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EFFECT OF INTERACTION BETWEEN P-FERTILIZATION (IN MINERAL OR BIO-FORM) AND FE-FOLIAR APPLICATION ON YIELD, CHEMICAL COMPOSITION AND SEED PRODUCTION OF SNAP BEAN PLANT *(Phaseolus Vulgaris L.)*

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ABSTRACT

Two field experiments were conducted during two successive summer seasons of 2003 and 2004 at El-Baramoon Experimental Farm; near El-Mansoura city; Dakahleya Governorate; Egypt to study the effect of P-fertilizer in mineral or bio-form and Fe-EDTA in foliar way on chemical composition, yield and its component for Nebrasca cv. of snap bean plant (*phaseolus vulgaris L.*).

16 treatments were arranged in a complete randomized design plot with 4 replicates, P_2O_5-levels 0,30,60 and 90 kg/fed. were studied in the presence or absence of phosphate dissolving bacteria (PDB) inoculation and Fe-EDTA (300 ppm) in foliar way.

Obtained results can be summarized as follow:

1- Application of P-levels solely tell the rate of 60 kg P_2O_5/fed. significantly increased P-content in the leaves of snap bean plant; increasing the rate of P_2O_5 up to 90 kg/fed. led to a depressive effect in the same character. On the other hand, P-content in snap bean stems significantly increased at any level of P-fertilizer under study.

2- Fe-content in snap bean plant tended to decreases in the leaves and increases in the stems as the level of P_2O_5 was increased.

3- The contents of P and Fe in the parts of snap bean plant has been reflected on the values of P/Fe ratio which were increased in the leaves and decreased in the stems as the level of P-addition solely was increased.

4- (PDB) inoculation for the seeds of snap bean plant grown under the levles of P_2O_5 0, 30 and 60 kg/fed. led to an increase in the contents of P and Fe in the parts of the plant than those obtained for the same levels of P_2O_5 solely. Increasing the rate of P_2O_5 from 60 to 90 kg/fed. had a depressive effect on the activity of (PDB).

5- Adding of Fe in foliar way for the plants treated with P levels under study either with or without (PDB) inoculation has been corrected the depressive effect of heavy phosphorus application. Then, P/Fe ratios tended to constant in the leaves of snap bean plant which led to increasing in the yield of snap bean plant.

INTRODUCTION

Snap bean (phaseolus vulgaris L.) is one of the most important leguminous crop cultivated in Egypt. It's growth as well as other legumes was found to be affected by phosphorus and micronutrients applications (Thalooth *et al.* (1981).

Phosphorus is one of the major nutrients for plant nutrition. It is considered as an essential component of the genetic material of the cell nucleus, its essentially in the energy transfer processes so, vital to life and growth is well confirmed. Furthermore, phosphorus increase root surface area and this was important in supplying the nutrients needed by plant Gamal (1996).

Ali (2000) on common bean reveal that, increasing the vegetative growth of plants as a result of phosphorine (PDB) application may be due to the active bacteria in bio-fertilizer which is capable to dissolve soil complex in organic and inorganic phosphate and the role of phosphate bio-fertilizer in increasing availability of soil immobilized phosphorus and consequently increased the content of such element in plant.

Heavy phosphorus application was found to be associated with incipient iron chlorosis due to precipitation in the soil, Elgala (1971). Rutland and Bukovac (1971) observed that in plants suffering from iron chlorosis there is a relatively high ratio of phosphorus to iron.

Therefore, the present work was undertaken to study the effect of p-fertilization, phosphate dissolving bacteria (PDB) inculcation and Fe-EDTA foliar application on yield and its component, chemical composition and seed quality of snap bean plant.

MATERIALS AND METHODS

Two field experiments were conducted in two summer seasons of 2003 and 2004, at El-Baramoon Experimental farm; near El-Mansoura city; Dakahlia governorate. The soil of the experimental field was clayey in texture. Data of chemical and mechanical properties as described by Chapman and Pratt (1961) and Iakson (1965) was shown in Table (1).

Table (1): Mechanical and chemical analysis of the soil during 2003 season.

Sand %	Silt %	Clay %	Tex. class	O.M. %	$CaCo_3$ %
16.72	25.65	56.95	clayey	1.95	3.13
Avail. N ppm	Avail P ppm	Avail K ppm	Fe ppm	EC. ds/m	pH
69	4.72	374	18.2	0.93	7.8

This study was undertaken to conceive the effect of heavy phosphorus application with or without phosphate dissolving bacteria (PDB) and Fe-EDTA foliar spraying on vegetative growth, chemical composition, flowering parameters and pod's yield as well as seed yield and its quality of snap bean plant.

Nebrasca Cv. of snap bean plant was used in this study. Each experiment included 16 treatments; eight treatments in the presence of (PDB) inoculation and the others in the absence of it as follow:

1- Control treatment.
2- Fe-EDTA 300 ppm.
3- 30 kg P_2O_5/fed.
4- 30 kg P_2O_5/fed + Fe 300 ppm.
5- 60 kg P_2O_5/fed.
6- 60 kg P_2O_5/fed + Fe 300 ppm.
7- 90 kg P_2O_5/fed.
8- 90 kg P_2O_5/fed. + Fe 300 ppm.

At sowing, seeds were divided into two equal portions, one was inoculated with (PDB) at the rate of 500 g/60 kg and the other was sown without inoculation. P-levels (0, 30, 60 and 90 kg/fed.) as calcium superphosphate were applied to the soil on two equal portions at 21 and 45 days from seed sowing. Fe-EDTA 300 ppm was foliarly applied 3 times by 7 days intervals; 30, 37 and 44 days from sowing. All other cultural practices were carried out as recommended by the Ministry of Agriculture.

Seeds of Nebrasca Cv. were sown on 10 March in the two seasons at 20 cm apart on one side of ridges (4m long and 70 cm wide). Each plot consisted of 4 ridges making an area about 10 m^2; 2 ridges were used for green production and the other two left for dry seed yield.

At 60 days from sowing, five plants were randomly taken from each plot for determining the vegetative growth parameters i.e. plant height, No. of leaves per plant and fresh weight/plant. Plant samples of leaves and stems were oven dried at 70 °C to a constant weight, and then the day weight per plant was calculated.

In the digested dry matter of leaves and stems; phosphorus was estimated colorimetircally as described by Olsen *et al.* (1954) and Fe was measured using an Atomic Absorption Spectrophotomemter according to Chapman and Pratt (1961).

- Setting percentage was calculated according to the equation:
  Setting % = 100 (total No. of green pods plant ÷ total No. of flowers/plant)
- At green maturity stage, mature green pods for each experimental plot were collected and calculated as pod's yield (kg/fed.).
- At seed maturity stage; plants were harvested, dry seeds were manually extracted and total dry seeds yield (kg/fed.) was calculated.
- 100 seeds were randomly taken from each plot for germination test. Germination rate estimated according to Bartlett equation (1937).
- All obtained data were subjected to statistical analysis according to Gomes and Gomes (1984).

RESULTS AND DISCUSSIONS

Vegetative growth parameters:

Data of Table (2) show the effect of P-fertilization, (PDB) inoculation and Fe foliar application on plant height, number of leaves per plant; fresh and dry weight of snap bean plant.

With regard to the effect of interaction between the studied treatments data at Table (2) reveal that no significant differences were found in plant height and number of leaves of snap bean plant in the two seasons of the experimentation.

Concerning the effect the investigated treatments on fresh and dry weight of snap bean plant the same data of Table (2) show that; these parameters were positively affected due to the application of both mineral or bio-phosphorus fertilizers as well as foliar application of Fe-EDTA as compared to the control treatment. In this connection, the heights values

(91.57 and 15.39 g/plant) for fresh and dry weight of snap bean plant, respectively were realized in the 1st season for the plants inoculated with (PDB) and received 90 kg P_2O_5/fed. in the presence of Fe- in folior spraying. The same trend was realized in the second season of study.

Such increments in fresh and dry weight of bean plant due to application of phosphorus and (PDB) inoculation may be attributed to the main role of phosphorus in most metabolic process of plant. On the other hand, increasing those parameters as a result of (PDB) inoculation may be due the active bacteria in bio-fertilizer which is capable to dissolve soil complex in organic and inorganic phosphate leading to increase availability of soil-phosphorus for the plant. In addition; foliar spray of Fe-EDTA has been corrected the deficient of iron when the heighest rate of phosphorus (90 kg/fed.) was added. Similar results were reported by Abdel-hafez 1994, Gamal 1996, Shahin et al., 2000 b and Tarek (2002) who reveal that, fresh and dry weight of snap bean plant were increased with the application of phosphatic fertilizer either in mineral or bio-form compared with the control treatment.

Chemical composition of plant foliage:

Data of Table (3) show the effect of interaction between P-fertilization, (PDB) inoculation and Fe foliar application on P-content (%). Zn content (ppm) and P/Zn ratio in snap beam plant foliage.

P-content (%):

Data of Table (3) reveal that, an application of phosphatic fertilizer at the rates of 30, 60 and 90 kg P_2O_5/fed. either solely or in combination with (PDB) inoculation significantly increased P-content in the leaves and stems of snap bean plant compared with the control treatment. In addition, increasing the rate of P_2O_5 from 60 to 90 kg/fed. had a depressive effect on P-content of leaves while, such effect significantly increased in the stems in the presence and absence of (PDB) inoculation. Moreover, foliar spraying of Fe on plant foliage combined with the rates of P-levels under study with or without (PDB) inoculation was recorded higher values of P-content in plant foliage than those obtained without Fe foliarly applied. On the other hand, the depressive effect which was happened at the highest rate of P-addition (90 kg P_2O_5/fed) has been corrected due to an application of Fe in foliar way. Thus, the highest phosphorus content in the foliage of snap bean plant was obtained at the rate of 90 kg P_2O_5/fed and PDB inoculation in combination with Fe-foliar application and this trend was noticed during both seasons of study.

Fe- content (ppm):

Data of Table (3) reveal that, adding of P-fertilizer at the rates of 30, 60 and 90 kg P_2O_5/fed solely had a depressive effect on Fe-content (ppm) in the leaves of snap bean during both seasons of the experiment comparing with the control treatment. On the other hand, adding of the same P-levels under study combined with (PDB) inoculation or Fe foliar application led to an increases in the values of Fe (ppm) in the leaves than those obtained for the plants received P-levels studied.

Moreover, increasing the rate of P_2O_5 from 60 to 90 kg/fed. significantly decreased the values of Fe-content in snap bean leaves during both seasons either with or without (PDB) inoculation.

On the contrary of leaves; Fe-content in snap bean stems was gradually and significantly increased as the level of P-addition was increased, either in the absence or combined with (PDB) inoculation. In addition, applying of Fe-EDTA in foliar way combined with P_2O_5 levels under investigation significantly decreased Fe-content in the stems of the plants grown without PDB inoculation while, the same character was increased at any level of P_2O_5 studied in the presence of PDB inoculation. Thus, the highest Fe content in snap bean stems (123 and 112 ppm) in the 1st and 2nd seasons, respectively was realized for the treatment of 90 kg P_2O_5/fed + Fe (300 ppm) + PDB inoculation whereas the lowest one (23 and 25 ppm) was happened for the control treatment.

P/Fe ratio:

In order to find out the effect of P-fertilization in mineral or bio-form and Fe foliar application on snap bean plant; P/Fe ratio in plant foliage was calculated by divided P-content on Fe-content (ppm) as shown from Table (3) - such data reveal that, soil application of P_2O_5 levels (30, 60 and 90 kg/fed.) solely significantly increased the values of P/Fe ratio of snap bean leaves while, the same character significantly decreased in the stems of the plant during both seasons of 2003 and 2004. Inoculation the seeds of snap bean plant with (PDB) combined with the levels of P_2O_5 (0, 30 and 60 kg/fed.) resulted in, approximately, a constant in the values of P/Fe ratio around 20 ± 2 in the leaves and 33 ± 2 in the stems in the 1st and 2nd seasons. Increasing the rate of P_2O_5 - addition from 60 to 90 kg/fed significantly increased the values of P/Fe ratio in the leaves and significantly decreased the same values in the stems.

Concerning the effect of interaction between Zn foliar application and P_2O_5 levels (0, 30, 60 and 90 kg/fed.) with or without (PDB) inoculation the same data of Table (3) reveal that, P/Fe ration in the leaves of snap bean plant tended to approximately constant around 19 ± 2 during both seasons of 2003 and 2004. The same trend was realized in snap bean stems in the presence of (PDB) inoculation while the absence of (PDB) inoculation resulted in gradually increase in the values of P/Fe ratios in the two seasons of the experiment.

It can be concluded that, heavy application of P-fertilizer solely induces imbalance between P and Fe contents in the leaves and stems of snap bean plant. P-content was increased in the leaves and stems while, Fe-content was decreased in the leaves and increased in the stems (Table 3). The possible explanation for the trend of P/Fe ratio can be declare the effect of high P-contents in the leaves and stems on Fe-translocation from stems to the leaves in spite of the accumulation of Fe in the stems as the level of P-fertilizer was increased, On the other hand, the activity of (P/DB) was decreased at the highest level of P-fertilization then, the value of P/Fe tended to increase in the leaves and stems than those obtained for the lowest P-levels. Moreover, foliar application of Fe combined with P-levels under study in the presence of PDB inoculation has been corrected the state of imbalance between P and Fe contents in the parts of snap bean plant and then P/Fe ratios tended to constant.

These results were in agreement with those obtained by Ez Eldin et al., (1984); Gamal, 1996 and Tarek (2002).

Flowering parameters and pod's yield:

Data of Table (4) show the effect of P-fertilization, PDB inoculation and Fe foliar application on flowering parameters expressed as number of flowers, number of pods and setting percentage as well as pod's yield of snap bean plant.

Data of Table (4) reveal that, adding of P-fertilizer at its different used levels either in mineral or bio-form or combined with Fe-foliar application and their interaction had no significant effect on number of flowers per plant and sitting percentage in snap bean plant during both seasons of study.

Regarding the effect of investigated treatments on number of pods per plant the same data of Table (4) show that, the value of this character was increased as the level of P_2O_5 was increased up to the level of 60 kg/fed. either in the presence or absence of (PDB) inoculation and/or Fe-foliar application. Increasing the rate of P_2O_5 from 60 to 90 kg/fed. in mineral form significantly decrease the values of this parameter. At the same time, the highest number of pods per plant was realized for the plants treated with 90 kg P_2O_5/fed. in the presence of (PDB) inoculation and Fe-foliar spraying during both seasons of the experimentation.

Data of Table (4) also reveal that, at any level of P-fertilizer under study either in the presence or absence of (PDB) inoculation and/or foliar application pod's yield of snap bean plant in kg/fed. significantly increased as compared to the control treatment and this trend was true in the two seasons of experimentation. The highest yield of pods (8825 and 8150 kg/fed.) in the 1st and 2nd seasons, respectively were realized for the treatment of interaction between 90 kg P_2O_5/fed., PDB inoculation and Fe foliar application whereas, the lowest one was happened for the untreated plants.

It can be concluded that, at the highest level of P_2O_5 (90 kg/fed.) foliar application of Fe on snap bean plant inoculated with PDB encouraged the translocation of nutrients especially, P and Fe from the soil, stems to the leaves leading to an increase in the green yield and its component. This results was in a good agreement with those obtained by Gamal (1996) and Tarek (2002).

Seed quality and seed yield:

Date presented in Table (5) show the effect of P-levels under study, (PDB) inoculation and Fe-foliar application on seeds quality expressed as, seed germination percentage, germination rate and seed index as well as seeds yield of snap bean plant.

Regarding the effect of the interaction between the studied treatments such data reveal that; with the exception of weight of 100 seeds (seed index) which was significantly affected no significant differences could be detected in both germination percentage and rate during the two growing seasons.

However, the highest seed index was obtained due to the application of the highest used level of P_2O_5 combined with PDB inoculation and Fe foliar application which was 45-95 in the first season and 42-69 in the second season. Simlar results were obtained by Kerolus et al., (1998) and Ismael (2001).

Concerning the effect of P-fertilizer, PDB inoculation and Fe foliar application either in a single form or in combination on seed yield of snap bean plant (kg/fed.) data of Table (5) show that, the treatment of PDB inoculation and foliar application of Fe under the highest level of P_2O_5 (90 kg/fed.) was superior for increasing the yield of snap bean seeds as compound to the other treatment and this trend was true in the two seasons. However, the values of seed's yield for the plants inoculated with (PDB) or spraying with Fe under P-levels studied was higher than those obtained for the plants treated with the same levels of P_2O_5 only. Moreover, at the highest level of P_2O_5 (90 kg/fed.); foliar application of Fe has been corrected the decrease in the yield of snap bean seeds which was happened as the level of P_2O_5 was increased from 60 to 90 kg/fed. in the absence of Fe foliar application. It can be concluded that, adding of Fe in foliar way necessary to correct the imbalance between P and Fe, specially at heavy phosohorus levels. Similar results were obtained by Sorour (1993) and Gamal (1996).

CONCLUSION

Under such conditions of this study, it can be concluded that:

- Although, adding of P-fertilizer at the rates of this investigation encouraged the snap been roots to absorb more Fe and P from the soil, but the high contents of P in the leaves reduces the translocation of Fe from the stems to the leaves specially at the highest rate of P_2O_5.
- An inhibition case was happened for the activity of phosphate dissolving bacteria when the highest level of P_2O_5 was added.
- Adding of Fe in foliar way has been corrected the trend mention previously and causes balance between P and Fe and thus, it recommended for obtaining the highest yield for snap bean plant.

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تأثير التفاعل بين التسميد الفوسفاتى على صورة معدنية أو حيوية والرش الورقى بالحديد على الفاصوليا

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أجريت تجربتان حقليتان خلال الموسم الصيفى لعامى ٢٠٠٣، ٢٠٠٤ فى المحطة البحثية بالبرامون - (بالقرب من مدينة المنصورة) - محافظة الدقهلية - مصر.

لدراسة تأثير إضافة الفوسفور على صورة معدنية أو حيوية والرش الورقى بالحديد المخلبى على التركيب الكيماوى والمحصول لصنف نبرسكا فى نبات الفاصوليا.

واشتملت التجربة على ١٦ معاملة فى قطاعات كاملة العشوائية فى ٤ مكررات، استخدمت مستويات التسميد الفوسفاتى صفر، ٣٠، ٦٠، ٩٠ كجم فو٢أ٥/فدان فى وجود وعدم وجود البكتيريا المذيبة للفوسفات، وكذلك أضيف الحديد بالرش عند مستوى ٣٠٠ جزء/مليون.

يمكن تلخيص النتائج كما يلى:

1- إضافة مستويات التسميد الفوسفاتى بصورة منفردة حتى مستوى ٦٠ وحدة فو٢أ٥/ فدان أعطت زيادة معنوية فى محتوى أوراق الفاصوليا من الفوسفور، زيادة معدل إضافة السماد الفوسفاتى حتى مستوى ٩٠ كيلو جرام / فدان أدى إلى حدوث نقص لنفس الصفة. ومن ناحية أخرى فإن محتوى الساق من الفوسفور انخفض معنوياً عند أى زيادة من معدل التسميد الفوسفاتى تحت الدراسة.

٢- محتوى الحديد فى نبات الفاصوليا يميل إلى النقص فى الأوراق والزيادة فى السيقان كلما زاد معدل إضافة السماد الفوسفاتى.

٣- محتويات الفوسفور والحديد فى أجزاء نبات الفاصوليا انعكست على قيم نسبة الفوسفور : الحديد التى زادت فى الأوراق ونقصت فى الساق بزيادة معدل إضافة الفوسفور منفرداً.

٤- تلقيح بذور الفاصوليا بالبكتيريا المذيبة للفوسفات والتسميد الفوسفاتى بمعدلات صفر، ٣٠، ٦٠ كجم فو٢أ٥/ فدان أدى إلى زيادة فى محتويات أجزاء نبات الفاصوليا من الفوسفور والحديد عن القيم المتحصل عليها فى حالة التسميد الفوسفاتى بصورة منفردة. زيادة معدل التسميد الفوسفاتى من ٦٠ إلى ٩٠ كجم فو٢أ٥/ فدان أحدث تأثير مثبط على نشاط البكتيريا المحللة للفوسفات.

٥- الإضافة الورقية للحديد للنباتات المعاملة بمستويات التسميد الفوسفاتى تحت الدراسة سواءاً فى وجود أو عدم وجود البكتيريا المحللة للفوسفات - أدت إلى تصحيح التأثير المثبط عند إضافة المعدلات الزائدة من الفوسفات - وبالتالى فإن قيم الفوسفور : الزنك اتجهت إلى الثبات فى أوراق نبات الفاصوليا الذى أدى بالتالى إلى زيادة المحصول.

Table (2): Vegetative growth parameters of snap bean plants as influenced by the interaction between P-fertilization, (PDB) inoculation and Fe-folior application during 2003 and 2004 seasons.

Seasons		Season 2003				Season 2004			
Char. Treat.		Plant height cm	No of leave per plant	F.W. g/plant	D.W. g/plant	Plant height cm	No of leave per plant	F.W. g/plant	D.W. g/plant
Without (PDB)	Control	31.99	10.57	81.23	12.26	30.72	10.33	80.58	11.16
	Fe 300 ppm	32.77	11.00	83.70	13.65	31.57	10.95	82.63	12.32
	30 kg P_2O_2/fed	34.05	11.50	86.88	14.25	33.09	11.26	84.12	13.09
	30 kg P_2O_2/fed + Fe	35.46	11.92	87.35	14.56	33.89	11.79	85.09	13.42
	60 kg P_2O_2/fed	35.79	12.05	87.59	13.19	33.75	12.10	85.15	13.66
	60 kg P_2O_2/fed + Fe	36.38	12.21	89.74	13.95	34.90	12.45	86.10	14.10
	90 kg P_2O_2/fed	32.92	11.16	85.66	12.80	32.65	11.32	84.32	12.95
	90 kg P_2O_2/fed + Fe	36.45	12.24	90.25	13.66	33.20	11.93	85.41	13.12
With (PDB)	(PDB)	32.82	10.69	84.22	13.57	31.33	10.63	82.60	12.36
	Fe 300 ppm	33.74	11.18	85.98	13.48	32.41	11.28	82.92	12.92
	30 kg P_2O_2/fed	35.92	11.75	89.11	13.73	34.02	11.72	85.10	13.89
	30 kg P_2O_2/fed + Fe	36.75	12.07	90.69	14.92	34.66	11.99	85.76	14.10
	60 kg P_2O_2/fed	36.58	12.33	86.72	14.80	34.72	12.08	86.17	14.25
	60 kg P_2O_2/fed + Fe	37.88	12.73	91.19	15.09	35.12	12.69	87.22	14.91
	90 kg P_2O_2/fed	34.31	11.59	86.77	12.36	34.23	12.25	86.22	14.35
	90 kg P_2O_2/fed + Fe	38.56	12.95	91.57	15.39	35.29	12.81	88.05	14.61
L.S.D. 0.05		**N.S.**	**N.S.**	**2.15**	**0.95**	**N.S.**	**N.S.**	**1.95**	**0.65**

Table (3): Total phosphorus (%) and Fe (ppm) as well as P/Fe ratio of snap bean foliage as influenced by the interaction between P-fertilization, (PDB) inoculation and Fe-folior application during 2003 and 2004 seasons.

Seasons		**Season 2003**						**Season 2004**					
	Char.	**P %**		**Fe (ppm)**		**P/Fe ratio**		**P %**		**Fe (ppm)**		**P/Fe ratio**	
Treat.		**Leaves**	**Stem**	**Leaves**	**stem**	**Leaves**	**Stem**	**Leaves**	**Stem**	**Leaves**	**Stem**	**Leaves**	**Stem**
Without (PDB)	Control	0.208	0.110	80	23	26	48	0.185	0.123	77	25	24	49
	Fe 300 ppm	0.224	0.150	118	47	19	32	0.244	0.172	122	49	20	35
	30 kg P_2O_2/fed	0.252	0.140	74	31	34	45	0.234	0.132	71	30	33	44
	30 kg P_2O_2/fed + Fe	0.257	0.168	143	41	18	41	0.276	0.185	145	43	19	43
	60 kg P_2O_2/fed	0.273	0.189	62	45	44	42	0.299	0.189	65	46	46	41
	60 kg P_2O_2/fed + Fe	0.288	0.200	160	37	18	54	0.300	0.196	158	35	19	56
	90 kg P_2O_2/fed	0.240	0.209	48	55	50	38	0.255	0.191	50	53	51	36
	90 kg P_2O_2/fed + Fe	0.302	0.279	168	34	18	82	0.330	0.233	165	31	20	75
With (PDB)	PDB	0.217	0.118	114	36	19	33	0.248	0.109	118	34	21	32
	Fe 300 ppm	0.240	0.169	120	44	20	38	0.271	0.158	123	45	22	35
	30 kg P_2O_2/fed	0.277	0.173	132	52	21	33	0.297	0.176	135	49	22	36
	30 kg P_2O_2/fed + Fe	0.300	0.215	150	82	20	26	0.294	0.204	147	73	20	28
	60 kg P_2O_2/fed	0.298	0.206	149	60	20	34	0.305	0.203	145	58	21	35
	60 kg P_2O_2/fed + Fe	0.312	0.269	164	104	19	26	0.369	0.263	168	94	22	28
	90 kg P_2O_2/fed	0.289	0.237	85	87	34	27	0.267	0.221	89	79	30	28
	90 kg P_2O_2/fed + Fe	0.310	0.309	163	123	19	25	0.357	0.302	170	112	21	27
L.S.D. 0.05		**0.025**	**0.033**	**6**	**3**	**6**	**3**	**0.03**	**0.035**	**12**	**4**	**5**	**3**

Table (4): Flowering parameters and pod's yield of snap bean plants as influenced by the interaction between P-fertilization, PDB inoculation and Fe folior application during 2003 and 2004 seasons.

Seasons		Season 2003				Season 2004			
Treat.	Char.	No. of f Flowering	No. of pods/plant	Sitting %	Pod's yield kg/fed.	No. of flowering	No. of pods/plant	Sitting %	Pod's yield kg/fed.
Without (PDB)	Control	39.75	22.32	56.15	3780	38.15	21.26	55.72	3133
	Fe 300 ppm	41.12	23.85	58.00	4199	38.76	21.80	56.25	3560
	30 kg P_2O_2/fed	45.36	26.77	59.01	6495	40.32	23.12	57.33	5250
	30 kg P_2O_2/fed + Fe	45.97	27.20	59.16	6639	41.03	23.74	57.85	5811
	60 kg P_2O_2/fed	43.30	27.79	64.18	7630	41.53	25.03	60.26	6260
	60 kg P_2O_2/fed + Fe	48.14	28.36	58.91	8233	41.88	25.51	60.92	7150
	90 kg P_2O_2/fed	43.12	25.15	58.32	6312	39.92	23.13	57.95	5914
	90 kg P_2O_2/fed + Fe	47.45	29.45	62.06	7792	40.65	24.02	59.22	6215
With (PDB)	(PDB)	42.50	24.76	58.25	4315	39.46	22.16	56.16	3320
	Fe 300 ppm	42.66	25.19	59.04	6308	39.85	22.74	57.07	3840
	30 kg P_2O_2/fed	47.14	28.15	59.71	7938	42.51	24.61	57.90	3912
	30 kg P_2O_2/fed + Fe	47.82	29.73	62.17	8701	43.16	25.40	58.85	6732
	60 kg P_2O_2/fed	48.77	29.58	60.65	8515	43.72	25.78	58.96	6750
	60 kg P_2O_2/fed + Fe	48.53	30.25	62.33	8788	44.18	26.64	59.44	7214
	90 kg P_2O_2/fed	43.73	25.80	58.99	6989	43.98	25.68	58.38	6320
	90 kg P_2O_2/fed + Fe	48.92	31.29	63.96	8825	45.03	27.07	60.12	8150
L.S.D. 0.05		**N.S.**	**2.5**	**1.05**	**382**	**N.S.**	**1.30**	**N.S**	**165**

Table (5): Seed quality and seed yield of snap bean plants as influenced by the interaction between P-fertilization, (PDB) inoculation and Fe-folior application during 2003 and 2004 seasons.

Seasons		Season 2003				Season 2004			
Treat.	Char.	Germination %	Germination Rate	Seed index	Seed yield kg/fed	Germination %	Germination Rate	Seed index	Seed yield kg/fed
Without (PDB)	Control	82.3	3.35	36.72	689.8	81.9	2.92	35.99	617.6
	Fe 300 ppm	82.6	2.31	38.10	777.6	82.3	2.75	37.18	725.3
	30 kg P_2O_2/fed	87.3	2.21	41.12	1170.3	86.1	2.44	40.77	932.9
	30 kg P_2O_2/fed + Fe	89.4	2.17	42.15	1185.5	88.7	2.23	41.52	995.4
	60 kg P_2O_2/fed	90.7	2.15	42.55	1387.3	89.6	2.12	41.95	1301.5
	60 kg P_2O_2/fed + Fe	91.6	2.09	43.10	1524.6	91.0	2.03	43.05	1512.3
	90 kg P_2O_2/fed	86.1	2.25	40.20	1190.9	85.3	2.47	41.45	1280.4
	90 kg P_2O_2/fed + Fe	92.3	2.07	43.46	1456.4	91.8	2.02	42.25	1313.9
With (PDB)	PDB	84.2	2.28	39.65	770.5	83.3	2.50	37.62	663.2
	Fe 300 ppm	86.7	2.23	40.83	1106.7	84.9	2.41	38.26	811.3
	30 kg P_2O_2/fed	91.3	2.14	42.97	1404.9	87.6	2.19	39.82	1150.6
	30 kg P_2O_2/fed + Fe	94.2	1.99	45.05	1526.5	89.1	2.03	41.74	1420.3
	60 kg P_2O_2/fed	93.4	2.04	43.85	1520.5	90.9	1.99	41.82	1317.9
	60 kg P_2O_2/fed + Fe	94.8	1.94	45.32	1552.7	91.4	1.93	41.93	1485.5
	90 kg P_2O_2/fed	88.8	2.18	41.60	1282.4	91.3	1.89	39.88	1309.2
	90 kg P_2O_2/fed + Fe	95.1	1.92	45.95	1604.5	93.5	1.85	42.69	1562.7
L.S.D. 0.05		**N.S.**	**N.S.**	**1.33**	**325**	**N.S.**	**N.S.**	**1.02**	**216**