of the soil could lead to higher quality and quantity crops. Urea is one of the most widely used fertilizers. The importance of urea as a major source of nitrogen in agriculture depends on its low cost of production; it has been indicated by (Liu *et al*., 2006). However, the ineffective and indiscriminate use of urea often leads to apparent environmental pollution, as mentioned (Akelah, 1996 and Al-Zahrani, 2000) in addition to economic losses. Environmental pollution is mainly due to the high solubility and toxicity of urea, which is responsible for groundwater pollution. And therefore since the early 1970s, this has encouraged many researchers to develop new formulations that help overcome the problems and disadvantages of applying urea fertilizer. In order to overcome the limitations of using urea in agriculture, the researchers had access to a slow-acting fertilizer preparation. (Jarosiewicz and Tomasezewska. 2003 and Guo *et al*., 2006). By reacting formaldehyde with excess urea fertilizer under controlled conditions to produce a mixture of methylene urea with a long polymer chain, by controlling manufacturing conditions, chain length, solubility and nitrogen release rates can be changed. The dispersion pattern is also influenced by changes in soil temperature, moisture, and soil microorganisms and their activity, as mentioned (Trenkel, 2010). Despite much research in the world, the use of slow-applied fertilizers faces a problem due to the high cost of producing them. It has also been reported that the rate of nutrient release into soil is influenced by soil condition, environment and time factor (Shaviv *et al*., 2003). Canola (*Brassica napus L*), among the oilseeds, is a member of the Crusader family and has become one of the most important sources of vegetable oils in the world. Canola is the highest production in the world in recent decades, and ranks third after soybeans and palm oil, as noted (Perry and Spink, 2006). Canola contains the lowest percentage of saturated fats among vegetable oils, and thus represents a growing

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demand by consumers interested in diet; he noted this (Grombacher and Nelson, 1992).

If canola is one of the oldest oil crops archaeological studies have shown that the cultivation of sesame dates back to 5500 BC. Sesame seeds are rich in oil (44-58%), protein (18-25%), and carbohydrates (13.5%). The oil portion contains about 90% unsaturated fatty acids, including oleic acid and linoleic acid. As a protein breaker, sesame seeds are rich in arginine and leucine at approximately 140 mg $^{-1}$ g and 75 mg $^{-1}$ g respectively. (Namiki, 1995). It is extracted to produce vegetable oils for human consumption and extraction residues as animal feed.

Nitrogen plays an essential role in the basic growth of the plant, and it is one of the important elements for protein synthesis. The canola plant absorbs nitrogen fertilizer in the form of ammonium or nitrate, as indicated (Hopkins and Hunter, 2004). (Samir *et al*. 2015) found that Canola yield and nutrient uptake are highly dependent on soil fertility, and give high grain yields occurring in the presence of 120 to 180 kg nitrogen / ha^{-1}. (Esmail, 2020) it showed that although the use of nitrogen fertilizers led to an increase in the yield of canola seeds and their components, the use of biological nitrogen by pollinating the seeds with *Azotobacter and Azosprillum* resulted in an increase in the yield of canola seeds and accumulation of elements during the different growth periods and in the sesame seeds in the ripening stage. (*Sesamum indicum L*) in Egypt, sesame is an important oil crop, and an important source of income. (Weiss, 2000) and (Abdullahi, *et al.* 2013) he pointed out that the organic fertilizers (animal manure and poultry manure 5 tons ha^{-1}) mixed with bio-fertilizers produce plants with high growth standards, increase the absorption of nutrients, increase the numbers of *Azospirillum* in the soil, and increase the soil density, compared to using animal fertilizers. Or poultry manure 10 ha^{-1} tons individually without biological fertilizers, therefore it is recommended to mix bio-fertilizer with organic amendments to produce sesame successfully. (Ghosh and Mohiuddin, 2000) it was found that bio-fertilizers induced significant increase in sesame (plant height and yield components) such as (number of capsules, number of seeds, 1000 seed weight and seed yield plant) when compared with the control. *Azospirillum and Azotobacter* in the root environment produce biological active substances such as vitamin B, nicotinic acid, pentatonic acid, biotin, auxin, gibberellin, etc. which play an important role in root growth. (Roesti, 2006) and (Blal *et al*., 2013) It was found that fertilization with nitrogen up to 40 kg / fedan^{-1} in addition to bio-fertilizers led to a significant increase in the weight of 1000 seeds, the number of plant capsules, the weight of the capsules, the yield of the plant seeds, and the oil percentage. This current study aims to study the effect of mixing different nitrogen sources with biological fertilizers on the quality and quantity of canola and sesame crops.

MATERIALS AND METHODS

The field experiments were conducted at in the Experimental Research Farm of Sads Agricultural Research Station, Bani-Swief Governorate, Middle Egypt, during winter season 2016/2017 and summer season (2017) for canola and sesame crop Respectively, study the effect of different sources of nitrogen fertilizers with or without bio-fertilizers and the results of their interaction on growth, productivity and chemical components (total oil content and total protein) of both canola and sesame plants. The experiment was carried out by designing the complete randomization sectors by arranging the splitting pieces with three replications. The main plot consists of the bio-fertilizers and nitrogen sources designated for the sub-plots. The soil analyzes of the study site and the organic fertilizers are presented in Tables (1 and 2).

Table 1. Some physical and chemical analysis characteristics of studied soil.

Properties	Value	Texture	
Clay (%)	66.4	clay	
Silt (%)	24.37	Properties	Value
Sand (%)	9.14	Depth (Cm)	0 - 30
CaCO3 (%)	3.54	Soluble ions(me/L)	
EC (dS m-1)	0.95	$HCO3^-$	2.6
pH (1:2.5)	8.2	Cl^-	4.18
Organic Matter (%)	1.125	$SO^=4$	2.72
Available macronutrients (mg kg-1)		Ca^{++}	4.49
N	45	Mg^{++}	1.45
P	5.2	Na^+	3.31
K	162.80	K^+	0.15

Table 2. organic fertilizer analysis:

Property	pH	EC dS m^{-1}	cubic meter kg	Humid %	Total N %	NH_4 mg kg^{-1}	N Nitrate mg kg^{-1}	O.M %	O.C %	Ash %	C / N %	Total P %	TotalK %
Value	6.8	3.22	650	66	2.08	78	59	60	34.8	36.4	1:17.7	1.54	1.38

The experiment included six treatments that were a mixture of three nitrogen sources; first, (NH_4NO_3) ammonium nitrate, (AN) (33.5% N). ureaform aldehyde, (SRF 44% N) as slow release nitrogen fertilizer and organic fertilizer (OF, 2.08% N) at rate of 30 kg N feddan^{-1} and 30 N feddan^{-1} for both canola and sesame, respectively when addition without bio-fertilizer, for bio-fertilizers (control, *Azospiriillum Lipoforum and Azotobacter Chroccocum* Mixed with seeds at rate of 2 kg /fedaan^{-1} combined with 75 % of recommendation nitrogen fertilizers. These coefficients were arranged in a randomized complete split-plot design with three replications. Nitrogen sources were added randomly in the main plots, while the biological fertilizers were randomly arranged in the main and subsidiary plots. The amount of nitrogen fertilizer was divided at a rate of 30 kg N / fedaan^{-1} into three equal batches after 30, 60 and 90 days of planting alongside the plants. All agricultural practices were implemented as recommended for the production of Canola and Sesame in Egypt. *Azotobacter sp* (nitrogen fixing bacteria) and *Azospirillum sp* (nitrogen fixing bacteria) were obtained from the Agriculture Equalization Fund of the Public Authority for Agriculture (GOAEF), Ministry of Agriculture, and Egypt. The bio-fertilizer used is added by mixing it with canola seeds and sesame. The bio-fertilizer, *Azotobacter and Azospirillum*, was provided to both by mixing them with wet seeds with the addition of 20% gm. Arabic solution before planting.

Different nitrogen sources were used in three equal doses; the first dose was applied 30 days after sowing, the second dose after 45 and the third 60 days after sowing, respectively. doses of phosphorus at rates (30 kg P_2O_5 fedaan^{-1} and 30 kg P_2O_5 fedaan^{-1}) and K at rates (24 kg K_2O fedaan^{-1} and 50 kg K_2O fedaan^{-1}) respectively, for Canola and Sesame, calcium phosphate (P2O5 15%) and potassium sulfate (K_2O 48%) respectively, potassium was divided into two doses (50% upon sowing + 50% with second dose of nitrogen fertilizer) However, N. For sesame yield, phosphorus and potash were applied as a base dose of 30 and 24 kg K_2O fedaan^{-1} each, respectively when preparing seed bed for each plot.

The local cultivar *Serw 4* was the Canola plant (*Brassica napus L*), the former winter crop. Canola seeds were sown on November 15, 2018/2019. Each plot consists of 7 rows, 40 cm apart, 20 cm apart from one plant to another. Seeds were propagated at a rate of 3 kg fedaan^{-1}. Recommended agricultural practices were applied from planting to harvest, at the end of the experiment (155 days). At the time of harvest, a square meter was taken from each piece and measurements were made as follows, plant height , number of pods ,weight of 1000 seed, number of branches weight straw, seed yield (ton fedaan^{-1}), biological yield (ton fedaan^{-1}) and harvest index (%). Sesame seeds (*Sesamum indicum L*) were cultivated with cultivar (*Sindwell 3*) at a rate of 5 kg feddan^{-1} during summer 2018 on these lands. The experiment was carried out in designing randomized whole sectors with the same cut design for canola crop. At harvest, taken randomly five plants to estimated, plant height (m), number of pods/plant, weight of 1000 seeds and number of capsules/plant as well as determined as straw, seed yield (ton faddan^{-1}), biological yield (ton faddan^{-1}) and harvest index (%).Plant samples were collected from matures of both canola and sesame plants at harvest stage for analysis. Plant samples were dried at 55 C° for 48 hrs, ground and wet digested using H2SO4: H2O2 method (Benton and Jones, 2001). Then, the digested samples were subjected to measuring the seed and straw content of (N, P and K) using the Kjeldahl nitrogen device, while phosphorous and potassium were determined by extracting acetic acid and measuring them using a spectrophotometer and a flame photometer as explained by (Johnson, 1959) and (Knudsen *et al.* 1982) for P and K, respectively. As for the content of crude oil: the oil content of the seeds was estimated according to (AOAC, 1980) and the protein content by the total nitrogen specified by the Kjeldahl method according to (AOAC, 1980). The crude protein was calculated by multiplying the nitrogen percentage by the conversion factor (6.25).

Statistical analysis:

Data were analyzed with Procedure of Variation (ANOVA) analysis using statistical software package MSTAT-C (Michigan State University, 1983) where (F) test showed statistically significant differences between mean differences (LSD) at 0.05 levels.

RESULTS AND DISCUSSION

Data in Table (3) Showed that the effect of mineral nitrogen fertilizers and bio-fertilizers showed the highest values of plant height, number of pods / plant, weight of 1000 seeds (g), number of seeds / capsule for both canola and sesame. Sesame yield was increased by using bio-fertilizers such as *Azotobacter and Azespirilium* along with nitrogen fertilizers.

Table 3. Effect of different nitrogen sources combined with bio-fertilizer on canola and sesame crops of plant height, number of pods, weight of 1000 Seeds, and number seeds capsule

Treatments		canola					Sesame			
Sources Of nitrogen fertilizer	Bio-fertilizer	Plant Height (Cm)	Number of Pads Plant	1000 Seeds (g)	Number of Seeds/ Capsule.	Number of Branches/ Plant.	Plant Height (Cm)	Number of Pads Plant	1000 Seeds (g)	Number of Seeds/ Capsule.
AN	O	197.00	536.00	3.820	23.00	12.00	157.00	166.00	4.430	45.00
SRF		210.00	576.00	4.000	24.00	12.00	162.00	170.00	4.500	46.00
OF		175.00	481.00	3.600	23.00	10.00	150.00	158.00	4.250	46.00
Mean		194.00	531.00	3.800	23.00	11.00	156.00	165.00	4.390	46.00
AN (75%of RD)	Bio	199.00	550.00	3.900	24.00	12.00	161.00	177.00	4.580	46.00
SRF (75%of RD)		220.00	586.00	4.100	23.00	12.00	165.00	182.00	4.580	46.00
OF(75%of RD)		185.00	489.00	3.710	23.00	10.00	152.00	168.00	4.430	46.00
Mean		201.00	542.00	4.00	23.00	11.00	159.00	176.00	5.00	46.00
LSD at 0.05	A	34.966	103.336	0.5878	0.5321	1.6554	11.993	51.858	1.011	1.2382
	B	3.597	10.829	0.0225	1.1376	0.6894	3.655	7.802	0.059	1.6757
	AB	4.799	14.447	0.0230	1.5176	0.9197	4.877	10.441	0.078	2.2354

Ammonium nitrate (AN)* slow release nitrogen fertilizer ureaform aldehyde (SRF)* organic fertilizer (OF)* bio fertilizer (Azospirillum Sp and Azotobacter Sp).

The higher values of the above transactions were obtained with the application of bio-fertilizer with slow release fertilizer (ureaform), (220.00&165 cm), (586.6&182), (4.1&4.58) and (23.2&46.0) Plant height, number of pods per plant, 1000 seed weight (km), number of seeds / capsule for both canola and sesame crop, respectively. On the other hand, the lowest values of obtained with ammonium nitrate without any fertilizer from bio-fertilizer. Furthermore, these results may be due to the application of bio-fertilizer improved the conditions for root growth and increase the growth of the organs which up enhanced the biological functions of the plant also, when comparing slow release nitrogen fertilizer with conventional nitrogen fertilizer, slow release nitrogen fertilizer distributes nitrogen slowly and evenly, thus reducing unnecessary nitrogen loss during the early stage of growth, increasing nitrogen supply in the peak stage of growth, yield formation and nitrogen demand, and reducing Spending on production requirements and increasing income. (Carson *et al.* 2014a) and Eidizadeh *et* *al.* (2010) reported that the addition of chemical and biological fertilizers led to an increase in the biological yield and the grain yield of the corn plants. The number of grains, the weight of 100 grains, the yield of pods and the weight of straw were increased by using bio-fertilizers such as *Azotobacter* at a rate of 5 kg / acre with nitrogen fertilizers with ammonium sulfate. (Youssef, 2011) concluded that the use of bio-fertilizer in the presence of mineral nitrogen resulted in an increase in the yield of wheat grains.

Recorded results in Table (4) indicates the existence of statistically significant differences within the averages of seed yield, straw, biological yield and harvest index, as well as affected by the application of nitrogenous, biological and mineral fertilizers. The use of nitrogenous fertilizers in the presence of biological fertilizers resulted in the highest seed values and straw yields; Biological yield and harvest index compared to the plants received nitrogen fertilizer alone. The highest values of seeds and straw yields, biological yield and harvest index were obtained by application of SRF, however the lowest values were recorded when applied N as ammonium nitrate without bio-fertilizer.

Table 4. Effect of different nitrogen sources combined with bio-fertilizer on yield of straw, seeds,Biological yield and harvest index of both canola and sesame crops.

Treatments		Canola yield				Sesame yield			
Sources of nitrogen fertilizer	Bio-fertilizer	Seeds (ton fed^{-1})	Straw (ton fed^{-1})	Biological (ton fed^{-1})	Harvest index (%)	Seeds (ton fed^{-1})	Straw (ton fed^{-1})	Biological (ton fed^{-1})	Harvest index (%)
AN		0.833	1.888	2.721	30.614	0.680	1.750	2.430	27.984
SRF	O	0.911	1.920	2.831	32.179	0.709	1.800	2.509	28.258
OF		0.706	1.452	2.158	32.715	0.575	1.645	2.222	25.878
Mean		0.82	1.75	2.57	31.84	0.65	1.73	2.39	27.37
AN(75% of RD)		0.848	1.912	2.760	30.725	0.689	1.768	2.457	28.042
SRF(75% of RD)	Bio	0.848	1.912	2.760	30.725	0.689	1.768	2.457	28.042
OF(75% of RD)		0.920	1.960	2.880	31.944	0.713	1.827	2.540	28.071
Mean		0.87	1.93	2.80	31.13	0.70	1.79	2.48	28.05
	A	0.1758	0.1780	0.3539	2.0909	0.0855	0.0394	0.1721	1.5951
LSD at 0.05	B	0.0182	0.0608	0.0704	0.7797	0.0121	0.0127	0.0538	0.5607
	AB	0.0243	0.0811	0.0939	1.0402	0.0162	0.0169	0.0717	0.7479

Ammonium nitrate (AN)* slow release nitrogen fertilizer ureaform aldehyde (SRF)* organic fertilizer (OF)* bio fertilizer (Azospirillum Sp and Azotobacter Sp).

Results in Table (5) Showed that with the use of mineral nitrogen fertilizer combined with bio-fertilizer, the values of N, P, K and absorbance values differed significantly between all treatments. Plants inoculated with bio-fertilizers along with nitrogen sources increased nutrient content and absorption compared to nitrogen. Sources add alone.

Table 5. Effect of different nitrogen sources combined with bio-fertilizer on N, P and K Concentration and uptake in seeds by both canola and sesame crops

Treatments		Macronutrients content in canola Seeds (%)			Macronutrients content in Sesame Seeds (%)		
Sources of nitrogen fertilizer	Bio-fertilizer	N	P	K	N	P	K
AN		3.51	0.63	0.852	3.260	0.43	1.80
SRF	0	3.57	0.62	0.865	3.277	0.41	1.85
OF		3.50	0.64	0.861	3.250	0.45	1.81
Mean		3.53	0.63	0.86	3.26	0.43	1.82
AN(75% of RD)		3.55	0.68	0.838	3.300	0.49	1.843
SRF(75% of RD)	Bio	3.57	0.71	0.857	3.283	0.47	1.933
OF(75% of RD)		3.55	0.74	0.861	3.280	0.47	1.867
Mean		3.56	0.71	0.85	3.29	0.48	1.88
	A	0.2061	0.0997	0.1992	0.0591	0.1318	0.1301
LSD at 0.05	B	0.0860	0.0503	0.0196	0.0379	0.0278	0.0901
	AB	0.1148	0.0670	0.0262	0.0505	0.0370	0.1202
		Macronutrients uptake by canola Seeds(kg/feddan)			Macronutrients uptake by sesame Seeds(kg/feddan)		
		N	P	K	N	P	K
AN		29.24	5.25	7.097	22.168	2.924	12.240
SRF	0	32.52	5.65	7.880	23.234	2.907	13.117
OF		24.71	4.52	6.079	18.688	2.588	10.408
Mean		28.84	5.15	7.02	21.37	2.82	11.92
AN(75% of RD)		30.104	5.77	7.106	22.737	3.376	12.698
SRF(75% of RD)	Bio	32.844	6.53	7.884	23.408	3.351	13.782
OF(75% of RD)		26.590	5.54	6.449	19.680	2.820	11.202
Mean		29.87	5.96	7.15	21.93	3.2	12.55
	A	8.1210	2.0710	2.7260	2.6676	1.3223	2.4352
LSD at 0.05	B	0.8566	0.5076	0.1225	0.9008	0.2287	0.6237
	AB	1.1428	0.6771	0.1635	1.2017	0.3051	0.8321

Ammonium nitrate (AN)* slow release nitrogen fertilizer ureaform aldehyde (SRF)* organic fertilizer (OF)* bio fertilizer (Azospirillum Sp and Azotobacter Sp).

The highest nitrogen, phosphorus and potassium (3.53, 0.63 & 0.86 %) and (3.26, 0.43 &1.82%), (29.87, 5.96 & 7.15 kg fedaan^{-1}) and (21.93, 3.2 &12.55 kg fedaan^{-1}) concentration and uptake by seeds of both canola and sesame, respectively were obtained due to inoculation of bio-fertilizers with mineral nitrogen sources. While the highest values nutrients concentration and uptake (3.57, 0.71 &0.857%) and (3.283, 0.47&1.933%) and (37.844, 6.53 & 7.884) and (23.408, 3.351 &13.782 kg fedaan^{-1}) were obtained when using bio fertilizer with SRF in treating both canola and sesame seeds, respectively, compared to other sources. These results may be attributed to the effective role of pollination of bio-fertilizers in plant growth which could be related to its ability to produce high amounts of auxin, such as indole acetic acid. Moreover, these microorganisms have the ability to stabilize N, mobilize P and K, which leads to enhanced nutrient absorption and plant growth. (Djajadi and Hidayati, 2020) found that a mixture of bio-fertilizer and C. juncea with 100% NPK recommended fertilizer rate gave the highest nitrogen uptake and sugarcane stalk length.

The data presented in Table (6) Showed that the effect of different nitrogen sources alone with biological fertilizer on the concentration and absorption of nitrogen, phosphorus and potassium through straw in canola and sesame crops had a significant effect at 0.05. The data also showed that mixing nitrogen and bio-fertilizers, especially with the SRF fertilizer, is slow to dissolve. Recorded the highest nitrogen, phosphorous and potassium concentrations with straw for both canola and sesame plants. The proportions of the relative increase in the concentration in straw for the use of nitrogen fertilizer in the presence of biological fertilizer: (0.788, 0.355, 2.535%, 0.8, 0.704, 1.482%) for both canola and sesame respectively when compared with the same treatments without adding biological fertilizer except for the relative increase in absorption Nitrogen for phosphorus and potassium were (15.445, 6.958, 49.686%, 14.616, 12.862, 27.076%) for growing canola and sesame respectively. Additionally, the use of bio-fertilizers effectively helps in improving planting. The biological fertilizer increases the level of gibberellin, which increases the growth of roots when increasing the roots and the ability of the plant to absorb nitrogen, phosphorous and potassium. (Hamidi *et al*., 2015 and Mahmoud *et al*., 2016) all mineral nitrogen treatments and biological fertilizers showed a significant increase in concentration and total absorption of N, P and K compared to the control treatment (the recommended dose of nitrogen fertilizer only).

Bio-fertilizers improve the performance of the sesame plant by enhancing the absorption of water and your nutrients, by (Purima *et al*., 2007). *Azospirillum and Azotobacter* in the root environment are able to produce biological active substances such as vitamin B, nicotinic acid, pentatonic acid, biotin, auxin, gibberellin and others which play an important role in root growth as well as increase nutrient absorption by (Roesti, *et al*, 2006).

Table 6. Effect of different nitrogen sources combined with bio-fertilizer on N, P and K,Concentration and uptake in seeds by both canola and sesame crops

Treatments		Macronutrients content in canola Straw (%)			Macronutrients content in Sesame Straw (%)		
Sources of nitrogen fertilizer	**Bio-fertilizer**	**N**	**P**	**K**	**N**	**P**	**K**
AN		0.777	0.330	2.490	0.772	0.678	1.338
SRF	0	0.780	0.342	2.510	0.788	0.688	1.425
OF		0.765	0.340	2.525	0.848	0.695	1.524
Mean		0.774	0.337	2.508	0.803	0.687	1.429
AN(75% of RD)		0.785	0.350	2.515	0.820	0.690	1.450
SRF(75% of RD)	Bio	0.788	0.355	2.535	0.800	0.704	1.482
OF(75% of RD)		0.776	0.360	2.555	0.860	0.708	1.668
Mean		0.783	0.355	2.535	0.827	0.701	1.533
	A	0.0382	0.0324	0.0363	0.0836	0.0166	0.2284
LSD at 0.05	B	0.0207	0.0045	0.0186	0.0261	0.0379	0.0406
	AB	0.0276	0.0061	0.0248	0.0348	0.0504	0.0541
		Macronutrients uptake by canola Straw (kg/feddan)			Macronutrients uptake by sesame Straw (kg/feddan)		
		N	P	K	N	P	K
AN		14.670	6.230	47.011	13.510	11.865	23.415
SRF	0	14.976	6.566	48.192	14.184	12.384	25.650
OF		11.108	4.937	36.663	13.950	11.433	25.070
Mean		13.568	5.908	43.965	13.908	11.899	24.750
AN(75% of RD)		15.009	6.692	48.087	14.498	12.199	25.636
SRF(75% of RD)	Bio	15.445	6.958	49.686	14.616	12.862	27.076
OF(75% of RD)		11.578	5.371	38.121	14.328	11.795	27.789
Mean		14.000	6.347	45.326	14.506	12.296	26.889
	A	2.1686	1.2108	5.1839	1.8176	0.5387	4.5102
LSD at 0.05	B	0.5999	0.2837	1.5322	0.3903	0.5896	4.5102
	AB	0.8002	0.3784	2.0440	0.5207	0.7866	1.0449

Ammonium nitrate (AN)* slow release nitrogen fertilizer ureaform aldehyde (SRF)* organic fertilizer (OF)* bio fertilizer (Azospirillum Sp and Azotobacter Sp).

Applications of mineral nitrogen fertilizers with bio-fertilizer resulted in an increase in seed protein and oil content (22.77% & 38.75%) and (20.66% & 48.4) for canola and sesame, respectively. Table (7) the seed protein and oil yields were (191.04 & 325.11 kg fedan^{-1}) and (137.8 & 322.81 kg fedan^{-1}) compared with the nitrogen treatments without bio-fertilizer. On the other hand, the higher values of protein and oil content as well as yield in both seeds of canola and sesame crops were obtained by application of SRF with bio-fertilizer. These results may be attributed to balanced use of N-fertilizer to allow the crop to give rapid growth of the plant, can contribute positively to the increase in grain size, which was reflected in the increase in the weight of the economic seed yield in addition to increasing the protein and oil composition in the seeds.

These results are in agreement with those obtained by (Kumar *et al*., 2002) Increasing the protein content as a result of applying bio-fertilizers has been previously reported, as compared to the control. (Ayman *et al*., 2016) reported that the interaction among treatments application organic fertilizer 72 N kg per hectare $^{-1}$ with combined bio-fertilizers achieved appropriate oil content and could improve the yield, quality and environment of canola seeds for growth. (Kumar *et al*., 2009) stated that the use of bio-fertilizers along with a low percentage of chemical fertilizers in the sesame plant greatly increases the seed oil content.

Table 7.Effect of different nitrogen sources combined with bio-fertilizer on protein and Oil content (%) and yields (kg/fed.) in seeds by both canola and sesame crops

Treatments		Canola				Sesame			
Sources of nitrogen fertilizer	Bio-fertilizer	Seed Protein(%)	Protein yield(Kg/fed.)	Seed Oil(%)	Oil yield (Kg/fed.)	Seed Protein(%)	Protein yield (Kg/fed.)	Seed Oil(%)	Protein (%)
AN		21.94	182.76	37.00	308.210	20.375	138.550	47.10	320.280
SRF	0	22.31	203.24	38.09	347.000	20.481	145.210	48.53	344.078
OF		21.88	154.47	38.18	269.551	20.313	116.800	48.83	280.773
Mean		22.04	180.16	37.76	308.25	20.39	133.52	48.15	315.04
AN(75% of RD)		22.69	192.41	38.37	325.378	20.731	142.837	48.83	336.439
SRF(75% of RD)	Bio	23.00	211.60	39.59	364.228	20.706	147.634	48.13	343.167
OF(75% of RD)		22.63	169.50	38.30	286.867	20.544	123.264	48.23	289.380
Mean		22.77	191.04	38.75	325.11	20.66	137.80	48.4	322.81
	A	1.28	49.99	1.84	85.59	0.36	21.38	0.06	41.88
LSD at 0.05	B	0.53	5.36	0.26	7.98	0.23	2.95	1.15	10.65
	AB	0.71	7.16	0.35	10.65	0.31	3.94	1.53	14.20

Ammonium nitrate (AN)* slow release nitrogen fertilizer ureaform aldehyde (SRF)* organic fertilizer (OF)* bio fertilizer (Azospirillum Sp and Azotobacter Sp).

Soil salinity (EC), Soil pH value and OM content:

Data presented in Table (8) show that the estimated electrical conductivity values for all parameters tend to decrease when treating soils with different sources of mineral nitrogen fertilizers alone or in combination with bio-fertilizers compared to the primary soil. Mean values decreased with (AN) and (SRF) approximately (22.1% and 21.05% EC dSm^{-1}) and (23.15% and 22.1% EC dSm^{-1}). After the canola and sesame crops were harvested compared to the initial electrical conductivity of the soil as a result of using mineral nitrogen without bio-fertilizers.

Table 8. Effect of nitrogenous fertilizers with bio-fertilizers on EC, pH, and OM in soil after harvesting of canola and sesame crops.

Treatments		Canola			Sesame		
Sources of nitrogen fertilizer	Bio-fertilizer	EC dSm^{-1}	pH 1:2.5	O.M %	EC dSm^{-1}	pH 1:2.5	O.M %
AN		0.74	8.15	1.190	0.75	8.12	1.100
SRF	0	0.73	8.14	1.190	0.74	8.10	1.120
OF		1.25	7.95	1.380	0.95	7.90	1.300
Mean		0.91	8.08	1.253	0.81	8.04	1.173
AN(75% of RD)		0.83	8.12	1.200	0.78	8.10	1.160
SRF(75% of RD)	Bio	0.76	8.08	1.210	0.73	8.08	1.160
OF(75% of RD)		1.28	7.92	1.400	0.93	7.87	1.360
Mean		0.96	8.04	1.270	0.81	8.02	1.227
	A	0.0608	0.0541	0.0439	0.0203	0.2078	0.1081
LSD at 0.05	B	0.0972	0.0575	0.0475	0.1621	0.1621	0.0530
	AB	0.1297	0.0766	0.0634	0.0963	0.2162	0.0707

Ammonium nitrate (AN)* slow release nitrogen fertilizer ureaform aldehyde (SRF)* organic fertilizer (OF)* bio fertilizer (Azospirillum Sp and Azotobacter Sp).

Data presented in Table (8) show that the soil pH decreased slightly after harvesting canola and sesame under all treatments compared to the primary soil. In contrast to EC, the highest values of decrease in soil pH can be obtained when nitrogen is used in the presence of biological fertilizer and organic matter (7.92 and 7.87) or (7.95 and 7.9) compared to primary soil and in the absence of biological fertilizer compared to the primary soil. The decrease in soil pH may be due to the organic matter remaining at the end of the growing season. In addition, the activity of microorganisms led to the production of organic acids.

These results are attributed to the increased activity and efficiency of bacteria in reducing soil pH by excretion of organic acids and thus reducing soil pH (Yadav *et al*, 2002). Furthermore the microorganisms have been reported to secret certain organic acids and accumulate various soluble salts that may also decrease the pH. These findings are supported by (Babu *et al*. 2007). Significantly higher organic carbon content was recorded from the all treatment compared with initial soils (Table 8). Data indicate that the highest values of utilization from the fertilizer unit are in the case of using mineral nitrogen with bio-fertilizers compared with the individual nitrogen fertilizers. This could be due to increased vegetative growth and overall biomass that may be due to photosynthesis, and improved transport and accumulation of nutrients in the roots and plant. (Rana 2001).

Bio-fertilizers presence increases in organic carbon content of the soil. These bacteria can extract atmospheric nitrogen gas to synthesize mineral nitrogen, and then it is isolated in the soil after the death of the Azotobacter cells, which contributes to increasing soil fertility and plant nutrition. (Mazinani *et al*., 2012).

CONCLUSION

The overall results of this research indicated that the combined effect of bio-fertilizers and nitrogen fertilizers produced plants with high growth parameters and increased straw and seeds, N, P and K uptake in addition to the quantity and quality of oil and protein in canola and sesame plants, as well as improving some soil properties. Also, according to the results of these experiments, the use of bio-fertilizer can reduce the consumption of mineral nitrogen fertilizers by 25%.

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تأثير مصادر مختلفة من النتروجين متداخله مع الاسمده الحيويه على المحصول والمحتوى الكيميائى لكل من الكانولا والسمسم

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تم إجراء تجربتين حقليتين خلال موسم الشتاء (2017/2016) وموسم الصيف (2017) في المزرعة التجريبية لمحطة البحوث الزراعية بسدس التابعة لمركز البحوث الزراعية، بمحافظة بني سويف، مصر الوسطى لدراسة تأثير الأسمدة الحيوي (Azosporillum و *Azotobacter*) ومصادر الأسمدة النيتروجينية المختلفة، نترات الأمونيوم (AN)، والسماد النتروجينى بطيئ الذوبان اليوريا فورمالدهيد (SRF) والأسمدة العضوية (OF) بمعدل 100 ٪ في غياب الأسمدة الحيوية وعلى معدل 75 ٪ من النيتروجين من الجرعة الموصى بها فى وجود الاسمده الحيوية لكل من الكانولا كمحصول موسم الشتاء والسمسم كمحصول موسم الصيف وتأثيرها على عوامل النمو ، وكذلك تركيز ومحصول البروتين والزيت في محصولي الكانولا والسمسم. أظهرت النتائج أن استخدام السماد الحيوي مع النيتروجين المعدني وخاصة السماد بطيئ الذوبان ياليه نترات الامونيوم إلى زيادة معاملات نمو النبات (طول النبات ، عدد القرون / نبات ، وزن 1000 بذرة (جم) ، عدد البذور / الكبسولة ، محصول البذور والقش ، المحصول البيولوجي كذلك). كمؤشر حصاد لكل من نباتات الكانولا والسمسم مقارنة بالنيتروجين المعدني وحده. كذلك يمكن تقليل جزء كبير من النتروجين المعدنى المستخدم ن طريق التعويض باستخدام الاسمده الحيويه. كذلك اظهرت النتائج أن أعلى قيم تركيز وامتصاص النيتروجين والفوسفور والبوتاسيوم في كل من القش والبذور عن طريق استخدام سماد النيتروجين اليوريا فورمالدهيد مع الأسمدة الحيوية. كذلك السماد اعطى نسب متناسبة من البروتين والزيت ويمكن تحسين كفاءة بذور الكانولا والسمسم ، ومن ناحية أخرى تم تحسين بعض الخواص الكيميائية للتربة (EC، pH و OM) نتيجة استخدام النيتروجين المعدني مع السماد الحيوي.