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SOWING METHODS OF CANOLA UNDER DIFFERENT LEVELS OF ORGANIC AND MINERAL FERTILIZATION IN CALCAREOUS SOILS.

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ABSTRACT

Three field experiments were carried out in the Experimental Station of Desert Research Center at Maruyt, Western Delta during 2001, 2002 and 2003 winter seasons, respectively to study the effect of sowing methods (direct seeding and transplanting), applying three levels of ammonium sulphate (0, 20 and 40 kg N per feddan) and two amounts of compost (0 and 10 m^3 per feddan), on growth, yield and its components of canola (*Brascia napus* L) of Pactol variety.

Using the transplanting technique for canola cultivation under the new reclaimed soil conditions led to increase significantly all studied growth characters i.e. (plant height/ cm, plant fresh and dry weight/ g, leaf area index "LAI"), total pigments, total chlorophyll, and yield and its attributes i.e. plant survival at harvest (%), no. of branches per plant, no. of seeds per siliqua, weight of seeds per siliqua (mg), biological yield ton/fed., seed yield ton/fed., 1000 seed weight (g), oil % and oil yield ton/fed).

Canola growth characters, yield and its components, survived plants% at harvest and seed oil% were significantly increased by increasing N fertilization up to 40 kg N/ fed as ammonium sulphate (20.5 % N).

Applying compost as soil amendment significantly increased canola growth characters, yield and its components in addition to percentage of survival plants at harvest.

First and second orders of interactions in general increased all the studied characters significantly. Higher observations obtained from the combination of (transplanting × 40 kg N/fed), (transplanting × 10 m^3/fed of organic manure), (10 m^3/fed of organic manure × 40 kg N/fed) and (transplanting × 10 m^3/fed of organic manure × 40 kg N/fed).

Keywords: Canola, *Brascia napus* , transplanting, compost, N levels, growth characters, yield, yield attributes.

INTRODUCTION

Rapeseed (*Brascia napus*) is one of the important oil crops in the world, ranked the second after soybean concerning seed and oil production worldwide cultivated area, (Anonymous,2005). Recently in Egypt, it became as a new oil seed crop particularly under a wide range of soils in the new reclaimed areas as mentioned by (Mahrous,1991; Kandil *et al.*,1996 and Sharaan and Ghallab, 2002).

Transplanting technique may be useful to evade the stressed conditions prevailing during canola growing period especially under the new reclaimed soil conditions, where rain sometimes is the only available source of water irrigation. It increase the rain use efficiency (RUE), thus encourage all plant growth characters, yield and its components. Moreover, it ensures getting an appreciated yield if compared with normal seeding method under

stressful conditions, which sometimes fall to get any yield, as reported by (Anonymous, 1974; 1976 and Hassany, 2005).

Nitrogen is one of the major inputs of rape seed and oil production. In this concern, Abel-Gawad *et al.,* (1990) reported that the highest seed and oil yield/fed were obtained from applying 60kg N + 45 kg K_2O/ fed. In addition, plant growth characters, yield components beside oil seed were found to be increased significantly by increasing N fertilization rate up to 100 kg N/fed (Hassan, 1993; Hassan and El-Hakeem, 1996 and Ahmed *et al.,* 1998).

Compost (complete fermented organic materials) is an eco-friendly fertilizer. It is positively improve soil chemical and physical properties. It provides the plants with both major and minor elements after hydrolysis in the soil producing humic acid which plays a very important role in soil pH reduction. Many investigators reported that compost can act positively in controlling soil borne diseases within encouraging the plant nutrition , thus improve the plant metabolism therefore it increase the plant growth and yield as well. (Logsdon, 1993 and Hoitink *et al.,* 1993).

The target of this study is to scrutinize the effect of transplanting technique, different levels of nitrogen fertilizer and compost application on growth, yield and associated soil borne diseases of canola (*Brascia napus* L) under the new reclaimed calcareous soil conditions.

MATERIALS AND METHODS

Three field experiments were carried out in the Experimental Station of Desert Research Center at Maruyt, Western Delta during 2001, 2002 and 2003 winter seasons, respectively to study the effect of agricultural method treatments i.e. (direct seeding and transplanting technique), applying nitrogen fertilization treatments as (three levels of ammonium sulphate (20.5 % N) namely 0, 20 and 40 kg N per feddan) and different amounts of Maruyt compost i.e (0 and 10 m^3 per feddan) , on growth, yield and associated soil borne diseases of canola (*Brascia napus* ,L) Pactol variety.

The mechanical and chemical properties of the experimental soil at 30 cm depth are presented in Tables 1 and 2, while Maryut compost chemical properties were presented in Table 3.

Table 1: Mechanical properties of Maryut experimental soil (mean of 2001, 2002 and 2003 seasons):

O.M	Particle size distribution (mm)				
	Course Sand	Fine Sand	Silt	Clay	Class texture
0.67	14.38	37.17	23.29	25.16	Sandy Clay Loam

Table 2: Chemical properties of Maryut experimental soil (mean of 2001, 2002 and 2003 seasons):

pH	Ca Co3 %	E.C dsm^{-1}	Saturation soluble extract							
			Soluble anions (meq/L.)				Soluble cataions (meq/L.)			
			CO^{-3}	HCO^{-3}	SO^{-4}	CL^{-}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}
7.6	23.38	1.43	-	4.75	3.98	6.38	5.0	3.75	6.15	0.27

Table 3: Chemical analysis of Maryout compost

Moisture Content	Organic Matter	C/N Ratio	PH	Available %			ppm			S%
				N	P	K	Z	Mn	Fe	
8.3%	30.2%	18.1	7.3-7.1	2.15	1.14	1.25	2.1	3.9	4.2	0.25

The soil of the nursery was well-prepared and 15 kg P_2O_5/fed as calcium super-phosphate were incorporated. Seeds of canola of Pactol variety was sown in the nursery on 10th of October in the three studied seasons, as drill in the rows at a rate of 6 kg/fed. When seedlings 6 weeks old were available, they were transplanted in the permanent field along with the direct seeding. Seedlings were cultivated as one/seedling per hill in the rows, 50 cm apart, and 12.5 cm in between to obtain 16 plants/ m^2 as a plant density.

Regarding direct seeding, 3-5 seeds/ hill, with 12.5 cm apart in between were seeded, and were thinned to one plant/hill after 3 weeks from sowing date.

Prior to transplanting and during soil preparation of the experiment, calcium super-phosphate (15.5 % P_2O_2) was added at rate of 200 kg / fed. However, potassium sulphate (48% K_2O), while nitrogen as ammonium sulphate (20.5 % N) was added during the experiment following the schedule of N treatments as mentioned before in two equal doses the first after three weeks from sowing date, and the second after two weeks later.

Treatments were arranged in split-split plot design with six replicates; three of them were used to study the growth characters, while the rest were kept for yield and its attributes determination. Sowing method treatments i.e. (direct seeding, seedlings) occupied the main plots, compost treatment in sub-plots and ammonium sulphate in the sub-sub plots. The plot area was 10.5 m^2 (3m x 3.5 m) containing 6 rows (3.5 long and 50 cm apart).

Weed control was carried out after 2 weeks from transplanting by hand pulling and by hoeing 3 weeks later. However the common agricultural practices for growing canola were applied.

During canola growth, five guarded plants were taken randomly from three replicates after 7 weeks from sowing date to record the following data; growth charters i.e. plant height (cm), plant fresh and dry weight (g), leaf area index (LAI) and total pigments which was measured using SPDA-502 leaf chlorophyll meter, and then converted into total chlorophyll (a+b) as µmole m^{-2} following the method published by John *et al.*, (1988). Yield and its attributes i.e. Plant survival at harvest(%), no. of branches per plant, no. of seeds per siliqua, weight of seeds per siliqua (mg) , biological yield ton/fed., seed yield ton/fed., 1000 seed weight (g), oil % and oil yield ton/fed were also determined at harvest time, which was for direct seeding (142, 156 and 158) and for transplanting (127, 141 and 143) days after sowing date in the permanent field during the three studied seasons respectively. Oil content of seeds was determined by using Soxhelt apparatus and hexane (boiling point 65-70 °C) as a solvent according to A.O.A.C. (1975). Oil yield was calculated by multiplying seed yield kg/fed. by oil percentage.

Data of all parameters were exposed to the proper statistical combined analysis method according to the ANOVA procedure given by Snedecor and Cochran (1967). Duncan's multiple range test was used to verify the significant differences between mean treatments as described by Duncan (1955).

RESULTS AND DISSCUSSION

I. Effect of Sowing methods:

a. On growth characters, total pigments and total chlorophyll content:

As presented in Table 4, results indicated that using the transplanting technique in canola cultivation increased significantly plant height/cm, plant fresh and dry weight/g , leaf area index (LAI), total pigments/ SPDA units and total chlorophyll as μ mole m^{-2} . This may be as an outcome of the elongation which happened in the vegetative growth period as a direct gain of using transplanting technique compared with direct seeding methods as illustrated in fig (1-C). Following the fiction telling that, early sown crop is capable to complete its vegetative phase successfully in favorable climatic conditions (Brar *et al.*, 1998). Similar observation were found by Thakur and Singh, (1998) who found that early planted crop of some *Brassica* species had superior growth characters particularly plant height.

b. On percentage of survival plants at harvest , yield and its attributes:

Results presented in Table 4 indicated that, canola yield and its attributes beside the percentage of survival plants at harvest time were increased significantly by using transplanting technique as canola agricultural method compared with direct seeding one. This may be is an upshot of the longer growth period accessible for canola transplants compared with those cultivated by direct seeding method as shown in fig (1-C). Meanwhile, when lower temperatures accompanied with significant reduction in the evapotranspiration rate are presented particularly at maturity, it elongates the maturity period (Fig-1), through delaying synthesis and generating juveniility, which increased the plant capability of photosynthesis and enhance source/sink relationship (Kumar and Shaktawat, 1992 and Shivani and Kumar,2002). Similar observations were found by (Gupta, 1994) who reported that days to flowering and maturity of direct seeded canola were reduced by 14 days at least, thus vacated the field a fortnight earlier compared with transplanted one.

It could be concluded that, transplanting technique is recommended rather than the direct seeding method especially under the stressful conditions (The dominant environmental conditions in the studied region), where there are always inadequate environmental elements to allow plant finishing its life cycle successfully. As it well known, each plant have certain growth stages in its life cycle i.e. vegetative, reproductive and maturity growth stages and each one had its requirements of the environmental conditions to satisfy before the plant can shift from one to another growth stage. Transplanting made the plant capable to use efficiently the favorable environmental conditions which are available at the beginning of the growth stage particularly rain water , and end its life cycle earlier with an appreciated yield compared with direct seeding method (Fig 1-C).

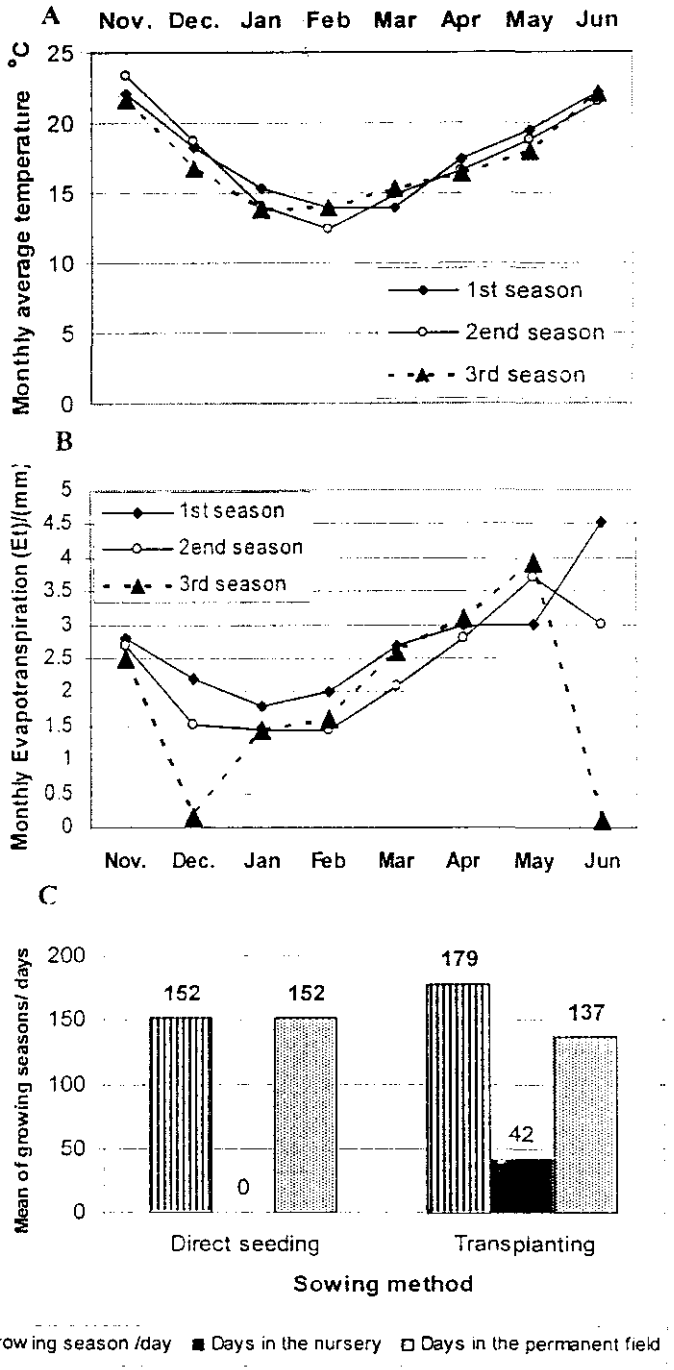

Fig 1: Canola (*Brascia napus*, L) mean of growing seasons /day (C), as affected by (A) monthly average temperature °C, and (B) monthly evapotranspiration (Et)/(mm) during 2000, 2001 and 2002 seasons.

Table 4: Effect of sowing method, nitrogen fertilization levels and organic manure on growth characters, total pigments and chlorophyll contents, percentage of survival plants, yield and its attributes of canola variety Pactol (combined analysis of 2001, 2002 and 2003 growing seasons).

Treatments	Certain parameters														
	Plant height (cm)	Plant fresh weight (g)	Plant dry weight (g)	Leaf area index	Total Pigments /SPDA units	Total Chlorophyll µ mole m^{-2}	Survival plants at harvest (%)	No. branches /plant	No. seeds /siliqua	Siliqua seeds weight (mg)	Biological yield ton/fed	Seed yield ton/fed	1000 seed weight (g)	Oil (%)	Oil yield ton/fed
Sowing method															
Direct seeding	33.8 b	57.0 b	6.9 b	5.2 b	40.1 b	466.8 b	65.8 b	7.6 b	26 b	64.3 b	4.7 b	0.51 b	2.75 b	46.2 b	0.24 b
Transplanting	64.8 a	211.2 a	42.4 a	10.2 a	51.8 b	706.7 a	88.8 a	10 a	27.1 a	72.8 a	7.7 a	0.68 a	3.05 a	49.8 a	0.32 a
Nitrogen fertilization levels															
0 kg N/fed	33.7 c	43.7 c	5.5 c	4.9 c	39.3 c	452.5 c	60.9 c	7.3 c	23.6 c	63.4 c	3.89 c	0.48 c	2.71 c	45.3 c	0.23 c
20 kg N/fed	46.5 b	117.7 b	13.6 b	7.6 b	45.8 b	580.2 b	77.7 b	8.7 b	25.2 b	68.5 b	6.23 b	0.59 b	2.91 b	47.9 b	0.28 b
40 kg N/fed	67.6 a	240.9 a	27.8 a	10.6 a	52.7 a	727.6 a	93.3 a	10.3 a	27.3 a	73.9 a	8.55 a	0.71 a	3.07 a	50.8 a	0.32 a
Organic manure as "Maryout compost"															
0 m^3 /fed	46.1 b	115.3 b	13 b	6.9 b	44.6 b	558.8 b	74.8 b	8.5 b	24.8 b	67.5 b	5.78 b	0.58 b	2.88 b	47.6 b	0.27 b
10 m^3 /fed	52.6 a	158 a	18 a	8.5 a	47.3 a	614.7 a	79.8 a	8.1 a	25.6 a	68.7 a	6.66 a	0.61 a	2.94 a	48.4 a	0.28 a

- **Means having similar letters in same row are not significantly differed at P ≥ 0,05.**

Effect of Nitrogen fertilization treatments:

c.On growth characters, total pigments and total chlorophyll content:

As indicated in Table 4, all studied growth characters were significantly increased by adding nitrogen fertilization up to 20 N units /fed. These results may be explained on the basis that nitrogen is essential for building up protoplast and proteins which induce cell division and elongation and this reflected on the progress happened in plant height, fresh and dry weight, leaf area index. While the increment happened in total pigments and chlorophyll content were as a result of endogenous promoters accumulation including cytokinines which act as a precursor of such photosynthetic pigments. (Salisbury, and Ross, 1992). Similar results are obtained by (Hassan, 1993; and Hassan and El-Hakeem , 1996).

d.On percentage of survival plants at harvest , yield and its attributes:

Results illustrated in Table 4 indicates that canola yield and its attributes in addition to percentage of survival plants at harvest, were significantly increased as a result of increasing N fertilization up to 40 N unit per fed.. following the results observed by (Hassan, 1993; and Hassan and El-Hakeem , 1996). This could be as a product of the enhancement happened in the plant growth, which led to increase its capability to photosynthesis and enriching the source to sink relationship beside the enlargement happened in the sink through plant growth improvement. Meanwhile, the significant increase happened in the oil yield came directly from the increment happened in seed yield and oil %. (Ahmed *et al.*, 1998)

II. Effect of Organic manure application:

a. On growth characters, total pigments and total chlorophyll content:

Results in Table 4 indicated that applying compost as a organic manure to the experimental soils significantly increased all canola growth characters as a result of the significant mineralization of the macro and micro elements particularly nitrogen , which led to increase the minerals availability to the plants. Moreover, applying compost led to produce the humic acid which plays a very important role in reducing the soil pH particularly under calcareous soils conditions,(Eghball, 2000).

b.On parentage of survival plant at harvest , yield and its attributes :

As indicated in Table 4, applying compost into the experimental soil as a soil amendment increased significantly canola yield and its attributes; also it increased the percentage of survival plants at harvest date compared with un-composted treatment. These may be out of the favorable enrichment happened in the soil fertility and texture which led to increase the canola growth thus yield and its attributes though enhancing the source to sink relations, similar results obtained by (Hammad *et al.*, 1999 and Eghball, 2002)

III. Effect of interactions:

a. On growth characters, total pigments and total chlorophyll content:

As presented in Tables 5, 6, and 7 , all first order of interactions including (sowing method x organic manure),(sowing method x nitrogen fertilization levels) and (organic manure x nitrogen fertilization levels) encouraged significantly all studied growth characters in addition to total pigments and chlorophyll content.

Table 5: Effect of the interaction between sowing method and nitrogen fertilization levels on growth characters, total pigments and chlorophyll contents, percentage of survival plants, yield and its attributes of canola variety Pactol (combined analysis of 2001, 2002 and 2003 growing seasons).

Treatments / Certain Parameters	Sowing Method					
	Direct seeding method			Transplanting method		
	Nitrogen fertilization rate					
	N1	N2	N3	N1	N2	N3
Growth characters						
Plant height (cm)	17.8 f	28.1 e	55.5 c	49.9 d	64.9 b	79.7 a
Plant fresh weight (g)	2.48 f	32.6 e	135.9 c	84.9 d	202.9 b	346 a
Plant dry weight (g)	0.99 e	4.37 e	15.35 c	10.07 d	22.91 b	40.34 a
Leaf area index	1.25 e	4.73 d	9.57 bc	8.51 c	10.48 ab	11.59 a
Total Pigments /SPDA units	32.05 f	39.24 e	48.89 c	46.49 d	52.42 b	56.53 a
Total chlorophyll µ mole m^{-2}	321.2 f	443.5 e	635.7 c	583.9 d	716.9 b	819.4 a
Yield and its components						
Survival plants at harvest (%)	51.94 f	61.77 e	83.6 c	69.8 d	93.67 b	102.9 a
No. of branches / plant	6.3 f	7.35 e	9.1 c	8.35 d	10.1 b	11.6 a
No of seeds per siliqua	22.2 f	23.6 e	26.0 c	24.9 d	26.9 b	28.6 a
Siliqua seeds weights (mg)	59.4 f	63.9 e	69.7 c	67.4 d	73.1 b	78 a
Biological yield ton/fed	2.83 f	4.20 e	7.20 c	4.95 d	8.25 b	9.9 a
Seed yield ton /fed	0.39 f	0.48 e	0.66 c	0.57 d	0.70 b	0.77 a
1000 seed weight (g)	2.58 f	2.74 e	2.93 c	2.84 d	3.08 b	3.22 a
Oil (%)	44.03 f	45.20 e	49.28 c	46.63 d	50.60 b	52.23 a
Oil yield ton/fed	0.18 f	0.23 e	0.30 c	0.28 d	0.32 b	0.34 a

N1 = 0 kg N/fed N2 = 20 kg N/fed N3 = 40 kg N/fed

- **Means having similar letters in same row are not significantly differed at P ≥ 0.05.**

Table 6: Effect of the interaction between sowing method and organic manure on growth characters, total pigments and chlorophyll contents, percentage of survival plants, yield and its attributes of canola variety Pactol (combined analysis of 2001, 2002 and 2003 growing seasons).

Treatments / Certain Parameters	Sowing method			
	Direct seeding		Transplanting	
	Organic manure as Maryout compost			
	Without	With 10 m^3/fed	Without	With 10 m^3/fed
Growth characters				
Plant height (cm)	30.4 d	37.2 c	61.7 b	67.9 a
Plant fresh weight (g)	41.8 c	72.2 c	188.7 b	233.8 a
Plant dry weight (g)	5.59 c	8.22 c	21.11 b	27.77 a
Leaf area index	3.99 c	6.36 b	9.85 a	10.54 a
Total Pigments /SPDA units	38.31 c	41.81 b	50.79 a	52.83 a
Total chlorophyll µ mole m^{-2}	435.2 d	498.4 c	682.4 b	731.1 a
Yield and its components				
Survival plants at harvest (%)	63.2 c	68.4 b	86.4 a	91.2 a
No. of branches / plant	7.31 d	7.85 c	9.60 b	10.38 a
No of seeds per siliqua	23.53 d	24.37 c	26.42 b	27.15 a
Siliqua seeds weights (mg)	63.08 d	65.58 c	71.92 b	73.77 a
Biological yield ton/fed	4.28 d	5.20 c	7.28 b	8.12 a
Seed yield ton /fed	0.49 b	0.52 b	0.67 a	0.69 a
1000 seed weight (g)	2.71 d	2.79 c	3.00 b	3.09 a
Oil (%)	45.72 b	46.62 b	49.45 a	50.18 a
Oil yield ton/fed	0.23 b	0.25 b	0.31 a	0.32 a

- **Means having similar letters in same row are not significantly differed at P ≥ 0.05.**

Table 7: Effect of the interaction between organic manure and nitrogen fertilization levels on growth characters, total pigments and chlorophyll contents, percentage of survival plants, yield and its attributes of canola variety Pactol (combined analysis of 2001, 2002 and 2003 growing seasons).

Treatments / Certain Parameters	Organic manure (as Maryout compost)					
	Without			With 10 m^3/fed		
	Nitrogen fertilization rate					
	N1	N2	N3	N1	N2	N3
Growth characters						
Plant height (cm)	32.7 d	35 cd	40.8 c	52.2 b	64.7 a	70.4 a
Plant fresh weight (g)	36.1 c	51.2 c	86.3 c	149.1 b	223.4 a	258.6 a
Plant dry weight (g)	4.75 c	6.31 c	9.52 c	17.76 b	25.78 a	29.91 a
Leaf area index	4.37 b	5.39 b	6.17 b	9.03 a	10.22 a	10.94 a
Total Pigments /SPDA units	38.26 d	40.28 d	43.82 c	47.85 b	51.59 a	53.84 a
Total chlorophyll µ mole m^{-2}	434.5 e	470.6 e	542.2 d	618.3 c	699.8 b	755.4 a
Yield and its components						
Survival plants at harvest (%)	57.9 d	63.8 d	76.4 c	79.1 c	90.1 b	96.5 a
No. of branches / plant	7.00 f	7.65 e	8.43 d	9.00 c	9.95 b	10.7 a
No of seeds per siliqua	23.1 e	24.1 d	25.0 c	25.5 c	26.9 b	27.8 a
Siliqua seeds weights (mg)	62.0 f	64.8 e	67.6 d	69.4 c	72.9 b	74.9 a
Biological yield ton/fed	3.3 e	4.48 d	6.0 c	6.5 c	8.1 b	9.0 a
Seed yield ton /fed	0.47 c	0.50 c	0.58 b	0.61 b	0.70 a	0.72 a
1000 seed weight (g)	2.66 f	2.76 e	2.87 d	2.96 c	3.04 b	3.11 a
Oil (%)	44.8 c	45.9 c	47.8 b	48.0 b	50.2 a	51.4 a
Oil yield ton/fed	0.22 d	0.24 d	0.26 c	0.29 b	0.32 ab	0.33 a

N1 = 0 kg N/fed N2 = 20 kg N/fed N3 = 40 kg N/fed

Means having similar letters in same row are not significantly differed at P ≥ 0.05.

Likewise, the second order interaction as presented in Table 8 which increases significantly all the studied growth characters, total pigments and chlorophyll content. Higher observations obtained from the combination of (transplanting × 10 m^3/fed organic manure× 40 kg N/fed).

On percentage of survival plants at harvest , yield and its attributes:

Results illustrated in tables 5, 6, 7 and 8 indicated that, all first and second order interactions were permissible to enhance significantly canola percentage of survival plants at harvest time, yield and its attributes. Higher results obtained from the combination of (transplanting × 40 kg N/fed), (transplanting × 10 m^3/fed of organic manure), (10 m^3/fed of organic manure × 40 kg N/fed) and (transplanting × 10 m^3/fed of organic manure × 40 kg N/fed).

Table 8: Effect of the interaction between sowing method, organic manure and nitrogen fertilization levels on growth characters, total pigments and chlorophyll contents, percentage of survival plants, yield and its attributes of canola variety Pactol (combined analysis of 2001, 2002 and 2003 growing seasons).

Treatments / Certain Parameters	Sowing Method											
	Direct seeding method						Transplanting method					
	Organic manure (as Maryout compost)											
	Without			With 10 m^3/fed			Without			With 10 m^3/fed		
	Nitrogen fertilization rate											
	N1	N2	N3	N1	N2	N3	N1	N2	N3	N1	N2	N3
Growth characters												
Plant height (cm)	17.1 i	18.7 i	19.9 i	36.4 h	54.2 ef	56.7 e	48.4 g	51.4 f	61.7 d	68.1 c	75.2 b	84.2 a
Plant fresh weight (g)	2.4 i	2.6 i	2.8 i	62.4 h	120.3 f	151.7 e	69.9 h	99.9 g	169.9 d	235.9 c	326.4 b	365.6 a
Plant dry weight (g)	0.9 h	1.0 h	1.1 h	7.6 g	14.7 e	16.0 de	8.5 g	11.6 f	17.9 d	27.9 c	36.9 b	43.8 a
Leaf area index	0.6 k	1.9 j	2.1 j	7.3 i	9.3 f	9.9 e	8.1 h	8.9 g	10.2 d	10.7 c	11.2 b	12.1 a
Total Pigments /SPDA units	31 j	33.1 i	35.7 h	42.8 g	48.2 de	49.6 d	45.6 f	47.4 e	51.9 c	52.9 c	54.9 b	58.1 a
Total chlorophyll µ mole m^{-2}	304.6 j	337.7 i	379.8 h	504.2 g	621.1 de	650.3 d	546.3 f	603.5 e	704.5 c	729.3 c	778.4 b	860.4 a
Yield and its components												
Survival plants at harvest (%)	48.6 j	55.3 i	60.4 h	63.2 h	80.5 e	86.7 d	67.2 g	72.4 f	92.4 c	94.9 c	99.6 b	106.3 a
No. of branches / plant	5.95 k	6.65 j	7 i	7.7 h	9 e	9.2 e	8.1 g	8.7 f	9.9 d	10.3 c	10.9 b	12.2 a
No of seeds per siliqua	21.4 g	23.1 f	23.6 f	23.7 f	25.7 de	26.4 cd	24.8 e	25 e	26.4 cd	27.3 bc	28 b	29.2 a
Siliqua seeds weights (mg)	57.4 h	61.4 g	62.6 g	65.3 f	69.3 d	70.2 d	66.7 ef	68.2 de	72.7 c	73.6 c	76.5 b	79.6 a
Biological yield ton/fed	1.9 j	3.8 i	4.2 h	4.3 h	6.8 e	7.6 d	4.7 g	5.2 f	7.8 d	8.7 c	9.4 b	10.5 a
Seed yield ton /fed	0.37 i	0.42 h	0.46 g	0.5 f	0.64 c	0.67 c	0.56 e	0.59 d	0.70 b	0.71 b	0.76 a	0.78 a
1000 seed weight (g)	2.52 j	2.60 h	2.71 g	2.78 f	2.90 e	2.96 d	2.80 f	2.89 e	3.03 c	3.13 b	3.19 b	3.25 a
Oil (%)	43.5 j	44.6 i	45.1 hi	45.3 h	48.6 e	50.0 d	46.2 g	47.1 f	50.5 cd	50.7 c	51.7 b	52.8 a
Oil yield ton/fed	0.17 j	0.19 i	0.21 h	0.26 g	0.29 de	0.30 d	0.28 f	0.29 ef	0.32 c	0.33 b	0.34 b	0.35 a

N1 = 0 kg N/fed N2 = 20 kg N/fed N3 = 40 kg N/fed

- **Means having similar letters in same row are not significantly differed at P ≥ 0.05.**

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طرق زراعة الكانولا تحت معدلات مختلفة من التسميد العضوي والمعدني بالأراضي الجيرية

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أقيمت ثلاث تجارب حقلية بمحطة بحوث مريوط التابعة لمركز بحوث الصحراء ، بإقليم غرب الدلتا الساحلي خلال المواسم الشتوية للأعوام ٢٠٠١ ، ٢٠٠٢ ، ٢٠٠٣ علي الترتيب ، لدراسة تأثير إستخدام طريقة الزراعة بالشتل ، والتسميد المعدني بثلاثة معدلات مختلفة من سماد سلفات الأمونيوم هي (صفر ، ٢٠ ، ٤٠ وحدة ن / فدان)، إضافة إلي إستخدام الكمبوست (سماد المكمورة) بمعدلات (صفر ، ١٠ م^{٣} /فدان) ، علي نمو ومحصول الكانولا صنف "بكتول".

أدي إستخدام طريقة الزراعة بالشتل تحت ظروف الأراضي حديثة الإستصلاح إلي زيادة معنوية في كل صفات النمو المدروسة (طول النبات /سم ، الوزن الغض والجاف للنبات/ جم ، دليل مساحة الأوراق) ، إضافة إلي زيادة محتوي النبات من الصبغات الكلية والكلوروفيل الكلي ، وكذلك المحصول ومكوناتة (النسبة المئوية للنباتات الناجية عند الحصاد، عدد الأشطاء /نبات ، عدد البذور/ كبسولة، وزن بذور الكبسولة/مجم ، المحصول البيولوجي و محصول الحبوب طن/فدان ، وزن الـ ١٠٠٠ بذرة ، % للزيت ، محصول الزيت طن/ فدان).

أظهرت النتائج أنه بزيادة التسميد النتروجيني حتي ٤٠ وحدة ن / فدان ، فإن ذلك قد أدي إلي زيادة صفات نمو الكانولا المدروسة معنويا ، إضافة إلي نسبة ومحصول الزيت ، محصول الكانولا و مكوناتة ، إضافة إلي النسبة المئوية للنباتات الناجية عند الحصاد.

أدت إضافة الكمبوست (سماد المكمورة) إلي الكانولا المنزرعة شتلا أو بالبذرة إلي زيادة معنوية في جميع الصفات المدروسة خلال هذة الدراسة مقارنة بتلك التي لم يستخدم فيها الكمبوست.

وجد أن جميع تفاعلات الدرجة الأولي والثانية قد أدت إلي زيادة معنوية في الصفات المدروسة في جميع الحالات . وقد كانت أعلي النتائج المتحصل عليها ناتجة عن التفاعلات الثنائية التالية: (طريقة الزراعة بالشتل مع التسميد النتروجيني بمعدل ٤٠ كجم نتروجين / فدان) ، (طريقة الزراعة بالشتل مع التسميد العضوي بمعدل١٠ م^{٣} /فدان) ، (التسميد العضوي بمعدل ١٠ م^{٣} /فدان مع التسميد النتروجيني بمعدل ٤٠ كجم نتروجين / فدان) إضافة إلي معاملة التفاعل الثلاثي التالي: (طريقة الزراعة بالشتل مع التسميد النتروجيني بمعدل ٤٠ كجم نتروجين / فدان و التسميد العضوي بمعدل١٠ م^{٣} /فدان)