Egypt. J.Hort. **29**, No. 2, pp. 187 - 203 (2002)

Effect of Bio- and Mineral Phosphorus Fertilizer on the Growth, Productivity and Nutritional Value of Faba Bean

A.M. Abdalla

Horticulture Research Deptartment, National Research Centre, Cairo, Egypt.

TWO FIELD experiments were carried out in the Experimental Farm of the National Research Centre at Shalakan, Kalubia Governorate in 2000/2001 and 2001/2002 seasons to study the response of Faba bean plants to bio and mineral phosphorus fertilizers. The experiment included nine treatments representing the interaction of 3 bio-fertilizer treatments (without, one dose and two doses) with three mineral fertilizer treatments (100, 150 and 200 kg superphosphate/fed).

Obtained data showed that bio-fertilizer (one and two doses) improved plant growth, *i.e.*, plant height, leaves and shoots number and dry matter, than the control. Application of superphosphate (150 - 200 kg/fed) improved plant growth. The interaction between bio- and mineral phosphorus improved plant growth which was highest with plants receiving two doses of bio- P combined with 150 kg superphosphate/fed, and poorest with plants receiving zero bio- P and 100 kg superphosphate/fed.

Pod yield expressed as number of pods, average pod weight and green pod yield (g/plant and/or ton/fed) were highest with two doses of bio-fertilizer treatments and/or with 200 kg superphosphate/fed. The interaction between bio- and mineral phosphorus showed the highest values of green pod yield with plants receiving two doses of bio-fertilizer combined with 200 kg superphosphate/fed.

The chemical composition, *i.e.*, N, protein, P, K, total soluble sugars % and V.C. content were increased with bio-fertilizer treatments and/or with increasing the mineral P level from 100 to 150 and 200 kg superphosphate/fed. The highest values of nutrients in green pods were recorded with plants receiving two doses of bio- P combined with 200 kg/fed of superphosphate.

Faba bean is an important vegetable crop in Egypt as a necessary protein source for human consumption.

Fertilization is a major factor for increasing the seed yield production as well as its quality.

Many investigators directed their contribution to P solubilization, others went to production of plant growth modifying substances by such bio-fertilizers (El-Sheekh, 1997).

Bio-fertilizers were reported to affect plant growth (Ascosta *et al.*,1995 and Shen, 1997) and total yield of plant (Arkhipenko, 1996 and Kwon *et al.*, 1996) as well as its physical and chemical properties (Ranganathan & Selvaseelan, 1997 and Zahir *et al.*, 1997).

The significant effect of bio-fertilizers may be due to the effect of different strain groups and nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted material and increased levels of extractable minerals (El-Kramany *et al.*, 2000).

Bio-fertilizer application improves plant growth, fruit yield and chemical composition, as compared with the control (Abdalla *et al.*, 2001, on pepper plants and Abdel-Mouty *et al.*, 2001 on potato plants). Application of NPK with bio-fertilizer resulted in the best growth, total yield and fruit characters of guar plants (Ali , 2001).

Phosphorene is a bio-fertilizer product containing active microorganisms hydrolyzing the insoluble phosphate into soluble one under high soil pH and greater percentage of calcium carbonate, consequently, partially overcomes the phosphate fixation of Anna apples (Mansour, 1998).

Applying phosphate bio-fertilizers to soil increased soluble phosphates, plant growth, dry matter, protein and N and P contents of maize plant (El-Sawah *et al.*, 1995).

The promoting effect of bio-fertilizer is due to the active bacteria in phosphorene which is capable of transforming the tri-calcium phosphate to mono-calcium phosphate (Ashour, 1998). Sherif *et al.* (1997) added that phosphates dissolving bacteria presses the ability to bring insoluble phosphate in soluble forms secreing organic acids such as formic acetic and lactic acids. Such acids lower the pH and bring about the dissolution of bonds forms of phosphate and render then available for growing plants.

Application of P at 25.8 kg/ha or phosphate solubilizing (PS) resulted in marked increase in growth and grain yield of pea plants (Srivastava *et al.*, 1998). They added that availability of P influences the productivity by affecting the processes of energy storage and transfer.

Application of phosphorus fertilizer encouraged plant to stimulate flowering and improving quantity and quality of seeds, and it is necessary for protoplasm formation and yield of guar plants (Ali , 2001).

Increasing the rates of superphosphate up to 300 kg/fed resulted in an increment in average number of leaves, dry matter, pod length, seed number/pod, total green and dry yield of broad bean (Shaheen *et al.*, 1989) and of pea plants (Omar *et al.*,1990).

Dry matter yield, leaf area and P contents of bean plants were increased with increasing P supply in all experiments (Al-Karaki, 1992).

Yields of faba bean and onion were increased with increasing P rates. Phosphorene application increased total yield (El-Kalla *et al.*,1999).

This study aimed to explore the response of faba bean plants growth and productivity to mineral and bio-fertilizer phosphorus treatments.

Material and Methods

Two successive field experiments were carried out in the Experimental Farm of the National Research Centre, in Shalakan, Kalubia Governorate in 2000 and

2001 seasons to study the response of faba bean plants growth and productivity to mineral and/or bio-fertilizer treatments of phosphorus as well as their interaction.

The experimental soil was clay loam in texture with E.C. 2.3 mmhos/cm, pH 7.8 and 141 meq/l. available N, 4.9 meq/l. P and 0.32 meq/l exchangeable K.

Each experiment included nine treatments representing the interaction between three application doses of the bio-fertilizer (phosphorene), *i.e.* , without, one dose and two doses with three rates of mineral phosphorus, *i.e.*, 100, 150 and 200 kg superphosphate (16.5 % P_2O_5)/fed. The nitrogen and potassium mineral fertilizers were applied as the recommended rates, *i.e.*, 200 kg ammonium sulphate (20.5 % N) and 100 kg potassium sulphate (48 % K_2O/fed) .

Phosphorene was applied as recommended by Ministry of Agriculture (two packages each of 1 kg/fed) once at sowing time and/or twice, *i.e.*, at sowing and one month later, as compared to the control (without).

Faba bean seeds cv. El-Kobrsy were sown on 15^{th} and 20^{th} of October in 2000 and 2001 seasons, respectively. The experimental plot area was 10.5 m^2 which included rows each was of 3.5 m length and 60 cm width. The distance between plants was 20.0 cm.

Treatments were arranged in a split block design with 4 replicates where the phosphorene treatments were distributed in the main plots and the mineral phosphorus treatments occupied the sub-plots.

Vegetative growth samples were taken 45 and 90 days after sowing. A random sample of five plants was taken from each plot for plant height, number of leaves and shoots, as well as dry matter content determinations.

In the beginning of April of both seasons, pods were harvested and measurements of number of pods, number of seeds per pod as well as seeds dry weight per plant, were recorded.

A random sample of ten pods of each treatment was taken for the chemical analysis purposes, *i.e.* N,P,K, protein, total soluble sugars and ascorbic acid (vitamin C) determinitions. N,P and K were determined according to Black (1983), Watanab & Olsen (1965) and Jacksen (1965), respectively. The percentage of crude protein, total soluble sugars and ascorbic acid (Vitamin C) were determined according to A.O.A.C. (1975).

The obtained data were subjected to the analysis of variance procedure and means were compared using the L.S.D. method at 5 % level of significance according to Gomez & Gomez (1984).

Results and Discussion

Vegetative growth

Effect of bio-fertilizer

Data presented in Table 1 showed that application of phosphorene improved plant growth expressed as plant height, number of leaves and shoots as well as dry matter content, as compared to the control (without bio-fertilizer). Such response was shown in both samples, *i.e.*, 45 and 90 days, in both seasons. Data also indicated that two doses application of phosphorene showed an increment in plant growth than that of one dose application treatments. However, the differences between these two treatment failed to reach the 5 % level of significance, in most cases.

It could be concluded that application of the bio-P fertilizer named phosphorene increased plant growth and dry matter due to that phosphorene enhanced phosphorus solubilization (El-Sheekh, 1997). The effect of bio-fertilizer may be due to the effect of nutrients mobilizing microorganisms which help in availability of metals and increased levels of extractable minerals (El-Kramany *et al.*,2000).

The obtained results agreed with those of Sherif *et al.* (1997) who mentioned that phosphates dissolving bacteria presses the ability to bring a soluble phosphate in soluble forms secreting organic acids which lower the pH and bring about the dissolution of bonds forms of phosphate and render then available for growing plants.

TABLE 1. Effect of bio- and mineral phosphate fertilizers on the growth characters of faba bean plants in 2000/2001 and 2001/2002 seasons.

Characters / Fertilizer treatments		Plant height (cm)		Leaves No. /plant		Shoots No./plant		Dry wt. (g/plant) 90 days
Bio	Mineral kg/fed.	45 days	90 days	45 days	90 days	45 days	90 days	
First season (2000/2001)								
Without	100	55	66	26	35	3	5	67
	150	55	68	27	37	3	6	65
	200	58	73	29	42	4	6	69
Mean		56.3	69.0	27.3	38.0	3.3	5.7	65.3
One dose	100	53	70	28	43	4	7	75
	150	55	72	33	52	5	8	82
	200	60	78	35	57	5	9	90
Mean		56.0	73.3	32.0	51.0	4.7	8.0	82.3
Two doses	100	57	75	35	55	4	7	80
	150	59	81	39	60	6	11	99
	200	61	83	38	58	6	9	92
Mean		58.0	80.0	37.3	58.0	5.3	9.0	90.3
Average of	100	55.0	70.3	29.7	44.3	3.3	6.3	72.3
	150	56.3	73.7	33.0	49.7	4.7	8.3	82.0
	200	59.7	78.0	34.0	52.3	5.0	8.0	83.7
L.S.D. at 5 % level	Interaction	6.04	7.81	5.16	5.92	1.26	1.51	8.62
	Bio	N.S	6.41	4.52	7.00	1.13	1.42	9.13
	Mineral	N.S	5.83	4.17	6.14	1.31	1.36	N.S
Second season (2001/2002)								
Without	100	49	62	24	29	3	5	57
	150	52	66	25	33	3	6	59
	200	55	71	29	39	3	6	63
Mean		52	66.3	26.0	33.7	3.0	5.7	59.7
One dose	100	50	69	27	39	4	6	64
	150	55	72	31	46	5	8	71
	200	59	75	35	51	5	8	75
Mean		54.7	72.0	31.0	45.3	4.7	7.3	70.0
Two doses	100	56	72	34	50	4	7	79
	150	59	79	38	58	6	9	86
	200	62	81	36	55	6	10	84
Mean		59.0	77.3	36.0	54.3	5.3	8.7	83.0
Average of	100	51.7	67.7	28.3	39.3	3.7	6.0	66.7
	150	55.3	72.3	31.2	45.7	4.7	7.7	72.0
	200	58.7	75.7	33.3	48.3	4.7	8.0	74.0
L.S.D. at 5 % level	Interaction	6.6	8.7	4.9	5.2	1.4	2.6	7.8
	Bio	N.S	7.3	5.6	5.5	1.2	1.9	6.4
	Mineral	N.S	5.0	3.4	4.9	0.8	1.1	N.S

The findings of El-Sawah *et al.* (1995), Ashour (1998), Mansour (1998), Abdalla *et al.* (2001), Ali (2001) and Abdel Mouty *et al.* (2001) supported our results.

Effect of mineral fertilizer

The obtained results (Table 1) clearly indicated that the addition of phosphorus fertilizer at rates within 100-200 kg of superphosphate resulted in a slight increase in values of growth characters obtained with application of superphosphate at a rates of 100-150 kg/fed, however increasing P rate more than 150 kg/fed Showed no significant response. These findings were supported by previous workers such as El-katkat (1992) on broad bean, El-Awag *et al.* (1993) on soybean and Ali (2001) on guar plants.

Effect of the interaction

All plant growth measurements significantly responded to the interaction treatments. These results held good in both plant samples of the two experimental seasons, except plant height at 90 days sample. Generally, it could be concluded that the highest values of plant height, number of leaves and shoots per plant as well as dry weight of whole of plant were recorded by plants treated with bio-P-fertilizer at two doses and supplied with the medium rate of chemical P. On the contrary, the poorest plant growth was noticed in case of plants which received no bio-P-fertilizer and supplied with the lowest rate of superphosphate (100 kg/fed). These findings were in good accordance in both samples of the two experimental seasons.

Total yield and its components

Effect of bio-fertilizer

Application of phosphorene increased the records of number of pods and average pod weight as well as green yield, than the control plants (Table 2). Two doses application of phosphorene overcame one dose treatment, for all pod yield characters studied. This effect of phosphorene on pod yield of faba bean was shown in both experimental seasons. The positive effect of bio-fertilizer on pod yield of faba bean is an expected result for its effect on improving plant growth and dry matter production. Such response to bio-fertilizer was reported

TABLE 2. Effect of bio- and mineral phosphate fertilizers on the pod yield characters of faba bean plants in 2000/2001 and 2001/2002 seasons.

Characters / Fertilizer treatments		Pod No./plant	Aver. Pod wt. (g.)	Green yield (g/plant)	Green yield (ton/fed.)
Bio	Mineral kg/fed.				
First season (2000/2001)					
Without	100	25	14	350	2.80
	150	27	15	405	3.24
	200	30	18	540	4.32
Mean		27.3	15.7	431	3.45
One dose	100	25	18	450	3.60
	150	30	20	600	4.80
	200	32	21	672	5.38
Mean		29.0	19.7	574	4.59
Two doses	100	28	20	560	4.48
	150	31	21	651	5.21
	200	30	20	600	4.80
Mean		29.7	20.3	604	4.83
Average of	100	26.0	17.3	453	3.63
	150	29.3	18.7	552	4.42
	200	30.7	19.7	604	4.83
L.S.D. at 5 % level	Interaction	5.6	6.1	64.3	0.68
	Bio	N.S	4.3	45.7	0.51
	Mineral	N.S	2.2	48.2	0.37
Second season (2001/2002)					
Without	100	24	12	288	2.31
	150	29	15	435	3.48
	200	30	17	510	4.08
Mean		27.7	14.7	411	3.29
One dose	100	26	16	416	3.33
	150	24	20	480	3.84
	200	32	21	672	5.38
Mean		27.3	19.0	523	4.18
Two doses	100	26	18	468	3.75
	150	29	23	667	5.34
	200	28	20	560	4.48
Mean		27.7	20.3	565	4.52
Average of	100	25.3	15.3	390	3.13
	150	27.3	19.3	527	4.22
	200	30.0	19.3	581	4.65
L.S.D. at 5 % level	Interaction	5.2	5.9	78.6	0.76
	Bio	N.S	4.3	52.4	0.53
	Mineral	N.S	3.1	47.0	0.51

by many investigators, *i.e.* El-Kalla *et al.* (1999), Abdalla *et al.* (2001), Ali (2001) and Abdel-Mouty *et al.* (2001) who stated that bio-fertilizer application increase result from its effect on improving plant growth and dry matter production. Such response to bio-fertilizer was reported by many investigators, *i.e.* El-Kalla *et al.* (1999), Abdalla *et al.* (2001), Ali (2001) and Abdel-Mouty *et al.* (2001) who stated that bio-fertilizer application increased total yield production of studied crops. Srivastava *et al.* (1998) added that the availability of P influences the productivity by affecting the processes of energy storage and transfer.

Effect of mineral fertilizer

Data in Table 2 showed that increasing the superphosphate treatments from 100 to 150 or 200kg /fed increased number of pods per plant, average pod weight as well as green yield, *i.e.*, gm/plant or ton/fed, in both seasons. The highest pod yield values were recorded with 200 kg superphosphate treatments. Differences between treatments were significant at 5 % level in both seasons, with a few exception.

It could be concluded that increasing the mineral phosphorus fertilizer increased pod yield of faba bean, as a result of its increment on plant growth and dry matter accumulation. The obtained results were in accordance with those mentioned by Omar *et al.* (1990), Srivastava *et al.* (1998) and Ali (2001) who reported that P fertilizer encouraged plant to stimulate flowering and improving quantity and quality of yield, and that P is necessary for protoplasm formation.

Effect of the interaction

The interaction between bio- and mineral phosphorus fertilizer positively affected faba bean yield and productivity (Table 2).

The highest values of number of pods per plant and average pod yield were recorded with faba bean plants receiving two doses of bio-fertilizer with 150 or 200 kg superphosphate/fed, with no significant difference.This effect was shown in both seasons. However, such records were lowest with plants receiving zero bio-fertilizer combined with 100 kg superphosphate/fed, in both experimental seasons.

Green pod yield (g/plant and/or ton/fed) was increased with bio- and/or mineral phosphorus fertilization, as compared to the control, in both seasons. The highest pod yield values were recorded with faba bean plants receiving two doses of phosphorene combined with 150 or 200 kg superphosphate, in both seasons. Whereas, pod yield was lowest with plants receiving zero bio-fertilizer combined with 100 kg superphosphate/fed. Data indicated that bio-fertilizer (phosphorene) combination with mineral fertilizer stimulated plant productivity. Data also showed that the increment of mineral fertilizer from 150 to 200 kg superphosphate/fed was not significant.

Nutritional value of green pods

Effect of bio-fertilizer

Data in Table 3 indicated that the nutritional value of green pods of faba bean is significantly affected by phosphorene addition since it was increased, especially with 2 doses application, as compared to the control. This effect was shown in both seasons for N,P,K and protein percentages. Differences between treatments were significant at 5 % level, except for K percentage character.

Total soluble sugars percentage as well as V.C. content showed a similar trend of response and recorded their highest values with plants receiving two doses of phosphorene and their lowest ones with the control plants, in both seasons.

The obtained results agreed with those of El-Sawah *et al.* (1995) and Kwon (1996) who reported that bio-fertilizer affected the physical and chemical properties of the plant. Abdalla *et al.* (2001) and Abdel-Mouty *et al.* (2001) reported that bio-fertilizer application improves fruit yield and chemical composition, which supports our results.

Effect of mineral fertilizer

Data shown in Table 3 indicated the promotive influence of the higher superphosphate dose on the nutritional value of the product. The highest values of N, P, K, protein percentages as well as of total soluble sugars and V.C. contents accompanied 150 or 200 kg superphosphate/fed treatments, in both

TABLE 3. Effect of bio- and mineral phosphate fertilizer on the chemical composition of faba bean green pods in 2000/2001 and 2001/2002 seasons.

Characters / Fertilizer treatments		N %	Protein %	P %	K %	Total soluble sugars %	V.C. (mg/10 g fresh wt.)
Bio	Mineral kg/fed.						
First season (2000/2001)							
Without	100	3.3	2.8	0.34	2.14	5.9	13.6
	150	3.3	2.9	0.37	2.26	5.8	14.2
	200	3.6	3.0	0.38	2.29	6.1	14.9
Mean		3.4	2.9	0.36	2.23	5.9	14.23
One dose	100	3.5	2.9	0.36	2.22	6.0	14.8
	150	3.7	3.0	0.38	2.33	6.3	15.9
	200	3.9	3.2	0.40	2.41	6.8	16.8
Mean		3.9	3.0	0.38	2.32	6.37	15.83
Two doses	100	3.7	3.0	0.38	2.27	6.2	15.9
	150	3.9	3.4	0.39	2.41	6.7	16.7
	200	4.3	3.5	0.44	2.49	7.3	17.9
Mean		4.0	3.3	0.40	2.39	6.73	16.83
Average of	100	3.5	2.9	0.36	2.21	6.03	14.77
	150	3.6	3.1	0.38	2.33	6.27	15.60
	200	3.9	3.2	0.41	2.40	6.67	16.53
L.S.D. at 5 % level	Interaction	0.41	0.21	0.08	N.S	0.63.	1.65
	Bio	0.36	0.17	0.03	N.S	0.42	1.32
	Mineral	0.26	0.16	0.02	N.S	0.36	1.16
Second season (2001/2002)							
Without	100	3.1	2.7	0.35	2.18	5.7	14.1
	150	3.2	2.9	0.38	2.25	6.1	15.3
	200	3.5	3.1	0.39	2.29	6.4	15.9
Mean		3.27	2.90	0.37	2.24	6.07	15.1
One dose	100	3.5	2.8	0.37	2.21	6.2	15.8
	150	3.6	3.1	0.39	2.27	6.5	16.7
	200	3.9	3.3	0.42	2.30	6.9	17.5
Mean		3.67	3.07	0.39	2.26	6.53	16.67
Two doses	100	3.8	3.0	0.39	2.29	6.3	15.9
	150	3.9	3.1	0.42	2.36	6.9	16.8
	200	4.2	3.5	0.44	2.44	7.5	17.7
Mean		3.97	3.20	0.42	2.36	6.90	16.80
Average of	100	3.47	2.83	0.37	2.23	6.07	15.27
	150	3.57	3.03	0.40	2.29	6.50	16.27
	200	3.87	3.30	0.42	2.34	6.93	17.03
L.S.D. at 5 % level	Interaction	0.53	0.37	0.07	N.S	0.57	1.86
	Bio	0.45	0.24	0.06	N.S	0.36	1.42
	Mineral	0.27	0.19	0.03	N.S	0.32	1.35

seasons. However, the lowest values were recorded with the control plants (receiving 100 kg superphosphate/fed), indicating that mineral phosphorus improves the nutritional value of the product as previously reported in other studies, *i.e.*, Srivastava *et al.* (1998) who recorded a marked increase in grain yield due to the availability of P which influences the plant productivity by affecting the processes of energy and transfer. Moreover, the findings of Shaheen *et al.* (1989) and Omar *et al.* (1990) supported our results. The findings of Ali (2001) agreed with the obtained results since it concluded that phosphorus fertilizer encouraged plants to stimulate flowering and improving quantity and quality of seeds and it is necessary for protoplasm formation and yield production of crops.

Effect of the interaction

Data shown in Table 3 represented the combined effect of bio- and mineral phosphorus treatments on the nutritional value of faba bean pods, in both experimental seasons. The highest values of N, P, K, protein, total soluble sugars percentages and V.C. content were recorded with plants receiving phosphorene (two doses) combined with 150 or 200 kg superphosphate/fed, with no significant difference between the two treatments. The lowest values were recorded with the control plants receiving zero bio- P combined with 100 kg superphosphate/fed. This effect was shown in both seasons. Data indicated the stimulatory influence of the interaction between bio- and mineral fertilizer as was reported by previous investigators. Ali (2001) concluded that application of NPK with bio-fertilizer resulted in the best yield and fruit characters, which supports the obtained results.

References

A.O.A.C. (1975) *Official Methods of Analysis Chemists.* 12^{th} ed. A.O.A.C., Wasshington D.C., U.S.A.

Abdalla, A.M.; Rizk , F. A. and Adam, S. M. (2001) The productivity of pepper plants as influenced by some bio-fertilizer treatments under plastic house conditions. *Bull. Fac. Agric. Cairo Univ.* **52** (4), 625.

Abdel-Mouty, M. M., Ali, A. H. and Rizk, F. A. (2001) Potato yield as affected by the interaction between bio-and organic fertilizers. *Egypt. J. Appl. Sci.* **16** (6) , 267.

Ali, A.F. (2001) Effect of micropene and calcium superphosphate on the growth and active ingredients of *Cyamopsis tetragonoloba* (L.) *Taub. Egypt. J. Appl. Sci.* **16** (3), 229.

Al-Karaki, G.N. (1992) Water stress and phosphorus nutrition effects on growth, phosphorus uptake and some physiological traits in sorghum and beans. *Ph.D.Thesis,* Univ.of Nebraska,USA, 157 p.

Arkhipenko, I.A. (1996) Production and application of the microbial granulated bamil fertilizer. *Russian Agricultural Sciences Ni.* **4,** 8 translated form Diklady Rossikoi Akademi ii sel'skohozyaistvennykh Nauk, No. **2,** 32.

Ascosta, S.M., Herrera, G. Alvaraodocapo, Y. and Dita, R.M.A. (1995) Use of bio-fertilizers in the field adaptation phase of microporpagated plants of potatoes, bananas and sugarcane. *Centro-Agricota,* **22** (2), 54.

Ashour, S.A. (1998) Influence of bio-fertilizers and phosphorus application on growth and yield of potato. *J. Agric. Sci., Mansoura Univ.* **23** (7), 3351 .

Black, C.A. (1983) *"Methods of Soil Analysis"* Parts I and II. Amer. Soc. Agron. Inc. Publ., Madison, Wisc., USA.

El-Awag, T.I., Hanna, A.M. and El-Nagar, I.M. (1993) Influence of bio and mineral phosphate fertilization on soybean production and some water characters under different levels of soil moisture. Zagazig Univ. *Egypt. J. Appl. Sci.* **8** (11) , 575.

El-Kalla, S.E., Mostafa, A.K., Lellah, A.A. and Rokia , A.A. (1999) Mineral and bio-phosphatic fertilization for intercropped faba bean and onion. *Egypt. J. Agric. Res.* **77** (1) , 253.

El-Katkat, M.B.O. (1992) Studies on dissolving phosphorus by some bacteria from the rhizosphere of some plants. *M. Sc. Thesis,* Fac. Agric., Ain Shams Univ., p. 183 .

El-Kramany, M.F., Ahmed, M.K., Bahr, A.A. and Kabesh, M.O. (2000) Utilization of bio-fertilizers in field crop production. *Egypt. J. Appl. Sci.* **15** (11) , 137.

El-Sawah, M.M.A., Hauka, F.I.A. and El-Hamdi, K.H. (1995) Role of bacterial phytate fertilizers on increasing soil fertility and crop production. *Egypt. J. Soil Sci.* **35** (3) , 311.

El-Sheekh, H.M. (1997) Effect of bio- and mineral phosphate fertilizers on growth, yield and storability of onion. *Egypt. J. Appl. Sci.* **12** (12), 213.

Gomez, K.A. and Gomez, A.A. (1984) "*Statistical Procedures for Agricultural Research*" (Second ed.). John Willey and Sons, New York, 680 p.

Jackosn, M.L. (1965) "*Soil Chemical Analysis Advanced Course*", publ. by Author, Madisoa, Wisconsin, USA.

Kwon, J.B., Kwon, J.R., Shin, J.S., Kim, C.R. and Choi , R.S. (1996) Effect of organic matters on horticultural characteristics and yield of potato (*Salanum tuperosum* L.) in greenhouse. *Journal of the Korean-Soc. Hort. Sci.*, **37** (6), 758.

Mansour, A.E.M. (1998) Response of Anna apples to some bio-fertilizers. *Egypt. J. Hort.* **25** (2) , 241.

Omar, N.M., Shaheen, A.M. and Bakry, M.O. (1990) The residual effect of sulphur and phosphorus fertilization on the growth and yield of pea (*Pisum sativum* L.) plants. *Egypt. J. Agron.* **15** (1-2), 87.

Ranganathan, D.S. and Selvaseelan, D.A. (1997) Effect of mushrean spent compost in combination with fertilizer application on nutrient uptake by potato in an ultic tropadall. *J. Ind. Soc. Soil.* **45** (3) , 515.

Shaheen, A.M., Bakry, M.O. and Abou-El-Magd, M.M. (1989) Response of growth and yield of broad bean (*Vicia faba* L.) plants to phosphorous and sulfur application. *Egypt. J. Appl. Sci.* **4** (1) B, 378.

Shen, R.Z. (1997) A broad spectrum, bio-pesticides type bio-fertilizer anaerobic fermentation effluent and plant adverse resistance. *Acta-Agriculture Shanghai* **13** (2), 89.

Sherif, F.A., Hegazy, M.H. and Abdel-Fattah, F.K. (1997) Lentil yield and its components as affected by bio-fertilization and phosphorus application. *J. Agric. Sci. Mansoura Univ.* **22** (7) , 2185 .

Srivastava, T.K., Ahlawat, I.P.S. and Panwar, J.D.S. (1998) Effect of phosphorous, molybdenum and bio-fertilizers on productivity of pea (*Pisum sativum* L.). *Indi. J. Plant Physiol.* **3** (3) , 237.

Watanab, F.S. and Olsen, S.R. (1965) Test of an ascorbic acid method for determining phosphorus and NaHCO3 extracts for soil. *Soil Sci. Soc. Amer. Proc.* **29**, 677.

Zahir, Z.A., Arshad, M., Azam, M. and Hussein, A . (1997) Effect of an auxin precurs on tryptophan and *Azotobacter* inoculation on yield and chemical composition of potato under field conditions. *J. plant Nutrition*, **20** (6) , 745.

(*Received* 30 / 7 / 2002)

تاثير التسميد الفوسفورى الحيوى والمعدنى على النمو والانتاجية والقيمة الغذائية للفول الرومى

ابو الفتوح محمد عبدالله

قسم بحوث البساتين - المركز القومى للبحوث - القاهرة - مصر.

تم اجراء تجربتين حقليتين فى موسمى الزراعة ٢٠٠٠/٢٠٠١ ، ٢٠٠١ / ٢٠٠٢ بمزرعة المركز القومى للبحوث بشلقان محافظة القليوبية لدراسة استجابة نباتات الفول الرومى للتسميد بالفوسفورين وكذلك سماد السوبرفوسفات والتفاعل بينهما .

اشتملت الدراسة على تسع معاملات تمثل التفاعل بين ثلاث معاملات للسماد الحيوى الفوسفورين وهى : بدون ، اضافة دفعة واحدة واضافة دفعتين وثلاث معاملات للتسميد المعدنى كالاتى : ١٠٠ ، ١٥٠ ، ٢٠٠ كجم سوبر فوسفات/للفدان .

اوضحت النتائج ان :

١- اضافة السماد الحيوى الفوسفورين (على دفعتين) قد ادى الى تحسين النمو الخضرى للنبات ممثلا فى ارتفاع النبات وعدد الاوراق والافرع ومحتوى النبات من المادة الجافة .

٢- اضافة السوبر فوسفات بمعدل ١٥٠ و ٢٠٠ كجم/للفدان قد ادى الى تحسن صفات النمو الخضرى للنبات .

٣- ادى التفاعل بين السماد الحيوى (الفوسفورين) والمعدنى (سوبر فوسفات) الى تحسين صفات النمو الخضرى - والتى كانت افضل مايمكن مع المعاملة بدفعتين من السماد الحيوى مضافا اليها ١٥٠ كجم سوبر فوسفات/للفدان.

٤- كان محصول القرون اعلى عند المعاملة بالسماد الحيوى (دفعتين) عن نباتات المقارنة كذلك عند المعاملة بالسوبر فوسفات بمعدل ٢٠٠ كجم/للفدان عن باقى المعاملات .

٥- كان التفاعل بين الفوسفورين والسوبر فوسفات افضل مايمكن بالمعاملة بدفعتين من الفوسفورين مضافا اليها السوبرفوسفات بمعدل ٢٠٠ كجم/للفدان حيث اعطت هذه المعاملة اعلى محصول للقرون الخضراء .

٦- كان المحتوى الكيماوى للقرون الناتجة ممثلا فى محتواها من النتروجين ، الفوسفور ، البروتين ، البوتاسيوم والسكريات الذائبة الكلية وفيتامين (ج) اعلى مع المعاملة بالفوسفورين (دفعتين) عن المقارنة وكذلك مع المعاملة بالسوبرفوسفات (١٥٠ ، ٢٠٠ كجم/للفدان) عن باقى المعاملات .

٧- ادى التفاعل بين الفوسفورين والسوبرفوسفات الى تحسين صفات المحتوى الكيماوى للقرون الناتجة من النتروجين ، الفوسفور ، البوتاسيوم والبروتين والسكريات الكلية الذائبة وفيتامين (ج) وكانت افضل مايمكن بالمعاملة بالفوسفورين (دفعتين) مع اضافة ٢٠٠ كجم سوبر فوسفات/للفدان.