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EFFECTS OF ORGANIC MANURE, MINERAL NITROGEN AND BIO-FERTILIZER APPLICATION ON YIELD, QUALITY AND CHEMICAL COMPOSITION OF PEA (*PISUM SATIVUM* L.)

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ABSTRACT: The scope of this investigation was to study the effects of two organic fertilizer rates (0 and 25 m^3 fad.$^{-1}$), three inorganic nitrogen levels (0, 20 and 40 kg N fad.$^{-1}$) and two biofertilizer inoculation treatments (inoculation with and without *Rhizobium*), as well as their different combinations on green pods, quality and chemical composition of pea. To achieve this goal, two field experiments at the Experimental Station Farm, Faculty of Agriculture, Alexandria University, during the two winter seasons of 1999/2000 and 2000/2001were conducted. The results, generally, indicated that application 25 m^3 organic manure fad.$^{-1}$ and 20 kg N fad.$^{-1}$, gave , significantly, the highest mean values for number and weight of green pods plant^{-1}, green seed weight pod^{-1}, and green pod characters as represented by weight, length and diameter, in both seasons. Seed inoculation with bacteria of genus *Rhizobium* , significantly, increased some of the studied characters in the first season; while, this treatment increased the studied parameters, in the second season. The treatment combinations of 25 m^3 fad^{-1} organic manure + 20 kg N fad.$^{-1}$, 25m^3 organic manure fad^{-1} + biofertilizer inoculation and 20 kg N fad.$^{-1}$ + biofertilizer inoculation, reflected the best effects on all the studied characters in the two winter seasons. The treatment combination among 25 m^3 organic manure fad.$^{-1}$ + 20 kg N fad.$^{-1}$ + biofertilizer inoculation by *Rhizobium* gave the best effects on the green pods yield and its components of pea in the two winter seasons. Application of mineral nitrogen either at the rate of 20 or 40 kg N fad.$^{-1}$ to the grown pea plants increased the concentrations of N, P and K in pea seeds, in both seasons, with only one exception in the case of P in the second season only. Whereas, *Rhizobium*

inoculation, organic manure and all different combinations of the studied factors, first and second-order interactions, did not reflect any significant effect on the concentrations of N. P and K in pea seeds.

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the major leguminous crops in Egypt, due to its enormous nutritional values and multifarous use as green shelled, dried, canned or frozen. Therefore, it is of great importance to improve its production by modifying the cultural practices such as using low levels of nitrogen fertilization and bacterial inoculation together (Abd El-Naby, 1998).

In recent years, man all-over the world began to come back to nature in various fields of life. The beneficial effect of using bio-organic farming system such as composting of organic residues and biofertilizers was documented (Gomaa, 1995). The value of organic fertilizers as a source of nutrients has been reviewed by Peavy and Greig (1972), who stated that organic manures were not soluble, and release nutrients slowly. Field studies have shown that organic fertilizers, significantly, increased N and K uptake and yield of some legume crops (Araujo *et* al., 1982; Mostovoi, 1986; Osman, 1998; Gabr, 2000).

Legumes require a comparatively small amount of nitrogen compared with other vegetable crops. These legumes are associated with symbiotic bacteria that convert atmospheric nitrogen into forms that the plant can use. Concerning the effect of these symbiotic N-fixing bacteria in supplying pea plants with N, Sundstron *et al.* (1982) stated that the application of 25 kg N $ha.^{-1}$ applied at sowing may be beneficial to the plant, as they allow the seedling to make a good start before N-fixation has a chance to occur.

So, this study was directed towards a balanced usage of organic manure, inorganic nitrogen fertilization combined with *Rhizobium* inoculation to optimize the yield and quality of pea.

MTERIALS AND METHODS

Two field experiments were carried out during the winter seasons of 1999/2000 and 2000/2001 at the Agriculture Experimental Station Farm (at Abies), Faculty of Agriculture, Alexandria University, in order to

investigate the effects of organic manure, inorganic nitrogen fertilization and biofertilizer inoculation on green pods yield and quality of pea. The physical and chemical analysis of the soil of the experimental sites were determined according to the methods outlined by Page *et al.* (1982), and the results are shown in Table 1.

Each experiment included 12 treatments, which representing the combinations among two organic fertilizer rates (0 and 25 m^3 $fad.^{-1}$), three inorganic N fertilizer levels (0, 20, 40 kg N $fad.^{-1}$) and two bioferilizer treatments (seeds inoculation with and without the symbiotic N-fixing bacteria of genus *Rhizobium*).

The experimental layout used was spilt-split plot in a randomized complete blocks design with three replications.Organic fertilizer rates were arranged in the main plots, inorganic nitrogen fertilizer levels were assigned to the sub-plots and biofertilizer treatments were distributed in the sub-sub plots. The sub-sub plot area was 8.4 m^2, including three ridges each of 4m long and 70 cm wide. A guard row was left without planting to separate each two adjacent sub-sub plots.

Before planting, cattle manure as a source of organic fertilizer uniformly broadcast and incorporated into the soil. The chemical properties of the used cattle manure were determined according to the published procedures and the results are summarized in Table 2.

Seeds of pea cv. "Master" were inoculated with the symbiotic N-fixing bacteria of genus *Rhizobium*, and then were directly sown on one side of the ridge at 20 cm a part on November 19, 1999 and October 19, 2000. The inorganic nitrogen fertilizer, in the form of ammonium nitrate (33.5% N), was applied to the growing plants at two equal parts; 25 and 35 days after planting. During the growing season, the common recommended cultural practices for the commercial production of pea were carried out. At maturity stage, green pods of each sub - sub plot were harvested and the following measurements were recorded: number and weight of green pods $plant^{-1}$, green seeds pod^{-1} and green pod characters (length, diameter and weight). One hundred grams of green seeds from each sub-sub plot were collected, washed with distilled water, oven dried at 70°C to constant weight and then ground. The concentrations of N, P and K contents in seeds were

Table 1: Physical and chemical properties of the experimental site, during the winter seasons of 1999/2000 and 2000/2001

Properties / Seasons	Physical				Chemical					
	Sand (%)	Silt (%)	Clay (%)	Texture	pH	E.C. ($ds.m^{-1}$)	N (%)	P (p.p.m)	K ($meql^{-1}$)	O.M (%)
1999/2000	44.59	16.81	38.60	Clay-loam	7.8	3.34	0.13	12	0.05	1.27
2000/2001	42.48	14.34	43.10	Clay-loam	7.83	2.56	0.14	13	0.05	2.62

Table 2: Chemical properties of the cattle manure during the winter seasons of 1999/2000 and 2000/2001

Properties / Seasons	N (%)	P (%)	K (%)	pH	O.M (%)
1999/2000	0.98	0.49	0.98	8.08	15.75
2000/2001	0.60	0.39	1.21	8.02	18.25

achieved as outlined in FAO (1980).

All obtained data were statistically analyzed using Costat Software (1985) and the revised L.S.D. test was used to compare the differences among treatment's means as illustrated by Smith (1978).

RESULTS AND DISCUSSIONS

Table 3 shows the main effects of organic manure, inorganic nitrogen and *Rhizobium* inoculation on green pods yield of pea and its characteristics.

Application 25 m^3 cattle manure fad.$^{-1}$, significantly, increased averages number and weight of green pods plant^{-1} and green seed weight pod-1, compared with those of the check treatment, in the two winter seasons. Likewise, all green pod characters as expressed by pod weight, length and diameter, significantly, appeared with than without the application of cattle manure, in the two growing seasons. This might be attributed to the enhancing influences of cattle manure on the nutritional status of the soil during the growing period, which was reflected on yield quality characters of pods. El-Mansi *et al.* (1999) reported that using organic manure increased soil pH, organic matter, availability of nutrients nitrogen-fixation, rhizosphere microorganisms that secrete phytohormones, and hormone like substances and in turn increased growth, dry matter accumulation, average weight and number of pods plant.$^{-1}$. Such results are on the same line with those reported by Soliman *et al.* (1991), Osman (1998) and Gabr (2000).

Application of nitrogen either at the rate of 20 or 40 kg N fad.-1 associated with significant increases in all the studied parameters of green pod yield and pods characters compared with those of the control, in both seasons. Application of nitrogen at the rate of 20 kg N fad.$^{-1}$, gave higher mean values of pea yield and its components, compared with the application of 40 kg N fad.$^{-1}$, in the two growing seasons, with the exception of the averages of green pod length and diameter which appeared to be insignificant, in the first season. The above mentioned results mean that more N addition is not economic. The satisfactory influences of N application on pea green yield might be attributed to the effect of N on plant growth as previously mentioned by Marschner (1995), who stated that nitrogen increase root primordia in which CYT synthesized, and there was close relationship between root primordia and leaf area duration, and also rapid leaf expansion which

Table 3: The main effects of organic manure, mineral nitrogen and biofertilizer inoculation treatments on green pods yield and yield components of pea plants, during the two winter seasons of 1999/2000 and 2000/2001

Seasons	1999/2000						2000/2001					
Treatments	No of green pods plant^{-1}	Green pods yield plant^{-1} (g)	Green seed weight pod^{-1} (g)	Green pod characters			No. of green pods plant^{-1}	Green pods yield plant^{-1} (g)	Green seed weight pod^{-1} (g)	Green pod characters		
				Weight (g)	Length (cm)	Diameter (cm)				Weight (g)	Length (cm)	Diameter (cm)
[X]Organic manure rates												
O_0	14.08 B	59.82 B	1.80 B	4.32 B	8.46 B	1.32 B	15.43 B	77.47 B	1.91 B	5.02 B	7.65 B	1.33 B
O_1	18.11 A	88.90 A	2.18 A	5.18 A	9.25 A	1.47 A	19.17 A	106.72 A	2.41 A	5.67 A	8.90 A	1.53 A
[Y]Mineral nitrogen rates												
N_0	13.08 C	52.58 C	1.73 C	4.13 C	8.05 B	1.27 B	13.79 C	64.80 C	1.77 C	4.59 C	7.42 C	1.28 C
N_1	18.34 A	91.03 A	2.51 A	5.20 A	9.35 A	1.49 A	19.49 A	110.49 A	2.44 A	5.8 A	8.91 A	1.55 A
N_2	16.87 B	79.48 B	1.99 B	4.90 B	9.17 A	1.42 A	18.62 B	100.99 B	2.27 B	5.63 B	8.50 B	1.46 B
[Z]Biofertilizer inoculation												
B_0	15.44 B	70.70 B	1.95 A	4.66 A	8.64 A	1.36 B	16.45 B	87.66 B	2.06 B	5.21 B	8.11 B	1.41 B
B_1	16.75 A	78.02 A	2.03 A	4.84 A	9.07 A	1.42 A	18.16 A	96.53 A	2.26 A	5.84 A	8.44 A	1.45 A

* Values followed by the same letter (s), within a comparable group of means of the main effects, are not significantly different, using revised L.S.D. test at 0.05 level.

[X] Organic manure rates (m^3 fad.$^{-1}$) : O_0 = without organic manure (control) and O_1 = 25.
[Y] Mineral nitrogen rates (kg N fad.$^{-1}$) : N_0 = without nitrogen (control), N_1 = 20 and N_2 = 40.
[Z] Biofertilizer inoculation: B_0 = Uninoculated and B_1 = inoculated with *Rhizobium*.

lead to an increase in photosynthesis, and this in turn increase yield. Similar findings were obtained by El-Oksh *et al.* (1991), Hassan *et al.* (1993); Merghany (1999).

Seed inoculation of pea with *Rhizobium* caused significant increases, in the number and weight of green pods plant^{-1}, and green pod diameter, as compared with the untreated control, in the first season. The same trend was obvious for green seed weight pod^{1}, green pod weight and green pod length, yet the differences did not reach the level of significance. In the second season, inoculation pea seeds with *Rhizobium* gave, significantly, higher mean values for all tested yield parameters and green pod characters, than the uninoculated ones. Such significant effect could be due to the increase in available N-fixed by *Rhizobium* bacteria (Abd El-Naby, 1998). These results matched well with those of Hassan *et al.*(1993)and Merghany (1999).

The effects of interaction between organic manure x inorganic nitrogen, organic manure x biofertilizer inoculation and inorganic nitrogen x biofertilizer inoculation on pea yield and its components are presented in Table 4.

The comparisons among the means of different combinations of organic manure x inorganic nitrogen rates for each studied parameter were found significant, in both years. The combined treatment 25 m^3 organic manure fad.$^{-1}$ plus 20 kg N fad^{-1}, produced the highest mean values for all parameters of pea yield and green pod characters. The previous result means that using organic manure had beneficial influence on reducing the amount of mineral nitrogen. This may be due to that addition organic manure encouraged the microorganisms living in the soil to convert the inorganic N to mineral form available for plants and hence can reduce inorganic N application (Abou-Hussien, 2001).

All the parameters of pea yield and green pods characters were, significantly, affected by the interaction between organic manure and biofertilizer inoculation. The application of organic manure at the rate of 25 m3 fad.-1 with *Rhizobium* inoculation was the best combination treatment for increasing yield parameters and pod characteristics, in both winter seasons. These results explain the efficiency of organic manure in increasing the microbial activity in the soil, which lead to increase the number of nodules plant^{-1} and this in turn improve the available N-fixed by *Rhizobium* bacteria (Abd El-Naby, 1998 and Arisha *et al.*, 1998).

Table 4: The first-order interaction effects of organic manure, mineral nitrogen and biofertilizer inoculation treatments on green pods yield and pod characters of pea plants, during the two winter seasons of 1999/2000 and 2000/2001

Seasons	1999/2000						2000/2001					
Treatments	No. of green pods plant^{-1}	Green pods yield plant^{-1} (g)	Green seed weight pod^{-1} (g)	Green pod characters			No. of green pods plant^{-1}	Green pods yield plant^{-1} (g)	Green seed weight pod^{-1} (g)	Green pod characters		
				Weight (g)	Length (cm)	Diameter (cm)				Weight (g)	Length (cm)	Diameter (cm)
[X] Organic x nitrogen												
$O_o + N_o$	12.08 d	44.25 e	1.63 b	3.86 d	7.68 c	1.19 c	11.82 d	54.03 e	1.54 e	4.31 e	6.98 d	1.19 e
$O_o + N_1$	15.27 c	69.80 c	1.89 b	4.56 c	8.84 a-c	1.39 a-c	17.27 c	88.66 c	2.13 c	5.36 c	8.03 c	1.42 c
$O_o + N_2$	14.90 c	65.42 cd	1.87 b	4.52 c	8.86 a-c	1.38 bc	17.22 c	89.72 c	2.04 cd	5.40 c	7.94 c	1.38 d
$O_1 + N_o$	14.09 c	60.90 d	1.83 b	4.40 c	8.42 bc	1.34 bc	15.77 c	75.56 d	2.00 d	4.87 d	7.86 c	1.38 d
$O_1 + N_1$	21.40 a	112.26 a	2.61 a	5.85 a	9.86 a	1.59 a	21.72 a	132.32 a	2.74 a	6.28 a	9.78 a	1.68 a
$O_1 + N_2$	18.84 b	93.54 b	2.11 ab	5.28 b	9.48 ab	1.47 ab	20.02 b	112.28 b	2.49 b	5.87 b	9.06 b	1.54 b
[Y] Organic x biofertilizer												
$O_o + B_o$	13.05 c	54.13 c	1.78 b	4.09 c	8.19 b	1.31 b	14.62 d	71.84 d	1.77 d	4.68 c	7.40 c	1.29 c
$O_o + B_1$	15.12 b	65.52 b	1.82 b	4.54 b	8.73 ab	1.33 b	16.24 c	83.11 c	2.04 c	5.19 b	7.90 b	1.37 b
$O_1 + B_o$	17.82 a	87.28 a	2.13 a	5.17 a	9.09 a	1.42 ab	18.27 b	103.48 b	2.35 b	5.57 a	8.82 a	1.53 a
$O_1 + B_1$	18.40 a	90.53 a	2.23 a	5.19 a	9.42 a	1.52 a	20.07 a	109.96 a	2.48 a	5.78 a	8.98 a	1.54 a
[Z] Nitrogen x biofertilizer												
$N_o + B_o$	12.67 c	49.66 c	1.65 c	3.98 c	7.82 c	1.23 c	12.63 d	54.96 e	1.65 d	4.29 d	7.20 d	1.25 e
$N_o + B_1$	13.49 c	55.49 c	1.81 bc	4.29 c	8.27 bc	1.30 bc	14.96 c	74.63 d	1.89 c	4.89 c	7.64 c	1.31 d
$N_1 + B_o$	16.78 b	82.77 b	2.20 a	5.02 ab	9.08 ab	1.43 ab	18.36 b	103.33 b	2.30 b	5.66 b	8.64 b	1.52 b
$N_1 + B_1$	19.89 a	99.30 a	2.30 a	5.39 a	9.62 a	1.55 a	20.63 a	117.65 a	2.58 a	5.97 a	9.17 a	1.58 a
$N_2 + B_o$	16.86 b	79.68 b	2.02 ab	4.97 b	9.02 ab	1.43 ab	18.35 b	104.68 b	2.22 b	5.68 b	8.48 b	1.45 c
$N_2 + B_1$	16.87 b	79.27 b	1.96 ac	4.84 b	9.32 ab	1.41 ab	18.88 b	97.31 c	2.31 b	5.58 b	8.51 b	1.46 c

* Values followed by the same letter (s), within a comparable group of means of the main effects , are not significantly different, using revised L.S.D. test at 0.05 level.

[X] Organic manure rates (m^3 fad.$^{-1}$) : O_o = without organic manure (control) and O_1 = 25.
[Y] Mineral nitrogen rates (kg N fad.$^{-1}$) : N_o = without nitrogen (control) , N_1 = 20 and N_2 = 40.
[Z] Biofertilizer inoculation: B_o = Uninoculated and B_1 = inoculated with *Rhizobium* .

With Respect to the interaction effects between inorganic nitrogen and biofertilizer inoculation, the combined treatment between 20 kg N fad.$^{-1}$ and *Rhizobium* inoculation produced the highest mean values for all the studied yield parameters, in the two growing seasons. This effect could be due to that biofertilizer inoculation play a organic form of nutrients such as N to mineral N. This led to increase in the uptake of nutrients from the soil by root of plant and hence promots plant growth, leading to an increase in plant yield (Lampkin, 1990).

Data presented in Table 5 illustrate the influence of interactions among the three studied factors on the green pods yield of pea and its characters. The best interaction effect among the different combination treatments was obtained from addition organic manure at the rate of 25 m3 fad.-1 with 20 kg N fad.-1, combined with biofertilizer inoculation by *Rhizobium*, in both winter seasons.

Data presented in Table 6 show the effects of all studied factors on nutrient contents; N, P and K%; of pea seeds.

The concentrations of N, P and K in pea seeds did not reflect any significant increase as a result of applying 25m^3 organic manure fad.$^{-1}$ compared with the control treatment, in the two growing seasons. The only exception was noticed on N content in the second season since, using of organic manure at the rate of 25 m^3 fad.$^{-1}$, significantly, increased the percentage of N in pea seeds compared with the untreated control.

Concerning the effect of inorganic nitrogen on the percentages of N, P and K contents, data in Table 6 reveal that application of mineral nitrogen either at the rate of 20 or 40 kg N fad.$^{-1}$. increased the concentration of nitrogen in seeds compared with those of the control (without nitrogen). However, the difference in nitrogen concentration of seeds between 20 or 40 kg N fad.$^{-1}$, in both years was not significant . Application of 20 kg N fad.$^{-1}$ caused a positive significant increase in P% of pea seeds in 1999/2000 season; whereas, the increase in 2000/2001 was not enough to be significant. Increasing N applied rate from 20 to 40 kg N fad.$^{-1}$, significantly, reduced P content in pea seeds. No significant differences were detected in the mean values of K concentration in seeds, in the first season. But, in the second season, the application of 20 or 40 kg N fad.$^{-1}$ gave similar content of K in pea seeds and at the same time

Table 5: The second-order interaction effects of organic manure, mineral nitrogen and biofertilizer inoculation treatments on green pods yield and pod characters of pea plants, during the two winter seasons of 1999/2000 and 2000/2001.

Seasons	1999/2000						2000/2001					
Treatment combinations	No. of green pods plant^{-1}	Green pods yield plant^{-1} (g)	Green seed weight pod^{-1} (g)	Green pod characters			No. of green pods plant^{-1}	Green pods yield plant^{-1} (g)	Green seed weight pod^{-1} (g)	Green pod characters		
				Weight (g)	Length (cm)	Diameter (cm)				Weight (g)	Length (cm)	Diameter (cm)
[x] Organic x [y] Nitrogen x [z] Biofertilizer												
$O_o + N_o + B_o$	11.67 f	40.03 g	1.58 b	3.60 e	7.52 a	1.22 ab	11.27 g	46.50 h	1.46 f	4.15 e	6.80 h	1.14 e
$O_o + N_o + B_1$	12.48 f	48.48 fg	1.68 b	4.12 de	7.84 a	1.16 b	12.37 fg	61.59 g	1.63 ef	4.47 de	7.14 gh	1.23 d
$O_o + N_1 + B_o$	13.27 ef	60.74 d-f	1.90 ab	4.31 de	8.48 a	1.32 ab	16.20 e	81.42 f	1.92 de	5.10 cd	7.64 fg	1.37 c
$O_o + N_1 + B_1$	17.27 b-e	78.86 cd	1.89 ab	4.82 b-d	9.20 a	1.46 ab	18.33 c-e	95.91 cd	2.53 bc	5.63 a-c	8.43 de	1.48 b
$O_o + N_2 + B_o$	14.23 d-f	61.62 d-f	1.86 ab	4.37 de	8.59 a	1.59 ab	16.40 e	87.60 ef	1.93 de	5.33 bc	7.74 fg	1.37 c
$O_o + N_2 + B_1$	15.57 c-f	69.21 de	1.89 ab	4.68 cd	9.13 a	1.37 ab	18.03 de	91.84 df	2.15 cd	5.47 bc	8.13 ef	1.40 c
$O_1 + N_o + B_o$	13.67 ef	59.29 ef	1.71 b	4.35 de	8.13 a	1.24 ab	14.00 f	63.43 g	1.84 de	4.43 de	7.59 fg	1.36 c
$O_1 + N_o + B_1$	14.50 d-f	62.51 d-f	1.94 ab	4.46 de	8.71 a	1.45 ab	17.55 a	87.68 ef	1.16 cd	5.13 bc	8.14 ef	1.39 c
$O_1 + N_1 + B_o$	20.29 ab	104.79 ab	2.50 ab	4.74 ab	9.69 a	1.54 ab	20.52 b	125.24 b	2.68 ab	6.23 \a	9.64 ab	1.67 a
$O_1 + N_1 + B_1$	22.52 a	119.73 a	2.72 a	5.96 a	10.04 a	1.64 a	22.92 a	139.40 a	2.81 a	6.32 a	9.92 a	1.96 a
$O_1 + N_2 + B_o$	19.50 a-c	97.74 b	2.19 ab	5.57 a-c	9.45 a	1.48 ab	20.30 bc	121.77 b	2.52 ab	6.04 ab	9.23 bc	1.54 b
$O_1 + N_2 + B_1$	18.17 b-d	89.33 bc	2.07 ab	5.00 a-d	9.50 a	1.46 ab	19.73 b-d	102.78 c	2.46 bc	5.70 a-c	8.89 cd	1.53 b

* Values followed by the same letter (s), within a comparable group of means of the main effects , are not significantly different, using revised L.S.D. test at 0.05 level.

[x] Organic manure rates (m^3 fad.$^{-1}$) : O_o = without organic manure (control) and O_1 = 25.
[y] Mineral nitrogen rates (kg N fad.$^{-1}$) : N_o = without nitrogen (control) , N_1 = 20 and N_2 = 40.
[z] Biofertilizer inoculation: B_o = Uninoculated and B_1 = inoculated with *Rhizobium*.

Table 6: Mineral contents of N, P and K (%) in the seeds of pea as influenced by organic manure, mineral nitrogen and biofertilizer inoculation treatments, during the two winter seasons of 1999/2000 and 2000/2001.

Seasons			1999/2000			2000/2001		
Treatments			N	P	K	N	P	K
Organic manure rates	Mineral nitrogen rates	Biofertilizer inoculation		%			%	
O_0			3.17# A	0.34 A	1.70 A	3.14 B	0.32 A	1.73 A
O_1			3.41 A	0.32 A	1.94 A	3.26 A	0.34 A	1.76 A
	N_0		2.75 B	0.29 B	1.69 A	2.84 B	0.33 B	1.59 B
	N_1		3.45 A	0.39 A	1.85 A	3.45 A	0.36 A	1.83 A
	N_2		3.66 A	0.31 B	1.90 A	3.31 A	0.29 B	1.81 A
		B_0	3.24 A	0.33 A	1.78 A	3.07 A	0.34 A	1.72 A
		B_1	3.34 A	0.34 A	1.85 A	3.03 A	0.32 A	1.77 A
First-order interactions								
O x N			*N.S	N.S	N.S	N.S	N.S	N.S
O x B			N.S	N.S	N.S	N.S	N.S	N.S
N x B			N.S	N.S	N.S	N.S	N.S	N.S
Second-order interactions								
O x N x B			N.S	N.S	N.S	N.S	N.S	N.S

Values followed by the same letter (s), within a comparable group of means, are not significantly differ, using revised L.S.D. test at 0.05 level.
* N.S.= not significant at 0.05 level.
X Organic manure rates (m^3 fad^{-1}) : O_0 = without organic manure (control) and O_1 = 25.
Y Mineral nitrogen rates (kg. N.fad^{-1}) : N_0 = without nitrogen (control), N_1 = 20 and N_2 = 40.
Z Biofertilizer inoculation: B_0 = Uninoculated and B_1 = inoculated with *Rhizobium* .

gave higher content of K in pea seeds than the control.

Regarding the effects of *Rhizobium* inoculation on nutrient contents of pea seeds, data in Table 6 indicated that there were no significant differences in the concentrations of N, P and K in seeds between the inoculated and uninoculated plants, in both years.

The effect of interactions among all the studied factors on N, P and K contents of seeds was not significant. Therefore Table 6 shows, only, the results of main effects.

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تأثيرات إضافة السماد العضوي والنيتروجين المعدني والسماد الحيوي علي المحصول والجودة والتركيب الكيماوي للبسلة

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يهدف هذا البحث إلي دراسة تأثير إضافة مستويات كل من مستويين السماد العضوي (صفر ، ٢٥ م٣ / فدان) وثلاث معدلات من السماد النيتروجيني المعدني (صفر ، ٢٠ ، ٤٠ كجم ن / فدان) ومستويين من السماد الحيوي (بدون تلقيح ، تلقيح ببكتيريا الرايزوبيم) وكذلك كل التداخلات الممكنة بينهم علي صفات محصول القرون الطازجة ومكوناته في البسلة (صنف ماستر) وتشمل هذه الصفات كل من عدد ووزن القرون الخضراء ، وزن البذور الطازجة للقرن، وزن وطول وقطر القرن. وكذلك تقدير محتوي البذور من عناصر النيتروجين والفوسفور والبوتاسيوم، أجريت هذه الدراسة في محطة البحوث الزراعية التابعة لكلية الزراعة جامعة الإسكندرية خلال المواسم الشتوية لعامي ١٩٩٩/٢٠٠٠ و ٢٠٠٠/ ٢٠٠١.

ولقد أظهرت النتائج أن التسميد العضوي بمعدل ٢٥م٣/ فدان وكذلك التسميد المعدني بمعدل ٢٠ كجم ن/ فدان أعطي أعلي القيم معنويا لصفات المحصول الطازج وصفات القرون. أيضا أظهرت النتائج أن المعاملة باللقاح البكتيري (الرايزوبيم) أدت إلي زيادة معنوية في صفات محصول القرون الخضراء للنبات ومكوناته.

بالنسبة للتداخلات بين المعاملات فقد تبين أن أفضل تداخل من المستوي الأول هو استخدام معدل ٢٥م٣/فدان سماد عضوي + ٢٠ كجم من النيتروجين / فدان، ٢٥م٣ / فدان سماد عضوي + التلقيح البكتريا الرايزوبيم، والتي اعطت أفضل القيم لصفات المحصول الطازج ومكوناته.

أظهرت نتائج التداخلات بين المعاملات (المستوي الثاني من التداخلات) أن استخدام السماد العضوي بمعدل ٢٥م٣/ فدان + النيتروجين بمعدل ٢٠ كجم ن/ فدان + التلقيح البكتيري بالرايزوبيم ، اعطى أفضل التأثيرات علي صفات المحصول للقرون ومكوناته.

بالنسبة لمحتوي البذور من العناصر (النيتروجين والفوسفور والبوتاسيوم) فقد تبين أن استخدام النيتروجين المعدني بمعدل ٢٠ كجم/ فدان أو ٤٠ كجم/ فدان أدي إلي زيادة محتوي البذور من هذه العناصر، وعلي العكس من ذلك لم يظهر أي تأثير علي محتوي البذور من العناصر باستخدام كل من التسميد العضوي أو الحيوي أو التداخلات بين مستويات جميع العوامل المدروسة.