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EFFECTS OF COMPOST AND BIOFERTILIZERS ON PRODUCTIVITY OF CANOLA PLANTS

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ABSTRACT

The present investigation was conducted to investigate the effects of biological and organic fertilization including cerealine, mycorrhizae and compost on growth, yield and oil percentage of canola plants grown under two levels of NPK mineral fertilizers, i.e. 50 and 100% of the recommended NPK. The experiments were carried out in the plastic green house of the Plant Physiology Division, Fac. of Agric., Cairo Univ., Giza, Egypt, during two successive growing seasons; 2004-2005 and 2005-2006. The obtained results confirmed the positive effects of bio and organic fertilization on growth and yield of canola plants either under half or full NPK dose which recorded significant increments in comparison with only mineral fertilized plants. In addition, the treated plants with the combination of half NPK+ compost+ cerealine+ mycorrhizae were able to approach their optimal productivity under only full NPK. Moreover, the percentage of oil was increased in seeds of canola plants treated with the half NPK + the combinations of compost, compost+ cerealine, compost+ mycorrhizae and compost+ cerealine+ mycorrhizae in comparison with the control plants of full NPK treatment. Furthermore, the value of seed oil content (g\plant) of half NPK+ compost+ cerealine+ mycorrhizae was exceeded the comparable value of the control plants of full NPK. Therefore, these results strongly suggest that it could be reduce the amount of NPK mineral fertilizers to the half dose to achieve the same yield of canola plants treated with full NPK dose when compost and bio fertilizers were added, leading to economical and environmental benefits through reducing the cost and the hazardous effects of mineral fertilizers on the environment.

Keywords: Canola, Mineral Fertilizer, Bio Fertilizer, Compost, Growth, Yield and Oil.

INTRODUCTION

Canola refers to the "double-low" variety of the rapeseed plant *Brassica napus* or *Brassica campestris*. Compared to rapeseed, canola produces high quality, edible oils containing a reduced content of erucic acid which has been related to heart disease and glucosinolates. Canada is the world's largest canola producer and consumer. Canola oil has received attention for its exceptional nutritional content. It is very high in monounsaturated fat, and also contains significant amounts of vitamin E and phytosterols. In Egypt, there is a great shortage in edible oils and large amounts are imported from abroad. Planting canola which is a major oil crop, can meet the increasing demands of oil. Moreover, Canola in Egypt, as a new introduced oilseed crop, is still in the research phase and not commercially grown until now. In spite of the wide gap (about 85%) between the local production and national consumption from edible oil, several advantages are favoring canola to be grown in Egypt. It is an annual winter crop with short duration period (4-5 months), limited water requirements, high seed yield in new reclaimed soils and relatively high oil content Ibrahim *et al.* (1989).

In Egypt, about 96% of total area is a desert and the competition between winter crops in Nile Valley and Delta region are very strong. However, growing these crops in Egypt faces many barriers and for these reasons, growing canola in Egypt may become successful if it is grown in less fertile soils and could produce relatively high economic yield with low levels of NPK fertilizer inputs as mixed with bio and organic fertilizers.

Biofertilization is used in order to compensate a part of the mineral fertilizer doses, taking in consideration the complementary or synergestic effects of such combination between bio and mineral fertilization. This could be of economic value from the point of view of minimizing the used doses of the mineral fertilizers and consequently reducing agricultural costs as well as soil pollution. Rhizobium, Azotobacter and Azospirillum are examples of N-fixing bacteria responsible for increasing N supply. Azospirillum (functioning bacteria of cerealine) increases mineral and water uptake of crops. The availability of Phosphorous is improved by mycorrhizae. They promote production of phytohormones (GA_3, IAA and CK) which increase the surface area of the root system for better absorption of nutrients from soil, enhance uptake of water and increase growth and yield of crops. Many investigators studied the effect of mineral, biological and organic fertilaization on canola plant. Abbass and Okon (1993) showed that treating rape seedlings with cultures of *Azotobacter paspali* changed plant growth and development and significantly increased weight of shoot and roots. Also, Singh and Dutta (2006) found that rapeseeds gave good response to *Azotobacter* in terms of growth and development. Moreover, Yasari and Patwardhan (2007) stated that the application of *Azotobacter* and *Azospirillum* helped increase the number of branches and weight of 1000-seeds.

Mycorrhizae is kind of fungus that increases Phosphorous availability. Gupta *et al.* (1990) showed that inoculation of rape with vesicular arbuscular mycorrhizal fungi caused significant increases in shoot and branch length, total dry matter, total pod weight and yield. On the contrary, some investigators found that *Brassicas* are generally regarded as non-hosts for vesicular arbuscular mycorrhizal fungi including Schreiner and Koide (1993).

Sanwal *et al.* (2006) cited that the use of solid organic materials and compost to *Brassica-oleracea* (broccoli) enhanced its yield and quality. Application of organic materials improved the organic matter and available nutrients of the soil. Moreover, Kumar *et al.* (2007) reported that the distillery effluent based pressmud compost (DEPC), farmyard manure (FYM), combinations of DEPC+FYM and inorganic fertilizer significantly increased the seed yield and quality content of Indian mustard.

Gondek and Filipek (2005) compared the effects of mineral treatments and the amendments by organic and organomineral fertilizers on rape plants. They stated that mineral fertilizer and liquid organomineral fertilizer application better affected crop yield in comparison with organic treatments in the first year of the experiment, whereas in the subsequent two years a consecutive effect of organic fertilizers was observed.

Therefore, the present investigation was carried out to study the effects of cerealine (bio fertilizer), mycorrhizae (fungus) and compost on growth, oil percentage and productivity of canola plants grown under different levels of NPK fertilization.

MATERIALS AND METHODS

The present investigation was conducted in the plastic green house of the Plant Physiology Division, Faculty of Agriculture, Cairo University, Giza, Egypt. This experiment was carried out during two successive seasons; 2004-2005 and 2005-2006 to investigate the effectiveness of some physiological effects of biological and organic fertilization on canola plants. Canola (*Brassica napus.cv. serw4*) seeds were obtained from the Field Crop Institute, Agricultural Research Centre in Giza, Egypt.

The mechanical and chemical analysis of soil sample is presented in Table (1). Canola seeds were sown on the 4^{th} November 2004 and on the 7^{th} November 2005 in the first and second season, respectively. The experimental design was split-plot in randomized complete block design with 3 replications. The main plots included mineral fertilizers at two levels (full and half recommended NPK)and the sub-plots included the biological and organic fertilizers. The study included the folioing treatments:

1-*R.Q.F (Control)
2- R.Q.F + Compost
3- R.Q.F + Cerealine
4- R.Q.F + Mycorrhizae
5- R.Q.F + Mycorrhizae + Cerealine
6- R.Q.F + Compost + Mycorrhizae
7- R.Q.F + Compost+ Cerealine
8- R.Q.F + Compost+ Mycorrhizae + Cerealine
9- ½ R.Q.F
10- ½R.Q.F + Compost
11- ½R.Q.F + Cerealine
12- ½R.Q.F + Mycorrhizae
13- ½R.Q.F +Mycorrhizae + Cerealine
14-½R.Q.F + Compost+ Mycorrhizae
15- ½R.Q.F + Compost+ Cerealine
16- ½R.Q.F + Compost+ Mycorrhizae + Cerealine

*R.Q.F. = The recommended quantities of NPK fertilizer.

A total of 320 pots of 30 cm in diameter and 35 cm in depth were prepared; 20 pots for each treatment. The pots were filled with a mixture of 2:1 fine sand and clay. The first group of pots were prefertilized with superphosphate at the rate of 200 Kg P_2O_5/fed* (P_2O_5 15.5%); potassium sulphate at the rate of 50 Kg K_2O/fed* (48% K_2O) and ammonium nitrate at the rate of 150 Kg N/fed*(33.5% N) as recommended. The second group was prefertilized with half the recommended fertilizer. Nitrogen fertilizer was supplied in two doses, half before planting and the other half after two weeks from planting. Mycorrhizae received from Agricultural Research Centre in

Cairo, were added to the pots after planting. Compost was supplied to the pots before planting at the rate of 20 m^3/fed*. It was obtained from Hamza Company in Cairo. Chemical and physical analysis of compost are shown in Table (2) Cerealine (Azospirillum sp.), which was obtained from the Agricultural Research Centre in Cairo, was inoculated to canola seeds before planting. Arabic gum (0.2%) was used as an adhesive agent. *1 feddan (fed) =4200m^2.

Two plant samples consisting of three plants with three replicates were taken at 45 and 75 days after sowing. In both samples plants were separated into shoot and roots then they were dried in an electric oven at 70 °C for 48 hours and then the following growth characters were measured: Shoot height (cm), shoot dry weight (g), root length (cm) and root dry weight (g). At harvest after 120 days, the following yield components were taken: Siliqua number, seed index (g) (weight of 1000 seeds) and seed yield per plant. Chemical analysis included seed oil percentage which was measured by using soxlet apparatus using petroleum ether as a solvent according to A.O.A.C. (1982).

Table (1): Mechanical and chemical analysis of soil sample

Soil characters	Mean
Mechanical analysis	
Sand %	58.50
Silt %	13.30
Clay %	28.20
Texture	Sandy clay loam
Chemical analysis	
E.C.	3.57
Ph	7.88
OM(%)	1.30
$CaCO_3$ (%)	29.00
Available N ug N/g soil	3.60
Available P ug P/g soil	60.00
Soluble cations	
Ca^{+2}	14.88
Mg^{+2}	13.40
Na^+	6.35
K^+	1.10
Soluble anions	
HCO^{-3}	5.25
Cl^-	25.53
SO^{-4}	4.82
Fe	3.50
Zn ppm	0.38
Cu ppm	0.80
Mn ppm	1.10

Table (2): Chemical and physical analysis of compost

Constituent	value	Constituent	value
Bulk density kg/m^3	550-650	Total Phosphorus %	0.6-1.0
Moisture content %	20-25	av. Phosphorus mg/kg (ppm)	300-450
Electrical conductivity ds/m	4-6	Total potassium %	0.8-1.2
pH	7-8	av. Potassium mg/kg (ppm)	400-600
Total organic carbon %	15-18	CEC cmol/100 g compost	70-80
Total organic matter %	30-36	Humus value	5
Total nitrogen %	1.4-1.6	Fe ppm	>250
C/N Ratio	<15:1	Zn ppm	>150
NH_4-N, mg/kg	300-400	Mn ppm	>100
NO_3-N, mg/kg	250-300	Cu ppm	>50

All data were subjected to statistical analysis according to the procedures outlined by Gomez and Gomez, (1984) using Randomized Complete Block Design. Least significant difference (L.S.D) at 5% level was used to differentiate between means.

RESULTS AND DISCUSSION

Growth characters:

Results in tables (3, 4, 5 and 6) show clearly that mineral fertilization, bio and organic fertilization had significant effects on growth characters of canola plants in both seasons. The application of full NPK mineral fertilizer gave higher values in shoot height, shoot dry weight, root length, and root dry weight as compared to half NPK mineral fertilizer. Oad *et al.* (2001) found in *Brassica napus* plants, that application of 120-80-40 kg/ha NPK fertilizer showed taller plants and more branches than 0-0-0, 30-20-10, 60-40-20 kg/ha NPK.

Application of Compost+ Mycorrhizae + Cerealine with full NPK gave the highest values of canola growth characters as compared with the control. Regarding shoot height, there was no significant difference between the application of Compost+ Mycorrhizae + Cerealine with half NPK, Compost+ Cerealine with half NPK and the control, therefore by reducing the mineral fertilizers to half the recommended dose + bio and organic fertilizers, the harmful effects of mineral fertilizers are reduced. Generally, shoot dry weight and root length at 75 days age followed the same trend. As for the root dry weight at 75 days age, there was no significant difference between the application of Compost+ Mycorrhizae + Cerealine with half NPK, Compost+ Mycorrhizae with half NPK and the control during 2004. However, in 2005, the difference between the control, Compost, Compost+ Mycorrhizae, Compost+ Cerealine and Compost+ Mycorrhizae + Cerealine with half NPK was not significant. All these results suggests that addition of bio and organic fertilizers to half NPK recommended dose will give similar results to the control but with the advantage of minimizing the harmful effects of mineral fertilizers. Mandal and Sinha (2004) found that application of 100% N, P and K + 10 t ha^{-1} farmyard manure increased crop growth rate of *Brassica juncea*. Abbass and Okon (1993) showed that treating rape seedlings with cultures of *Azotobacter paspali* changed plant growth and development and significantly increased weight of shoot and roots. Nelson and Achar (2001) reported that plant growth and biomass production of cabbage (*Brassica oleracea var. capitata)* were increased by vesicular arbuscular mycorrhizal fungi.

Table (3): Effect of Mineral (NPK), Bio and Organic Fertilizers on shoot height and shoot dry weight of canola plants at 45 and 75 days age in 2004.

Treatments		Shoot height (cm)		Shoot dry weight (g)	
NPK Mineral fertilizers (A)	Bio and organic fertilizers(B)	45 days	75 days	45 days	75 days
Full	Control	25.33	59.33	1.35	10.33
	Compost	33.33	65.00	1.50	13.83
	Compost + Mycorrhizae	33.67	68.33	1.55	14.07
	Compost + Cerealine	31.67	70.33	1.53	14.67
	Compost+ Mycorrhizae+ Cerealine	35.67	71.00	1.58	14.50
	Mycorrhizae	27.00	64.33	1.43	10.70
	Mycorrhizae + Cerealine	29.67	65.67	1.44	11.67
	Cerealine	27.67	63.67	1.32	11.10
Mean[a]		**30.50**	**65.96**	**1.46**	**12.61**
Half	Control	20.00	49.00	1.16	7.90
	Compost	24.00	51.33	1.30	9.67
	Compost + Mycorrhizae	24.67	56.67	1.30	9.50
	Compost + Cerealine	25.67	57.33	1.32	9.67
	Compost+ Mycorrhizae+ Cerealine	25.67	58.30	1.31	10.17
	Mycorrhizae	22.00	49.67	1.21	8.30
	Mycorrhizae + Cerealine	22.33	51.67	1.25	8.97
	Cerealine	23.33	50.00	1.23	8.83
Mean[a]		**23.46**	**53.00**	**1.26**	**9.13**
Mean[b]	Control	22.67	54.17	1.26	9.12
	Compost	28.67	58.17	1.40	11.75
	Compost + Mycorrhizae	29.17	62.50	1.42	11.79
	Compost + Cerealine	28.67	63.83	1.43	12.17
	Compost+ Mycorrhizae+ Cerealine	30.67	64.67	1.45	12.33
	Mycorrhizae	24.50	57.00	1.32	9.50
	Mycorrhizae + Cerealine	26.50	57.67	1.35	10.32
	Cerealine	25.00	57.83	1.27	9.97
L.S.D 0.05	a	**0.608**	**0.728**	**0.024**	**0.272**
	b	**1.217**	**1.455**	**0.047**	**0.543**
	a× b	**1.721**	**N.S**	**0.067**	**0.769**

Table (4): Effect of Mineral (NPK), Bio and Organic Fertilizers on shoot height and shoot dry weight of canola plants at 45 and 75 days age in 2005.

Treatments		Shoot height (cm)		Shoot dry weight (g)	
NPK Mineral fertilizers (A)	Bio and organic fertilizers(B)	45 days	75 days	45 days	75 days
Full	Control	24.33	61.67	1.35	11.67
	Compost	29.00	73.00	1.50	14.60
	Compost + Mycorrhizae	27.33	76.33	1.55	13.90
	Compost + Cerealine	27.67	73.00	1.53	14.70
	Compost+ Mycorrhizae+ Cerealine	29.00	77.33	1.58	17.83
	Mycorrhizae	26.33	63.33	1.43	11.90
	Mycorrhizae + Cerealine	25.33	67.00	1.44	12.77
	Cerealine	25.00	66.33	1.32	12.17
Mean[a]		**26.75**	**69.75**	**1.46**	**13.32**
Half	Control	17.00	48.00	1.16	8.93
	Compost	22.00	58.33	1.30	10.60
	Compost + Mycorrhizae	21.00	56.33	1.30	10.80
	Compost + Cerealine	21.33	60.33	1.32	11.20
	Compost+ Mycorrhizae+ Cerealine	22.67	61.33	1.31	11.33
	Mycorrhizae	18.33	51.00	1.21	9.57
	Mycorrhizae + Cerealine	19.33	53.00	1.25	10.00
	Cerealine	18.00	50.33	1.23	9.90
Mean[a]		**19.96**	**54.96**	**1.26**	**10.29**
Mean[b]	Control	20.67	54.33	1.26	10.30
	Compost	25.50	65.67	1.40	12.60
	Compost + Mycorrhizae	24.17	67.33	1.42	12.35
	Compost + Cerealine	24.50	66.67	1.43	12.95
	Compost+ Mycorrhizae+ Cerealine	25.8.3	69.33	1.45	13.08
	Mycorrhizae	22.33	57.17	1.32	10.73
	Mycorrhizae + Cerealine	22.30	60.00	1.35	11.38
	Cerealine	21.50	58.33	1.27	11.03
L.S.D 0.05	a	0.597	1.051	0.024	0.282
	b	1.195	2.102	0.047	0.564
	a× b	N.S	N.S	0.067	0.798

Table (5): Effect of Mineral (NPK), Bio and Organic Fertilizers on root length and root dry weight of canola plants at 45 and 75 days age in 2004.

Treatments		Root Length (cm)		Root dry weight (g)	
NPK Mineral fertilizers (A)	Bio and organic fertilizers(B)	45 days	75 days	45 days	75 days
Full	Control	15.00	24.00	0.120	1.41
	Compost	18.67	30.67	0.150	1.55
	Compost + Mycorrhizae	19.33	34.00	0.157	1.58
	Compost + Cerealine	23.33	34.00	0.163	1.56
	Compost+ Mycorrhizae+ Cerealine	24.33	35.00	0.177	1.62
	Mycorrhizae	18.00	26.67	0.143	1.44
	Mycorrhizae + Cerealine	20.33	28.00	0.150	1.45
	Cerealine	19.33	27.67	0.147	1.47
Mean[a]		**19.67**	**30.00**	**0.151**	**1.51**
Half	Control	10.33	15.67	0.087	1.10
	Compost	13.67	21.33	0.110	1.37
	Compost + Mycorrhizae	14.00	22.67	0.100	1.39
	Compost + Cerealine	15.00	21.67	0.110	1.37
	Compost+ Mycorrhizae+ Cerealine	16.33	23.00	0.117	1.40
	Mycorrhizae	11.67	19.00	0.090	1.24
	Mycorrhizae + Cerealine	13.00	20.00	0.103	1.32
	Cerealine	12.33	19.00	0.107	1.28
Mean[a]		**13.29**	**20.29**	**0.103**	**1.32**
Mean[b]	Control	12.67	19.83	0.103	1.25
	Compost	16.17	26.00	0.130	1.46
	Compost + Mycorrhizae	15.67	28.33	0.128	1.49
	Compost + Cerealine	19.17	27.83	0.137	1.46
	Compost+ Mycorrhizae+ Cerealine	20.33	29.00	0.147	1.51
	Mycorrhizae	14.83	22.83	0.117	1.34
	Mycorrhizae + Cerealine	16.67	24.00	0.127	1.39
	Cerealine	15.83	23.33	0.127	1.37
L.S.D 0.05	a	**0.954**	**0.698**	**0.007**	**0.013**
	b	**1.908**	**1.397**	**0.015**	**0.026**
	a× b	**N.S**	**1.976**	**N.S**	**0.036**

Table (6): Effect of Mineral (NPK), Bio and Organic Fertilizers on root length and root dry weight of canola plants at 45 and 75 days age in 2005.

Treatments		Root Length (cm)		Root dry weight (g)	
NPK Mineral fertilizers (A)	Bio and organic fertilizers(B)	45 days	75 days	45 days	75 days
Full	Control	15.67	25.67	0.103	1.74
	Compost	22.00	34.00	0.130	1.81
	Compost + Mycorrhizae	23.33	35.00	0.143	2.02
	Compost + Cerealine	25.00	38.00	0.147	2.03
	Compost+ Mycorrhizae+ Cerealine	27.00	38.33	0.153	2.05
	Mycorrhizae	18.33	28.00	0.113	1.84
	Mycorrhizae + Cerealine	19.00	30.67	0.120	1.96
	Cerealine	19.00	29.67	0.107	1.88
Mean[a]		**21.17**	**32.42**	**0.127**	**1.92**
Half	Control	11.00	16.00	0.077	1.32
	Compost	14.00	22.00	0.100	1.73
	Compost + Mycorrhizae	15.00	23.67	0.097	1.77
	Compost + Cerealine	16.33	24.00	0.097	1.71
	Compost+ Mycorrhizae+ Cerealine	15.33	25.00	0.103	1.79
	Mycorrhizae	12.00	18.67	0.090	1.32
	Mycorrhizae + Cerealine	13.67	22.00	0.093	1.40
	Cerealine	13.00	20.67	0.090	1.34
Mean[a]		**13.79**	**21.50**	**0.093**	**1.55**
Mean [b]	Control	13.33	20.83	0.090	1.53
	Compost	18.00	28.00	0.115	1.77
	Compost + Mycorrhizae	19.17	29.33	0.120	1.90
	Compost + Cerealine	20.67	31.00	0.122	1.87
	Compost+ Mycorrhizae+ Cerealine	21.17	31.67	0.128	1.92
	Mycorrhizae	15.17	23.33	0.102	1.58
	Mycorrhizae + Cerealine	16.33	26.33	0.107	1.68
	Cerealine	16.00	25.67	0.098	1.61
L.S.D at 0.05	a	**0.687**	**0.697**	**0.004**	**0.282**
	b	**1.372**	**1.393**	**0.009**	**0.564**
	a× b	1.942	1.970	0.012	0.798

Yield and yield components

The results in table (7) show clearly that mineral, biological and organic fertilizers and the interaction between them had significant effects on siliqua number, seed index and seed yield per plant in canola plants in both seasons. The application of full NPK mineral fertilizer gave higher values in siliqua number, seed index and seed yield per plant in both seasons, compred with half NPK mineral fertilizer. Application of all biological and organic fertilizers with full NPK gave higher values of yield and its components compared with the control. Combining Compost+ Mycorrhizae + Cerealine with half NPK, showed no significant difference when compared with the control. As for the seed yield per plant, there was no significant difference between the control, compost, Compost+ Mycorrhizae, Compost+

Cerealine and Compost+ Mycorrhizae + Cerealine with half NPK. These results reveal the importance of using bio and organic fertilizers to overcome the problems resulting from the excessive use of mineral fertilizers. However, the results from table (7) show that half NPK +Mycorrhizae only had the greatest significant difference when compared with the control. This suggests that mycorrhiza alone does not achieve the purpose of the study.

Table (7): Effect of Mineral (NPK), Bio and Organic Fertilizers on yield and yield components of canola plants in 2004 and 2005.

Treatments		Siliqua number		Seed index (gm)		Seed yield per plant (gm)	
NPK Mineral fertilizers (A)	Bio and organic fertilizers(B)	2004	2005	2004	2005	2004	2005
Full	Control	80.33	83.33	3.31	3.41	8.24	9.22
	Compost	92.33	94.67	3.65	3.72	11.15	12.50
	Compost + Mycorrhizae	93.67	94.67	3.69	3.80	11.04	12.67
	Compost + Cerealine	92.00	95.00	3.77	3.83	11.34	12.33
	Compost+ Mycorrhizae+ Cerealine	95.33	98.00	3.86	3.90	12.00	13.00
	Mycorrhizae	84.67	85.67	3.40	3.50	8.38	10.00
	Mycorrhizae + Cerealine	86.00	89.00	3.47	3.55	9.00	10.67
	Cerealine	85.33	86.67	3.45	3.52	8.67	10.33
Mean[a]		**88.71**	**90.88**	**3.58**	**3.65**	**9.98**	**11.34**
Half	Control	69.33	71.67	2.91	2.85	6.77	7.45
	Compost	78.33	80.33	3.15	3.25	7.90	8.67
	Compost + Mycorrhizae	78.67	79.00	3.20	3.27	7.67	8.90
	Compost + Cerealine	79.00	81.33	3.23	3.30	7.80	8.60
	Compost+ Mycorrhizae+ Cerealine	79.67	82.33	3.28	3.36	8.00	8.97
	Mycorrhizae	72.67	74.00	3.00	3.03	6.95	7.90
	Mycorrhizae + Cerealine	73.00	75.33	3.10	3.15	7.09	7.67
	Cerealine	72.00	74.00	3.05	3.10	7.00	7.57
Mean[a]		**75.33**	**77.08**	**3.12**	**3.16**	**7.40**	**8.22**
Mean [b]	Control	74.83	77.50	3.11	3.13	7.51	8.34
	Compost	85.33	87.50	3.40	3.49	9.53	10.52
	Compost + Mycorrhizae	86.17	86.83	3.45	3.53	9.35	10.78
	Compost + Cerealine	85.50	88.17	3.50	3.56	9.57	10.47
	Compost+ Mycorrhizae+ Cerealine	87.50	90.17	3.57	3.63	10.00	10.99
	Mycorrhizae	78.67	79.83	3.20	3.27	7.73	9.28
	Mycorrhizae + Cerealine	79.50	82.00	3.29	3.35	8.00	8.95
	Cerealine	78.67	80.33	3.25	3.31	7.81	8.83
L.S.D 0.05	a	**0.495**	**0.546**	**0.017**	**0.020**	**0.301**	**0.359**
	b	**0..99**	**1.091**	**0.033**	**0.040**	**0.603**	**0.719**
	axb	**1.401**	**1.544**	**0.047**	**0.056**	**0.852**	**1.017**

Percentage and content of oil in canola seeds

Data in Table (8) showed that, the highest oil percentage was obtained with half NPK + Compost + Mycorrhizae + Cerealine, while the lowest oil percentage was obtained with Full NPK + Compost + Cerealine. This can be attributed to the excessive levels in nitrogen which reduce the oil content of canola. Devi *et al.* (2003) stated that crop yield of *Brassica oleracea* was highest with the application of 50% recommended N + 25% poultry manure + biofertilizers. Rathke *et al.* (2005) compared the effect of 0, 80, 160, and 240 kg N/ha and found that under high N rate, the lowest oil contents were observed.

The results in Table (9) clearly indicate the effectiveness of half NPK with the combination of compost + cerealine + mycorrhizae treatment which resulted in an increase in the value of seed oil content (g\plant) that exceeded the comparable value of the control plants of full NPK treatment.

Table (8): Effect of Mineral (NPK), Bio and Organic Fertilizers on oil percentage of canola plants in 2005.

Bio and Organic Fertilization	Mineral Fertilization NPK	
	Full NPK (%)	Half NPK (%)
Control	34.26	33.88
Compost	32.44	34.32
Compost + Mycorrhizae	33.69	34.59
Compost + Cerealine	31.07	35.53
Compost + Mycorrhizae + Cerealine	31.13	35.63
Mycorrhizae	32.30	33.39
Mycorrhizae + Cerealine	32.84	34.92
Cerealine	31.21	33.13

Table (9): Effect of Mineral (NPK), Bio and Organic Fertilizers on seed oil content (g\plant) of canola plants in the second season 2005-2006.

Bio and Organic Fertilization	Mineral Fertilization NPK	
	Full NPK	Half NPK
Control	315.88	252.41
Compost	405.50	297.55
Compost + Mycorrhizae	426.85	307.85
Compost + Cerealine	383.09	305.56
Compost + Mycorrhizae + Cerealine	404..69	319.60
Mycorrhizae	323.00	252.76
Mycorrhizae + Cerealine	350.40	275.87
Cerealine	322.40	254.11

Conclusion

The obtained results here clearly confirmed the positive effects of bio and organic fertilization on growth and yield of canola plants either under half or full NPK dose which recorded significant increments in comparison with the control plants. In addition, the treated plants with the combination of half

NPK+ compost+ cerealine+ mycorrhizae were able to approach their optimal productivity which nearly similar to the control plants of full NPK treatment. Moreover, the percentage of oil was increased in seeds of canola plants treated with the half NPK+ the combinations of compost, compost+ cerealine, compost+ mycorrhizae and compost+ cerealine+ mycorrhizae in comparison with the control plants of full NPK. Furthermore, the value of seed oil content (g\plant) of half NPK + compost+ cerealine+ mycorrhizae was exceeded the comparable value of the control plants of full NPK treatment. Therefore, these results strongly suggest that it could be reduce the amount of NPK mineral fertilizers to the half dose to achieve the same yield of canola plants treated with full NPK dose when bio and organic fertilizers used, which lead to economical and environmental benefits through reducing the cost and the harmful effects of mineral fertilizers on the environment.

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تأثير الكمبوست و التسميد الحيوي علي إنتاجية نبات الكانولا

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اجري هذا البحث بهدف دراسة تأثير الكمبوست و التسميد الحيوي علي صفات النمو و المحصول و نسبة الزيت لنبات الكانولا مع استخدام مستويين من التسميد المعدني (٥٠ و ١٠٠ % من المعدل الموصي به).

أقيمت تجارب البحث داخل الصوبة الخاصة بفرع فسيولوجيا النبات بكلية الزراعة, جامعة القاهرة خلال موسمين متتاليين ٢٠٠٤-٢٠٠٥ و ٢٠٠٥-٢٠٠٦. أثبتت النتائج المتحصل عليها التأثيرات الإيجابية لإضافة الأسمدة الحيوية و الكمبوست علي صفات النمو و المحصول لنباتات الكانولا حيث سجلت زيادة معنوية بالمقارنة بنباتات الكنترول سواء تحت مستوي النصف أو الجرعة الكاملة الموصي بها من التسميد المعدني فقط. و قد أظهرت النتائج أن نسبة الزيت قد ازدادت في بذور النباتات المعاملة بالتسميد الحيوي + الكمبوست تحت مستوي النصف التسميد المعدني بالمقارنة بنباتات الكنترول تحت مستوي الجرعة الكاملة من التسميد المعدني فقط كذلك أظهرت النتائج أن قيمة المحتوي الكلي للزيت \ النبات قد ازدادت عما سجلته نباتات الكنترول المعاملة بالجرعة الكاملة من التسميد المعدني فقط. وتشير نتائج هذه الدراسة إلي انه في حالة استخدام الأسمدة الحيوية و الكمبوست يمكن خفض كمية الأسمدة المعدنية الموصي بها إلي النصف مما يؤدي إلي تحقيق فوائد اقتصادية و بيئية من خلال خفض التكلفة و التأثيرات الملوثة للتسميد المعدني علي البيئة .