Zagazig J. Agric. Res., Vol. 32 No. (5) 2005 1453 - 1473

EFFECT OF MINERAL AND BIOFERTILIZERS ON GROWTH, YIELD AND QUALITY OF PEA PLANTS UNDER SANDY SOIL CONDITIONS

El-Beheidi, M.A.[1], A.A. El-Mansi[1], E.A.El-Ghamriny[1], F.E. Mohamed[2], and M.M. Ramadan [2]

[1.] Hort. Dept., Fac. Agric., Zagazig Univ., Egypt.

[2.] Hort. Res. Inst., Agric. Res. Center, Dokki, Egypt.

Accepted 8 / 8 / 2005

ABSTRACT: Two field experiments were carried out during two winter seasons of 2000/2001 and 2001/2002 at El-Khattara Experimental Farm, Fac. Agric., Zagazig University, to study the effect of mineral nitrogen and phosphorus and biofertilizers, each alone or in combination on plant growth, plant chemical composition, yield and its components as well as quality of pea plants under sandy soil conditions.

Fertilization of pea plants with mineral (N+P) at 30+45 kg/*fed* with mixture of biofertilizers(rizobactrein + okadein + phosphorein), with phosphorein and/or with rizobactrein gave the highest values of stem length, number of both leaves, branches and nodules /plant , total dry weight/plant in both seasons, maximum values of chlorophyll a, b and (a+b) as well as carotenoides in leaf tissues, number of pods/ plant, number of seeds/ pod, yield /plant and total yield /*fed* in both seasons and total uptake of N,P and K / plant, while the minimum values were obtained by untreated plant (control) in the second season only. In addition, N, P and K contents in roots, stem and leaves as well as nodules number of pea plant were significantly increased by application of 20 kg N+30 kg P_2O_5 /*fed* with mixture of (rizobactrein+ okadaien and phosphorein).

Key words: Biofertilizers, mineral fertilizers, plant chemical composition, number of nodules, yield and its quality.

INTRODUCTION

Biofertilizers microbial inoculation) which contain efficient strains of nitrogen fixing, and phosphate-solublizing bacteria could be used partially instead of chemical fertilizers. Moreover, these bacterial cells increase the availability of nutrients in form which can be easily assimilated by plants (Subba Rao, 1993).

Inoculation of pea seeds with rhizobium bacteria increased stem length, number of both branches and leaves /plant and nodules number/ plant (El-Beheidi *et al.*, 1985), growth and nodulation (Prasad and Maurya, 1992), plant length, number of branches/ plant and number of nodules/ plant (Hassan *et al.*, 1993) of pea. In addition, number of leaves and branches, nitrogen content and green yield of beans were increased by adding 30 kg N */fed* along with rhizobium inoculation (El-Oksh *et al.*,1991) and number of nodules of pea plants with rhizobium inoculation and application of phosphorous (Gheeth, 1993) under sandy soil conditions. Plant height and number of nodules of pea were increased with increasing P_2O_5 level up to 25.8 kg/ha (Srivastava and Ahlawat, 1995). Under sandy soil conditions, the dry weight of peas increased with increasing N+P fertilizers up to 80 kg*/fed* (Gewaily *et al.*, 1996; Ahmed, 1999) found that number of nodules, branch number /plant, dry weight of nodules /plant and average fresh pod weight, weight of seeds, fresh pod yield*/fed* and 100 seed weight of peas were increased with NPK and inoculation with rhizobium. Moreover, N, P and k content in leaves, yield, as well as carbohydrate and protein of green pods of snap bean were enhanced with 92 kg N/ *fed* with inoculation with rhizobium (Merghany 1999); number of nodules, total dry weight/plant, dry weight of nodules and the yield were significantly increased with the combination of 30 kg P_2O_5*/fed* and inoculation with biophosphatic of faba been plants (Hamissa *et al.* 2000); nodules number and yield of snap bean were promoted with inoculation of seeds and 23 kg/ha. (Shibru and Mitiku 2000).

The application of nitrogen increased chlorophylls and carotenoids in pea leaves (El-Beheidi *et al.*, 1996; Arisha and Bardisi, 1999), weight of seed/pod and weight of 100 seed of peas (El-Khatib, 2003). Adding N and P at 30 kg and 20 kg */fed* ,respectively with biofertilizers (nitrobein + phosphorein) were favorable for plant length, number

of branches, pod length, pod weight and total yield, but less protein of pods was obtained by biofertilizers alone (Hewedy *et al.*, 2003) in common bean.

Inoculation of seeds with rhizobium bacteria increased N,P and K in leaves (Sarg and Hassan,2003 and Solieman *et al.*, 2003), P content (El-Neklawy *et al.*, 1985), N in green and dry seeds (Abdel-Ghaffar *et al.*,1994) and N,P,K, protein, carbohydrate and TSS in seeds (Ramadan,1997).

The aim of this work is to determine the suitable rates of mineral N, P and biofertilizers on the growth, yield and quality of peas under sandy soil conditions.

MATERIALS AND METHODS

Two successive winter experiments, during of 2000-2001 and 2001-2002 seasons, were carried out at El-Khattara Experimental Farm, Fac. Agric., Zagazig University, to study the effect of mineral nitrogen and phosphorus and biofertilizers, as single or in combinations, on plant growth, chemical composition, yield and its components and quality of pea seeds under sandy soil conditions using drip irrigation system.

This experiment included 17 treatments as indicated in Schedule 1.

The treatments were arranged in a randomized complete block design with three replications.

Pea cultivar Master B was used, seeds were sown on November 7th in both growing seasons.

The plot area was 12.6 m^2. Each plot contained three dripper lines (7 m long and 0.6 wide). One dripper line (4.2m^2) was used for evaluating vegetative parameters and the other two dripper lines (8.4 m^2) were used for yield determination.

Pea seeds were sown in hills on both sides of line (2-3 seeds/ hill) and 7.5cm apart on both sides and 5cm distance.

Biofertilizers were mixed with wet seeds by adding Arabic Gum solution before sowing and the treated seeds were, directly, sown in the same day. The biofertilizers used were rhizobactrein, okadein (contain a nitrogen fixing bacteria), and phosphorein, (contain *Bacillus megatherium* phosphate - dissolving bacteria). The source of biofertilizers were the General Organization for Agriculture Equalization Found (GOAEF). Ministry of Agriculture, Egypt.

This experiment included 17 treatments as indicated in Schedule 1.

Schedule 1: The applied N, P_2O_5, rizobactrein, okadein and phosphorein (kg/*fed*) as single or in combinations

N	P_2O_5	Rizobactrein	Okadein	Phosphorein
0	0	0	0	0
0	45	1.2	0	0
10	45	1.2	0	0
20	45	1.2	0	0
30	45	1.2	0	0
0	45	0	1.2	0
10	45	0	1.2	0
20	45	0	1.2	0
30	45	0	1.2	0
30	0	0	0	1.2
30	15	0	0	1.2
30	30	0	0	1.2
30	45	0	0	1.2
0	0	1.2	1.2	1.2
10	15	1.2	1.2	12
20	30	1.2	1.2	1.2
30	45	1.2	1.2	1.2

Ammonium sulphate (20.5% N), calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O), were used as sources of N,P and K, respectively. One third of these fertilizers was added with FYM ($30m^3$/*fed*) during soil preparation and the other two thirds of these fertilizers were divided into six equal portions and added weekly through irrigation water beginning 10 days

after complete emergence, but the rest of nitrogen and calcium superphosphate was divided into three equal amounts, and then added every fifteen days intervals as soil application and covered by sand. The other normal agricultural treatments of growing pea plants were practiced.

Data Recorded

I. Plant Growth

Five plants were randomly taken at 55 days after sowing from each plot for measuring the following items:

1. Stem length (cm),
2. Number of leaves / plant,
3. Number of branches / plant,
4. Number of nodules / plant, and
5. Dry weight of different plant organs; i.e.; root, nodules, stem, leaves and total dry weight/ plant (gm).

2. Yield and Its Components

Green pods of each plot were harvested at proper maturity stage, counted and weighed in each harvest and the yield components and total yield were determined as follows :

1. Number of green pods/plant,
2. Pod weight (g),
3. Seed number/ pod,
4. Green yield/plant (g),
5. Total green yield/fed Ton, and
6. Relative yield (%)

3. Leaf Pigments

Disk samples from the fourth upper leaf were taken at 50 days after sowing to determine chlorophyll a and b as well as carotenoids according to Wettestein (1957).

4. Plant Chemical Composition (Nitrogen, phosphorous and potassium)

They were determined in the roots and shoots on the basis of dry weight according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively.

5. Seed Chemical Constituents

4.1. Nitrogen, phosphorus and potassium contents, were determined on the basis of dry matter as in plant chemical composition.

4.2. Total protein (%); it was calculated by multiplying total nitrogen x 6.25

4.3. Total soluble sugars; it was determined according to the method described by Forsee (1938).

4.4. Nitrate content; it was determined according to the method described by Cafado *et al.* (1975).

4.5. Total carbohydrate (%); it was determined according to the methods described by Dubois *et al.* (1956).

4.6. Total soluble solids (TSS); They were determined by Carl zeis refractometer.

5. Statistical Analysis

The data of this experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980). and means separation was done according to LSD at 5 % level.

RESULTS AND DISCUSSION

1. Plant Growth

The effect of mineral nitrogen and phosphorus and biofertilizers on vegetative growth characters and nodules formation of pea plant are shown in Table 1. It is evident that application of nitrogen (N), phosphorus (P_2O_5), and biofertilizers, single or mixture in general, significantly enhanced all studied vegetative growth characters compared to control (without fertilizers). Meanwhile, application of N at 20 kg + P_2O_5 at 30 kg+ mixture of the three biofertilizers (Rizobacterein (Rizo.), Okadein (Okad.), phosphorein (Phos.) or N at 20 kg + P_2O_5at 30 kg + the same mixture of biofertilizers gave significantly higher mean values for all studied growth characters, without significant differences between the two treatments. Moreover, application of N at 30 kg + P_2O_5 at either at 30 or 45 kg+ Phos .also stimulated significantly the vegetative growth characters and total dry weight /plant except nodules number, without significant differences between these two treatments on one side, and among the four treatments on the other side. In other words, these four treatments being the most favorable treatments and there were no significant differences could be detected among them with respect to stem length and dry weight of leaves, branches and total/ plant.

In addition, the same results indicate that addition N at 20 or 30 kg+ P_2O_5 at 45 kg+ Rizobacterein (Rizo.) gave significant increases in all vegetative growth characters without significant differences between them and the increases in vegetative growth characters as

Table 1: Effect of mineral N and P and biofertilizers(1.2 kg/*fed* , each) on the growth characters of pea plant in 2000/2001 and 2001/2002 seasons

Treatments			Growth characters / plant									
			2000/2001 season					2001/2002 season				
N	P_2O_5	Biofertlizers	Stem length (cm)	Leaves No.	Branches No.	Nodules No.	Total dry weight (g)	Stem length (cm)	Leaves No.	Branches No.	Nodules No.	Total dry weight (g)
(Kg/*fed*)												
0	0	Without(control)	32.16	10.66	1.36	7.11	1.574	34.63	11.60	1.43	9.21	1.976
0	45	Rizobactrein	37.93	14.53	2.13	10.66	2.204	40.70	16.73	2.46	12.66	2.448
10	45	Rizobactrein	44.30	16.76	2.90	14.99	2.493	45.66	19.10	3.23	17.55	2.729
20	45	Rizobactrein	49.10	20.26	3.53	20.55	2.866	49.73	22.66	3.83	23.32	2.992
30	45	Rizobactrein	48.86	20.66	3.56	15.55	2.925	51.30	23.03	3.93	21.21	3.107
0	45	Okadein	36.16	13.60	2.00	9.66	2.091	38.43	15.10	2.10	12.21	2.307
10	45	Okadein	40.30	15.83	2.66	14.22	2.312	42.33	17.70	2.93	17.83	2.540
20	45	Okadein	43.46	19.90	3.36	19.10	2.553	47.30	21.96	3.60	21.66	2.768
30	45	Okadein	45.56	20.20	3.40	14.55	2.602	47.90	22.50	3.66	18.77	2.812
30	0	Phosphorein	39.36	16.43	2.46	10.33	2.313	41.96	18.66	3.10	11.99	2.567
30	15	Phosphorein	43.30	19.76	3.13	11.55	2.596	45.80	22.70	3.80	14.21	2.812
30	30	Phosphorein	46.86	22.60	3.73	14.21	2.850	49.30	25.33	4.43	15.66	3.065
30	45	Phosphorein	49.93	23.00	3.76	13.66	2.910	50.63	25.73	4.46	14.99	3.233
0	0	Rizo.+Okad.+Phos.*	37.50	13.93	1.83	10.55	2.053	39.56	16.36	2.10	12.66	2.238
10	15	Rizo.+Okad.+Phos.	42.36	18.70	3.10	16.77	2.547	44.63	20.96	3.53	19.66	2.684
20	30	Rizo.+Okad.+Phos.	46.80	24.33	3.80	21.44	2.998	49.56	25.33	4.33	25.55	3.147
30	45	Rizo.+Okad.+Phos.	48.46	25.16	4.16	19.99	3.054	51.70	26.10	4.46	21.77	3.198
LSD at 0.05 level			3.40	3.79	0.55	3.68	0.354	4.77	4.69	0.80	2.62	0.225

*Rizo., Okad. and Phos. : Rizobactrein , Okadein and Phosphorein , respectively.

well as thy dry weight in both seasons were, in general, corresponding to increased both N at P_2O_5levels.

From the above mentioned results, it could be suggested that application of N at 20 kg + P_2O_5 at 30 kg + mixture of the three biofertilizers followed by N at 30 kg + P_2O_5 at 45 + the same mixed biofertilizers were adjudged as the most effective treatments. However, the former treatment is the superior one.

The present results, in general, are in agreement with those obtained by El-Beheidi *et al.* (1985), Prasad and Maurya (1992), Gheeth (1993), Hassan *et al.* (1993), Srivastava and Ahlawat (1995), Gewaily *et al.* (1996) and Solieman *et al.* (2003) on pea plants and El-Oksh *et al.* (1991) on common bean

The necessity of nitrogen and phosphorus for pea growth has been demonstrated by many investigators, since nitrogen and phosphorus supply was desirable for vegetative growth, dry matter accumulation as well as nutrient uptake. The increase in plant growth may be attributed to the beneficial effects of N on stimulating the meristmatic activity for producing more tissues and organs, since N plays major roles in the synthesis of structural proteins and other several macro-molecules, in addition to its vital contribution in several biochemical processes in the plant related to growth (Marschner, 1995). Besides, nitrogen is an important constituents of protoplasm. Also enzymes, the biological catalytic agents, which speed up life processes, have N as their major constituents (Mengel and Kirkby, 1987). Phosphorus is an essential component of the energy transfer compounds, genetic information system, cell membranes and phosphproteins (Gardener *et al.*, 1985). This indicates the great importance of such elements for enhancing plant growth. Moreover, the superiority of inoculation with the biofertilizers might be owe much to the vital role of bacteria that present in the applied biofertilizers and capable of contributing some hormone substances; i.e., gibberellins, auxins and cytokinins (Tien *et al.*, 1970; Cacciari *et al.*,1989). These phytohormones may stimulate the cell elongation and development and hence plant growth (Paleg, 1985). The activity of these bacteria in the absorption zone of

plant roots might improve soil fertility, and consequently plant development by N_2-fixation and due to releasing of certain other nutrients; i.e., Fe, Zn and Mn (Bhonde *et al.*, 1997) through the break down of organic materials in the soil and make these elements in available forms. The increase in plant growth after inoculation with Rizobacterein may be due to the ability of rhizobium to form root nodules (Merghany, 1999).

In addition, the superiority of inoculation with the the biofertilizer phosphorein could be explained in the light of the great role played with such phosphate solublizing bacteria in correcting the solubility problem and releasing the fixed phosphate form to be ready available form for plant nutrition, then supply the plants with their phosphorus needs.

2. Leaf Pigments

The results, listed in Table 2, clearly show significant increments in leaf pigments; i.e., chlorophyll *a* and *b* as well as carotenoides due to application of N, P_2O_5 and biofertilizers as single or as a mixture. It is of great interest to note that application of higher levels of N (20 or 30 kg / *fed.*) and P_2O_5 (30 or 45 kg */fed*) alongside with single or mixed biofertilizers recorded, in general, higher values of these pigments in leaf tissues compared to control (unfertilized) or any other fertilization treatments. While, the minimum values of the photosynthetic pigments were obtained by untreated plants.

It is also clear that, obtained results of leaf pigments showed similar trends to those obtained by vegetative growth characters. That meant that these fertilization treatments had favorable significant effect on the photosynthetic pigments as previously described in case of vegetative growth. However, it is important to notice that fertilization with N at 20 or 30 kg / *fed* + P_2O_5 at 30 or 45 kg/*fed*+ mixture of the three biofertilizers (Rizo. + Okad. + Phos.) were the superior treatments, in this concern, without significant differences between them. In other words, high levels of N and P_2O_5 alongside with used biofertilizers gave pea leaves with intense chlorophyll and carotenoides.

Similar findings were gained by El-Beheidi *et al.* (1996); Arisha and Bardisi (1999) and Sarg and Hassan (2003) on pea plants.

The enhancing effect of N on photosynthetic pigments might be due to that N is a constituents of

Table 2: Effect of mineral N and P and biofertilizers (1.2 kg/*fed* , each) on the leaf pigments of pea plants in 2000/2001 and 20012002 seasons

Treatments			Leaf pigments (mg/g dry weight)							
			2000/2001 season				2001/2002 season			
N	P_2O_5	Biofertlizers	Chlorophyll			Carotenoids	Chlorophyll			Carotenoids
(Kg/*fed*)	(Kg/*fed*)		a	b	a+b		a	b	a+b	
0	0	Without(control)	2.96	0.93	3.89	2.10	2.75	0.91	3.66	2.24
0	45	Rizobactrein	3.51	1.28	4.79	3.22	3.18	1.75	4.93	3.41
10	45	Rizobactrein	3.85	1.32	5.17	4.18	3.89	1.85	5.74	3.69
20	45	Rizobactrein	4.27	2.12	6.39	4.35	4.19	2.08	6.27	3.97
30	45	Rizobactrein	4.54	2.17	6.71	4.43	4.32	2.26	6.58	4.10
0	45	Okadein	3.55	1.21	4.76	3.17	3.41	1.39	4.80	3.34
10	45	Okadein	3.81	1.35	5.16	3.37	3.67	1.68	5.35	3.65
20	45	Okadein	4.08	1.89	5.97	3.83	3.98	1.95	5.93	4.07
30	45	Okadein	4.46	2.11	6.59	4.16	4.30	2.13	6.43	4.27
30	0	Phosphorein	3.51	1.13	4.64	3.06	3.42	1.60	5.02	3.18
30	15	Phosphorein	3.93	1.30	5.23	3.24	3.71	1.84	5.52	3.12
30	30	Phosphorein	4.08	1.61	5.69	3.56	4.11	2.32	6.43	3.31
30	45	Phosphorein	4.34	2.00	6.34	3.68	4.22	2.39	6.61	3.48
0	0	Rizo.+Okad.+Phos.*	3.32	1.16	4.48	3.14	3.29	1.40	4.69	3.32
10	15	Rizo.+Okad.+Phos.	3.99	1.43	5.42	3.36	3.76	1.84	5.60	3.48
20	30	Rizo.+Okad.+Phos.	4.62	2.19	6.81	4.22	4.29	2.37	6.66	4.19
30	45	Rizo.+Okad.+Phos.	4.71	2.28	6.99	4.57	4.38	2.44	6.82	4.50
LSD at 0.05 level			0.33	0.24	1.17	0.30	0.32	0.19	0.37	0.34

*Rizo., Okad. and Phos. : Rizobactrein , Okadein and Phosphorein , respectively.

chlorophyll molecule. Moreover, it is the main constituents of all the amino acids and hence of proteins, acting as a structural component of the chloroplasts. Correspondingly, an enhancement of protein synthesis and chloroplasts formation leads to an increase in chlorophyll and carotene (Marschner, 1995).

3. Yield and Its Components

Data in Table 3 demonstrate that the application of NP and inoculation with biofertilizers (Rizo., Okad., Phos.) single form or as a mixture caused significant increases in yield and its components expressed as number of green pods/ plant, average pod weight, seed number/pod and green pods yield/ plant and well as per feddan compared to control treatment (unfertilized and uninoculated). Whereas, application of higher levels of N (20 or 30 kg / *fed*) and P_2O_5 (30 or 45 kg / *fed*) and inoculation of used biofertilizers mixed or single significantly enhanced the yield and its components in comparing with all other fertilization treatments.

Data also reveal that there were no significant differences in total green pods/ plant or per feddan after fertilization with 30 kg N+45 kg P_2O_5/ *fed* and inoculation with Rizo., Phos. or Rizo.+ Okad.+ Phos. in both seasons. Whereas, fertilization with the same levels of N and P_2O_5 and inoculation with Okad. was less effective than the other biofertilizers. The increases in total yield /fed were about 111%,112% and 106% in the first seasons and 105%, 106 % and 104 % , in the second season over the respective control when plants were fertilized with N at 30 kg/*fed* + P_2O_5 at 45 kg /*fed* + inoculation with the three biofertilizers, inoculation with Phos. or inoculation with Rizo., respectively. In fact, the trend herin was similar to that previously mentioned regarding vegetative growth characters and photosynthesis pigments. These results might be due to the increase in vegetative growth (Table 1) and photosynthesis pigments (Table 2), that possibly increased the efficiency of photosynthesis and resulted in more accumulation of carbohydrate in the foliage which was used in developing more vegetative growth factors that was highly effective in nodules formation, become responsible and N_2 fixation and thereby the increase in all yield components (Table 3). Moreover, the increases in total yield /fed were about 96% and 100% over the respective control in first and second seasons, respectively after fertilization with

Table 3: Effect of mineral N and P and biofertilizers (1.2 kg/*fed*, each) on yield and its components of pea plants in 2000/2001 and 2001/2002 seasons

Treatments			Yield and its components										
			Number of green pods/ plant	Pod weight (g)	Seed No. / pod	Green pods yield		Relative yield (%)	Number of green pods/ plant	Pod weight (g)	Seed No./pod	Green pods yield		Relative yield (%)
N (Kg/*fed*)	P_2O_5	Biofertilizers				Plant (g)	Feddan (ton)					Plant (g)	Feddan (ton)	
			2000/2001 season						2001/2002 season					
0	0	Without(control)	3.02	5.12	5.90	21.74	1.642	100	3.46	5.36	6.13	25.15	1.750	100
0	45	Rizobactrein	5.66	6.45	6.93	36.56	2.191	133	5.91	6.86	7.43	40.53	2.425	138
10	45	Rizobactrein	5.99	7.63	7.73	45.68	2.780	169	6.41	7.84	8.00	50.55	2.905	166
20	45	Rizobactrein	6.06	8.57	8.90	51.88	3.230	196	6.85	8.30	9.16	56.78	3.452	197
30	45	Rizobactrein	6.24	8.83	9.36	55.10	3.397	206	7.04	8.74	9.50	61.55	3.572	204
0	45	Okadein	4.83	6.00	6.80	28.99	2.043	124	5.71	6.64	7.06	37.85	2.320	132
10	45	Okadein	5.31	6.26	7.16	33.29	2.544	154	5.92	6.92	7.53	40.95	2.728	155
20	45	Okadein	5.92	7.12	7.56	42.17	2.988	181	6.28	7.79	8.63	48.97	3.261	186
30	45	Okadein	5.98	7.29	8.13	43.68	3.217	195	6.84	8.15	9.23	55.78	3.408	194
30	0	Phosphorein	5.16	6.43	7.60	33.23	2.069	126	5.78	6.96	7.46	40.22	2.307	131
30	15	Phosphorein	5.66	7.34	8.23	41.50	2.550	155	6.45	7.64	8.16	50.01	2.765	158
30	30	Phosphorein	6.03	7.95	9.03	48.03	3.283	199	7.05	8.36	9.30	59.02	3.377	192
30	45	Phosphorein	6.20	8.48	9.60	52.63	3.493	212	7.72	8.49	9.53	65.38	3.613	206
0	0	Rizo.+Okad.+Phos.*	5.20	6.07	6.66	31.59	1.982	120	5.43	6.62	6.96	35.96	2.141	122
10	15	Rizo.+Okad.+Phos.	5.78	7.47	7.73	43.26	2.476	150	5.96	7.91	7.30	47.22	2.807	160
20	30	Rizo.+Okad.+Phos.	6.11	8.39	8.73	51.29	3.222	196	7.12	8.80	8.63	62.70	3.503	200
30	45	Rizo.+Okad.+Phos.	6.28	8.57	9.50	53.93	3.467	211	7.24	9.10	8.90	65.95	3.602	205
LSD at 0.05 level			0.28	0.88	0.32	4.44	0.471	----	0.46	0.53	0.35	5.27	0.485	----

*Rizo., Okad. and Phos. : Rizobactrein , Okadein and Phosphorein , respectively.

N at 20 kg /fed+ P_2O_5at 30 kg/ *fed* + inoculation with the three biofertilizers. However, it was noticed that there were no significant differences between fertilization with this treatments and fertilization with N at 30 kg+ P_2O_5 at 30 kg + seed inoculation with mixture of the three biofertilizers concerning the yield and its components.

P deficiency leads to a reduction of most metabolic processes including cell division and expansion, respiration and photosynthesis. The level of P supply during productive stage regulate the starch/sucrose ratio which affect phytohormones balance (Marschner, 1995). P is an essential components for energy transfer compounds, the genetic information system, cell membrane and phosphoproteins, hereupon, it affects pea yield. On the other hand, biofertilizers enhance crop productivity through N_2- fixation, phosphate solubilization, plant hormone production and /or stimulate of disease resistance. (Pathak *et al.*, 1977; Hedege *et al.*, 1999).

Thus, from the economic view it could be concluded that 20 kgN+30 kg P_2O_5 alongside with inoculation with Rizo.+ Okad.+ Phos. was enough for high productivity .

Obtained results are in harmony with those reported by Ahmed (1999), El-Khatib (2003) and Sarg and Hassan (2003) on pea plant, Hamissa *et al.* (2000) on faba been plants, Shibru and Mitiku (2000) and Hewedy *et al.* (2003) on common bean plants. In this respect, El-Neklawy *et al.* (1985) reported that inoculation of pea seeds in Egypt with local inoculation (okadain) or with an introduced inoculation (TAL), significantly increased green pod yield.

4. N, P and K Contents and Their Uptakes

The effects of mineral nitrogen and phosphorus and biofertilizers on N,P and K contents as well as their uptaken amounts by pea plants are presented in Table 4. It is clear from such data that application of N and P fertilizers and seed inoculation with biofertilizers as single or mixture had favorable significant effect on N,P and K contents as well as their total uptaken amounts compared to control (untreated plants).

In general, application of N at 30 kg/ *fed* + P_2O_5 at 45 kg/ *fed* + mixture of the three biofertilizers (Rizo.+Okad.+Phos.) came in the first rank, followed by N at 20 kg+

P_2O_5 at 30 kg +the same mixture of biofertilizers, in the second rank, as they scored the highest values of N,P and K contents in roots, stems and leaves as well as their total uptaken amounts without significant differences between them except N content in stem and K uptake / plant which showed significant differences. Moreover, application of 30 kg N/ *fed*+ P_2O_5 at 30 or 45 kg */fed* and inoculation with Phos. also showed favorable significant effect on N,P and K contents and their uptaken amounts without significant differences between them except N content in roots and the uptake of P and K, which showed significant differences. Results, also, revealed that 20 or 30 kg N/*fed*+ 45 kg P_2O_5 in conjunction with seed inoculation with Rizo. had favorable significant effect on minerals content without significant differences between them except, P content in roots and leaves. In addition, total uptakes of N, P and K were enhanced by the two treatments without significant differences between them respecting P uptake only.

It could be concluded that the marked superiority of N, P and K contents and their uptakes are notable among N at 20 kg/ *fed* and P_2O_5 at 30 kg/*fed* used in conjunction with mixture of the three biofertilizers which came in the first rank and that was followed by N at 30 kg */fed* + P_2O_5 at 45 kg */fed* + inoculation with mixture of the three biofertilizers.

Obtained results are in harmony with those reported by Sarg and Hassan (2003) and Solieman *et al.* (2003) on pea, El-Oksh *et al.* (1991) and Merghany (1999) on snap bean

5. Seed Quality

The differences in minerals content (%) (N,P and K), protein, sugars, carbohydrates, nitrate and TSS content in pea seeds due to fertilization with mineral N and P and biofertilizers single or mixture are presented in Table 5. Data clearly indicate that such fertilization treatments, in general, significantly enhanced all seed quality characters compared to control (untreated).

It is also clear that all seed chemical constituents were at maximum values after fertilization with 20+30 or 30+45 kg / *fed* NP in combination with mixture of the three biofertilizers (Rizo., Okad. and Phos.) without significant differences between them and that was followed by fertilization with 20 or 30 kg N+45 kg P_2O_5+ Rizobacterein or with 30 kg N+30

Table 4: Effect of mineral N and P and biofertilizers (1.2 kg/*fed*, each) on the minerals content and total uptake of pea plants in 2001/2002 seasons

Treatments			Minerals content (%)									Total uptake (mg /palnt)		
			Roots			Stem			Leaves					
N	P_2O_5	Biofertlizers	N	P	K	N	P	K	N	P	K	N	P	K
(Kg/*fed*)														
0	0	Without(control)	1.47	0.120	1.37	1.34	0.133	1.29	2.35	0.184	2.27	32.98	2.915	31.71
0	45	Rizobactrein	1.64	0.146	1.55	1.57	0.214	1.50	2.53	0.243	2.52	46.44	5.325	45.10
10	45	Rizobactrein	1.77	0.154	1.66	1.77	0.227	1.66	2.80	0.252	2.67	57.17	6.195	54.02
20	45	Rizobactrein	1.97	0.160	1.80	2.04	0.231	1.99	3.15	0.256	2.82	71.01	6.893	66.44
30	45	Rizobactrein	2.07	0.154	1.88	2.15	0.214	2.10	3.20	0.247	2.87	76.75	6.767	71.97
0	45	Okadein	1.59	0.143	1.47	1.54	0.210	1.49	2.51	0.239	2.47	42.81	4.911	41.54
10	45	Okadein	1.69	0.156	1.63	1.74	0.222	1.59	2.75	0.243	2.59	52.12	5.624	48.54
20	45	Okadein	1.77	0.160	1.74	1.99	0.226	1.80	3.00	0.248	2.74	63.02	6.217	57.57
30	45	Okadein	1.90	0.156	1.77	2.12	0.218	1.89	3.05	0.243	2.79	67.13	5.968	60.62
30	0	Phosphorein	1.62	0.150	1.55	1.82	0.218	1.58	2.75	0.239	2.47	53.96	5.611	47.84
30	15	Phosphorein	1.67	0.172	1.71	1.90	0.247	1.74	2.80	0.260	2.62	60.48	6.850	56.38
30	30	Phosphorein	1.72	0.189	1.80	1.94	0.268	2.02	2.90	0.285	2.82	68.03	8.117	68.92
30	45	Phosphorein	1.67	0.189	1.82	1.90	0.272	2.10	2.90	0.289	2.84	71.80	8.701	75.16
0	0	Rizo.+Okad.+Phos.*	1.60	0.131	1.44	1.62	0.197	1.44	2.53	0.201	2.39	42.45	4.289	38.92
10	15	Rizo.+Okad.+Phos.	1.74	0.150	1.71	1.69	0.227	1.93	3.00	0.252	2.67	56.13	6.048	57.06
20	30	Rizo.+Okad.+Phos.	2.02	0.180	1.80	1.97	0.277	2.19	3.25	0.264	2.89	74.06	8.164	73.70
30	45	Rizo.+Okad.+Phos.	2.09	0.189	1.88	2.22	0.281	2.24	3.30	0.272	2.96	80.92	8.520	77.09
LSD at 0.05level			0.09	0.017	0.11	0.19	0.020	0.11	0.22	0.021	0.11	5.18	0.462	3.31

* Rizo., Okad. and Phos. : Rizobactrein , Okadein and Phosphorein , respectively.

Table 5: Effect of mineral N and P and biofertilizers (1.2 kg/*fed*, each) on the quality of pea seeds in 2001/2002 season

Treatments			Minerals content (%)			Total (%)			Nitrate (mg/kg DW)	TSS (%)
N (Kg/*fed*)	P_2O_5	Biofertlizers	N	P	K	Protein	Sugar	Carbohydrate		
0	0	Without(control)	3.20	0.321	2.34	20.00	5.18	47.04	199.07	9.76
0	45	Rizobactrein	3.60	0.351	2.62	22.50	6.25	49.98	180.11	10.73
10	45	Rizobactrein	4.00	0.373	2.92	25.00	6.49	52.24	194.68	11.50
20	45	Rizobactrein	4.30	0.377	3.06	26.87	7.13	55.01	229.77	12.10
30	45	Rizobactrein	4.35	0.358	3.13	27.19	7.30	57.78	222.06	12.56
0	45	Okadein	3.55	0.358	2.63	22.19	6.05	50.48	186.43	10.60
10	45	Okadein	3.85	0.381	2.84	24.06	6.35	51.82	214.34	11.20
20	45	Okadein	4.15	0.392	2.91	25.94	7.00	54.09	233.60	11.86
30	45	Okadein	4.28	0.373	2.99	26.77	7.20	55.94	212.41	12.10
30	0	Phosphorein	3.75	0.370	2.77	23.44	6.12	51.32	266.43	10.80
30	15	Phosphorein	4.05	0.403	2.94	25.31	6.29	53.17	299.22	11.60
30	30	Phosphorein	4.10	0.430	3.10	25.62	7.03	56.86	291.77	12.20
30	45	Phosphorein	4.10	0.436	3.15	25.62	7.23	57.78	304.22	12.63
0	0	Rizo.+Okad.+Phos.*	3.55	0.343	2.67	22.19	6.02	49.98	183.27	10.60
10	15	Rizo.+Okad.+Phos.	4.05	0.396	2.91	25.31	6.52	52.24	192.75	11.63
20	30	Rizo.+Okad.+Phos.	4.30	0.424	3.17	26.87	7.26	55.94	211.25	12.56
30	45	Rizo.+Okad.+Phos.	4.35	0.437	3.17	27.19	7.40	58.71	220.17	13.36
LSD at 0.05 level			0.21	0.016	0.14	1.36	0.29	3.51	35.59	0.36

*Rizo., Okad. and Phos. : Rizobactrein , Okadein and Phosphorein , respectively.

or 45 kg P_2O_5 in combination with phosphorein, without significant differences between those of phosphorein inoculation or those of rizobacterein with few exceptions.

For nitrate content (Table 5), the highest significant values were obtained after fertilization with 30 +45 kg/fed NP and seed inoculation with phosphorein (304.22 mg/kg DW) and after fertilization with 30+30 kg /fed NP+ phosphorein (291.77 mg/kg DW) with significant differences between them. While, the minimum value (180 mg/kg DW) was obtained with 0+45 kg/ *fed* NP used in conjunction with Rizo. Obtained results after application of high levels of both treatments P or phosphorein confirmed that P fertilizer is of great importance to pea plants. These results are agreeable with those reported by El-Neklawy *et al.* (1985), Abdel-Ghaffar *et al.* (1994), Ramadan (1997) on pea, and Merghany (1999) on snap bean for N,P,K, protein, carbohydrate and TSS in seeds.

REFERENCES

Abdel- Ghaffar, S.A., A.M. Hanna, and F.I. Mohamed. 1994. Effect of inoculation and foliar application of trace elements on nodulation and yield of bean. Egypt. J. Appl. Sci. 9 (4): 875 - 889.

Ahmed, A.M.A.1999. Studies on the response of some pea cultivars to the inoculation with rhizobium and fertilization rates with NPK in the new reclaimed land .Ph D. Thesis, Fac. Agric., Minia Univ.

Arisha, H.M. and A. Bardisi.1999. Effect of nitrogen fertilization and plant spacing on growth, yield and pod quality of common bean under sandy soil conditions. Zagazig J.Agric. Res. 26 (2):407-419.

Bhonde, S.R., S.B. Sharma, and A.B. Chougule.1997. Effect of biofertilizer in combination with nitrogen through organic and inorganic sources on yield and quality of onion. National Hort. Res. Develop. Found. 17 (2):1-3.

Bremner, J.M. and C.S. Mulvaney. 1982. Total nitrogen In: Page, A. L., R. H. Miller, and D. R. Keeney (Eds.). Methods of Soil Analysis. Part 2, Amer. Soc. Agron. Madison, W. I. USA. pp. 595- 624.

Cacciari, D.L., T. Pietrosanti, and W. Pietrosanti. 1989. Phytohormones – Like substances produced by single and mixed diazotrophic cultures of *Azospirillum* and *Arthrobacter*. Plant and Soil 115 : 151-153.

Cafado, D. A., M. Haroon, L. E. Sharderand, and V.L. Youn. 1975. Rapid colorimetric determination of nitrate in plant tissues by nitrification of salicylic acid comm. Soil Plant Anal. 6: 71-80.

Dubois, M., K.A. Gilles, J. Hamillon, P. A. Rebers, and F. Smith. 1956. Colorimetric methods for determination of sugars and related substances. Anal. Chem. 28:350.

El-Beheidi, M.A., A.A. Gad, M.H. El-Sawah, and H.M. El-Hady. 1985. Effect of inoculation with *Rhizobium leguminosarum* and nitrogen fertilization on pea plants. 1- Growth and plant chemical composition. Zoldsegtermesztesi Kutato Intezet Bulletinje. 18 : 17-25.

El-Beheidi, M. A., A.A. El-Mansi, M.A. Metwally, A.A. Guirgis, and Suzan A. Swidan. 1996. Level and number of application of nitrogen fertilizer and their interaction on growth and yield of pea plants. Zagazig J. Agric. Res., 23 (3): 413-425.

El-Khatib, H.A. 2003. Yield response of peas to nitrogen and bio-organic fertilization: A mathematical model. J. Adv. Agric. Res. Vol.8 (4): 767-783.

El-Neklawy, A.S., H.K.A. El-Maksoud, and A.M. Salim 1985. Yield response of pea *(Pisum sativum* L.*)* to NPK fertilization and to inoculation with rhizobium in a sandy soil. Annals Agric. Sci., Moshtohor, Egypt. 23 (2): 1362 - 1372.

El-Oksh, I.I., M.M. Soliman, M. H. El-Demardash, and Samira, El-Gizy. 1991. Effect of rhizobial inoculation and nitrogen supplementation on growth and yield of common bean (*Phoseolus vulgaris* L.) Annals Agric. Sci., Ain Shams Univ., Cairo, 36 (2): 599-607.

Forsee, W.T., Jr. 1938. Determination of sugar in plant materials. A photometeric method. Indus. Eng. Chem. Anal. Ed. 10:411-418.

Gardener, F.D., R.B. Pearce, and R.L. Mitchell.1985. Physiology of Crop Plants. The Iowa State Univ., Press. Amer., 327 pp.

Gewaily, E.M., I.H. Abd El-Fattah, and I.A. El-Garhi. 1996. Response of pea plants (*Pisum sativum* L.) to irrigation waste effluent, NPK fertilization and rhizobial inoculation in sandy soil. Zagazig J.Agric. Res. 23 (6):1065-1085.

Gheeth, R.A.M. 1993. Effcet of rhizobium application and nitrogen and phosphorus fertilization rates on growth and yield of peas (*Pisum sativum* L.) M.Sc. Thesis, Fac. Agric., El-Minia Univ., Egypt.

Hamissa, A.M., F. M. Hammouda, and R.E. Knany. 2000. Response of modulated faba bean crop to phosphate solublizing bacteria under phosphorus fertilization and copper foliar spray application. J. Agric., Sci., Mansoura Univ., 25 (5):2995-3007.

Hassan, M.N.M., M.M. Farrag, S.H. Gad El-Hak, and R.H.M. Gheath 1993. Effect of Rhizobium, nitrogen and phosphorus application on growth and yield of pea. I-Fresh yield. Minia First Conference for Horticultural Crops, 19-21 October:201- 225.

Hegde, D.M., B.S Dwivedi, and S.S. Sudhakara Babu. 1999. Biofertilizers for cereal production in India. A review Indian. of Agric. Res. 69 (2): 73 – 83.

Hewedy, A. M., M.A. Ahmed, and H.E. Asfour. 2003. Effect of biofertilizer in combination with different rates from N-P mineral fertilizers on the growth and green pods and dry seed yield of common bean. Minufiya J. Agric., Res. Vol.28 5, (2): 1651-1665.

Jackson, M.L. 1970. Soil Chemical Analysis. Prentic Hall, Englewood Ceiffs, N. J.

Marschner, H. 1995. Mineral Nutrition of Higher Plants. 2nd (ed.), Academic Press Limeted, Text Book.

Mengel,K. and E.A. Kirkby. 1978. Principles of Plant Nutrition. International Potash Institute, P.O.Box CH. 3048, Worblaufed Bern, Switzerland.

Merghany, M.M.1999. Response of snap bean to different rhizobium inoculation methods and nitrogen levels under two drip irrigation regimes in new reclaimed sandy soil. Zagazig J. Agric. Res. 26 (4): 1091-1123.

Olsen, S. R., and L. E. Sommers. 1982. Phosphorus. In: Page. A. L., R. H. Miller, and D. R.Keeney (Eds.). Methods of Soil Analysis .Part 2 Amer. Soc. Agron. Madison, W. I. USA. pp.: 403-430.

Paleg, L.G. 1985. Physiological effects of gibberellins. Ann. Rev. Plant Physiol. 16 : 291-322.

Pathak, D.V, A.L. Khurana, and S. Singh. 1977. Biofertilizers for enhancement of crop productivity. A review. Agric. Res. 18 (13):155-166.

Prasad, R.N., and Maurya, A.N. 1992. Note on effect of Rhizobium at different levels of P_2O_5 on growth, nodulation and yield of garden pea *(Pisum sativum* L.) cv. Arkel. Progressive Horticulture 21 (3-4): 208 - 212. (C.F. Hort. Abstr. 63 (6): 4248).

Ramadan, M.M. 1997. Effect of some agricultural treatments on the growth and yield of pea plant. M.Sc. Thesis, Fac. Agric., Zagazig Univ.

Sarg, Sawsean M.H.S. and M.A.H. Hassan. 2003. Effect of rhizobium inoculation , nitrogen fertilization and plant density on growth , yield and minerals content of pea under sandy soil conditions. J. Agric. Sci., Mansoura Univ., 28(11):6857-6873.

Shibru, D. and H. Mitiku. 2000. Effect of rhizobial inoculate and nitrogen fertilizer on yield and nodulation of common bean. J. of plant Nutrition 23 (5):581-591.

Snedecor, G.W. and W.G. Cochran 1980. Statistical method. 7 th (ed.) Iowa State Univ., Press, Amer., Iowa, USA.

Solieman, T.H.I., H.A. El-Khatib, and S.M. El-Araby. 2003. Effect of organic manure, mineral nitrogen and bio-fertilizer application on vegetative growth and chemical composition of pea (*Pisum sativum* L.) Zagazig J. Agric. Res., 30, (3): 751-767.

Srivastava, T.K. and I.P.S. Ahlawat. 1995. Response of pea (*Pisum sativum*) to phosphorous, molybdenum and biofertilizers .Indian J. Agron. 40 (4): 630-635.

Subba Rao, N.S.1993.Biofertilizers in Agriculture, 3 rd (ed.), Oxford, IBH Publishing Co. Ltd.,New Delhi, Bombay, Calcutta ,219 pp.

Tien, T.M., M.H. Gaskins, and D. H. Hubble. 1970. Plant growth substances produced by *Azospirillum barasillense* and their effect on growth of plants . Appl. Environ. Microb. 37: 1016-1024.

Wettestein, D. 1957. Cholorphyll-lethale und der submikroskopische formwechsel der plastiden. Exptl. Cell. Res. 12 : 427 - 433.

تأثير التسميد المعدنى والحيوى على النمو والمحصول وجودة محصول البسلة تحت ظروف الأراضى الرملية

محمد عبد الحميد البهيدى[1]- على أحمد عطية المنسى[1]- المتولى عبد السميع الغمرينى[1] - فايز ابراهيم محمد[2] - محمد محمد رمضان[2]

[1] قسم البساتين – كلية الزراعة –جامعة الزقازيق – مصر.

[2] معهد بحوث البساتين – مركز البحوث الزراعية – جيزة – مصر.

أجريت تجربتان حقليتان خلال موسمين شتويين متتالين لعامى ٢٠٠٠ / ٢٠٠١، ٢٠٠١ / ٢٠٠٢ في مزرعة التجارب الزراعية بالخطارة التابعة لكلية الزراعة ، جامعة الزقازيق – لدراسة تأثير كل من التسميد النيتروجينى والفوسفاتى المعدنى والحيوى على النمو والمكونات الكيماوية وجودة بذور البسلة تحت ظروف الأراضي الرملية .

أعطى تسميد نباتات البسلة بالسماد المعدنى النيتروجينى والفوسفاتى بمعدل ٣٠ +٤٥ كجم ن، فو٢أ٥ على التوالى مع إضافة مخلوط من الأسمدة الحيوية (ريزوباكترين + عقدين+ فوسفورين)، أو الفوسفورين أو مع الريزوباكترين منفردا أعلى القيم لكل من طول الساق، وعدد الأوراق، وعدد الأفرع، وعدد العقد الجذرية لكل نبات، والوزن الجاف الكلى فى كلا الموسمين. وتم الحصول على أعلى القيم لكل من الكلوروفيل أ، ب، (أ+ ب) والكاروتينويدات فى أنسجة الورقة، وعدد القرون على النبات، وعدد البذور فى القرن ومحصول النبات والمحصول الكلى للفدان فى كلا الموسمين، والممتص الكلى من النيتروجين والفوسفور والبوتاسيوم للنبات، بينما تم الحصول على أقل القيم فى النباتات غير المعاملة (الكونترول) فى الموسم الثانى فقط، وبالإضافة الى ذلك ازداد معنويا تركيز النيتروجين والفوسفور والبوتاسيوم فى أنسجة الجذور والساق والأوراق، وكذلك عدد العقد الجذرية للنبات بإضافة النيتروجين بمعدل ٢٠ كجم (ن)+ الفوسفور بمعدل ٣٠ كجم (فو٢أ٥) للفدان مع إضافة مخلوط من كل من (الريزوباكترين + العقدين+ الفوسفورين).