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INFLUENCE OF PHOSPHORUS AND BIO-FERTILIZERS ON PRODUCTION AND QUALITY OF SOME FABA BEAN VARIETIES (*Vicia faba*, L.)

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ABSTRACT

Two field Experiments were conducted at the agricultural experimental farm of Al-Azhar Univ. at Assiut, during ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons to study the response of three varieties of faba bean (Misr-١, Giza-٤٢٩ and Giza-٤٠) to application of bio-fertilizers (control and inoculation with phosphorien) and different phosphorus fertilizer rates (١٥.٥, ٣١.٠ and ٤٦.٥ kg P_2O_5 /fed.). The experiments were performed in a split-split plot design with four replicates; where faba bean varieties were assigned to the main plot, while phosphorus rates and bio-fertilizers were distributed randomly in the sub and sub-sub plot, respectively.

The obtained results showed that faba bean varieties exhibited significant differences in ١٠٠-seed weight; seed yield and straw yield/fed. and protein percentage in faba bean seeds in both seasons, except number of branches and seed yield/plant in the first season only. On other hand number of pods/plant and phosphorus percentage didn't show significant increase in both seasons. Misr-١ variety was superior to Giza-٤٢٩ and Giza-٤٠ in all studied traits.

Increasing the level of phosphorus applications from ١٥.٥ to ٣١.٠ or ٤٦.٥ kg P_2O_5 /fed. caused a significant increases in all traits under study in both seasons.

Applications of phosphorien induced significant increases in all studied characters, i.e. number of branches, number of pods, seed yield/plant, ١٠٠-seed weight as well as seed and straw yields/fed. Also, such treatment increased phosphorus and protein percentages of faba bean seeds.

The interaction between phosphorus rates and bio-fertilizer had a significant effect on number of pods and seed yield/plant, ١٠٠-seed weight (gm) and straw yield (ton/fed.) in both seasons and number of branches/plant in the first season only. Concerning the interaction between varieties and phosphorus fertilizer rates was significant on ١٠٠-seed weight and seed yield/fed. in the second season only.

In general, the highest value of seed yield/ fed. was obtained from Misr-١ when received ٤٦.٥ kg P_2O_5/fed. and inoculation with phosphorien under Assiut conditions.

INTRODUCTION

Faba bean (*Vicia faba*, L.*)* is one of the most important winter legumes crops for seeds in Egypt. Its importance lies chiefly in its high protein content (٢٤ %.*)* and inbeing source of carbohydrates. It is also well supplied with phosphorus and calcium in addition; it is relatively not expensive crop to produce. Bakheit *et al*. (٢٠٠١) showed that seed yield/fed. and ١٠٠-seed weight were significantly affected by faba bean cultivars (Giza-٢, Giza-٤٠٢, Giza-٤٢٩ and Giza-٦٧٤). While number of branches, number of pods and straw yield/fed. were not affected by cultivars. Khalil *et al*. (٢٠٠٤) found that Misr-١ cultivar surpassed Giza-٤٠ cultivar in number of pods/plant, weight of seeds/plant, weight of ١٠٠-seeds (gm), seed yield ard./fed., straw yield (ton/fed.) and protein percentage in faba bean seeds and not significantly affected phosphorus percentage in both seasons. Sharaan *et al*. (٢٠٠٤) indicated that the tested faba bean cultivars (Giza-٢, Giza-٤٢٩, Giza-٨٤٣ and Misr-١) showed significant differences for all of the studied characters (seed yield /plant, seed index, seed yield /fed. and protein percentage). Ahmed and El-Abagy (٢٠٠٧) showed that faba bean cultivars significantly differed in number of branches/plant, number of pods /plant, seed yield/plant, seed yield/fed. straw yield/ fed. and protein% per seeds. Talaatt and Abdallah (٢٠٠٨) showed that there were significant differences between the faba bean cultivars in

number of branches, number of pods/plant, weight seeds/plant; seed and straw yields/fed. as well as ١٠٠-seed weight. Sakha-١ cultivar significantly surpassed Giza- ٤٠ cultivar in all previous tested parameters, and it heid the highest values of protein and carbohydrates in seeds. El-Banna *et al.* (٢٠٠٩) found that there were significant differences between the two faba bean cultivars in number of branches/plant, number of pods/plant, seed yield /plant, seed yield /fed. straw yield/fed. and protein content in both seasons. Ragab *et al.* (٢٠١٠) showed that there were significant differences between the three faba cultivars (Nubaria-١, Giza-٧١٦ and Sakha-١) in seed yield kg/fed. and weight of ١٠٠-seeds.

Phosphorus is the second most commonly soil limiting nutrient element after nitrogen. Soil supply with phosphorus is very important practice for legumes, where it is considered the most important nutrient limiting pulse production. A vigorous plant growth, coupled with greater assimilates formation and translocation to plant fruiting parts, resulting in a better development for seed yield and its components are consequences for supplying legume plants with phosphorus at optimum rates (Parihar and Tripathy ١٩٨٩). Khalil *et al.* (٢٠٠٤) concluded that increasing phosphorus fertilization rate (٠.٠, ١٥.٠ and ٣٠.٠ Kg P_2O_5/fed.) to faba bean had significant increases in number of pods /plant, weight of seeds /plant, seed index, seed and straw yields /fed. and phosphorus and protein contents of seeds. Ahmed *et al.* (٢٠٠٥) found that all studied parameters (seeds yield, straw yield and protein percentage in seeds) were significantly increased due to increasing the level of phosphorus fertilization from (٠.٠, ٣٠ or ٤٥) Kg P_2O_5/fed. El-Set, Abd-El-Aziz (٢٠٠٥) indicated that applications of phosphorus fertilizer with ٢٢.٥ Kg P_2O_5/ fed. followed by ١٥.٠ Kg P_2O_5/ fed. and ٣٠.٠ Kg P_2O_5/ fed. induced significant increases in number of branches/ plant, number of pods /plant, ١٠٠-seed weight, seed yields /plant as well as seed and straw yields /fed. Also, such treatment increased protein content of faba bean seeds. Abd–Allah and Hamed (٢٠٠٦) reported that increasing phosphorus fertilizer level (١٠, ٢٠ and ٣٠ kg P_2O_5/fed.) to faba bean increased the number of branches/plant, number of pods/plant, seed

yield /plant, seed index and seed yield/fed. Getachew and Rezene (٢٠٠٦) found that highly significant positive responses of number of pods per plant, thousand seed weight, and seed yields of faba bean to phosphorus fertilizer. The highest number of pods per plant, total biomass and seed yields of faba bean were recorded from the application of ٣٠ kg P/ ha. Zaki and Radwan (٢٠٠٦) indicated that phosphorus levels supply on ١٠٠-seed weight and seed yield ton/fed. were significantly enhanced at all applied treatments. Abd El-Aziz (٢٠٠٧) found that increased phosphorus rates ٠, ٤٥, ٩٠ and ١٣٥ kg P_2O_5/ ha. caused a significant increase in number of branches/plant, number of pods/plant, seed yield /plant, seed index, and seed yield/fed. at the end of the growth. Ahmed and El-Abagy (٢٠٠٧) showed that phosphorous fertilizer at rate ٤٦.٥ Kg P_2O_5/fed. significantly increased all yield and its components (number of branches, seed yield/plant, straw yield/ fed. seed yield/fed. phosphorus and protein percentage). El-Habbasha *et al.* (٢٠٠٧) showed that significant increased in number of pods /plant, weight of seeds/plant, ١٠٠-seed weight, seed yield (kg./fed.), straw yield(kg/fed.) and seed protein content, except number of branches, increase with increasing phosphorus levels from zero to ٤٥ kg P_2O_5/fed. Talaatt and Abdallah (٢٠٠٨) showed that ٧٥٪ or ٥٠٪ of recommended phosphorus doses increased number of pods/plant; weight seeds/plant; seed and straw yields/fed. and ١٠٠-seed weight as well as phosphorus and protein. El-Gizawy and Mehasen (٢٠٠٩) indicated that the phosphorus fertilizers were highly significant in number of branches and pods/plant, ١٠٠-seed weight, seed yield/plant, seed and straw yields/fed. and protein% in both seasons. Ibrahim (٢٠٠٩) reported that applications of phosphorus fertilizer up to (٣٠ kg P_2O_5/fed.) significantly increased number of pods/plant, seed yield/plant, ١٠٠-seed weight, straw yield (ton/fed.), seed yield (ard./fed.), phosphorus and protein contents in faba bean seeds. Rugheim and Abd El-Gani (٢٠٠٩) showed that application of phosphorus chemical fertilizer significantly increased crude protein in faba bean seeds.

Bio-fertilization became an important factor to increase the availability of phosphorus in soil or applied as fertilizer. Phosphate

dissolving bacteria are considered as biological fertilizers which have an important role in the solubility of phosphorus and enhancing its absorption by plants (Koreish *et al*. ٢٠٠١). On the other hand, some soil microbes such as phosphate dissolving bacteria play an important role in supplying the growing plants with available forms of phosphorus through the production of organic, inorganic acids and $CO^{٢}$. They increase the soil acidity and consequently convert the insoluble forms of phosphorus to soluble forms (Saad and Hammad ١٩٩٨). El-Set, Abd-El-Aziz (٢٠٠٥) indicated that applications of phosphorien induced significant increases in number of branches/ plant, number of pods /plant, ١٠٠-seed weight, seed yields /plant as well as seed and straw yields /fed. Also, such treatment increased protein content of faba bean seeds. Mohamed and Abbas (٢٠٠٥) pointed out that phosphorien gave the highly significant increase in number of branches/plant, number of pods/plant, seed weight/plant, ١٠٠-seed weight, seed yield (ard./fed.) and straw yield (ton/fed.) in the two seasons compared with citreen and control. Phosphorien as a bio-fertilizer gave the highest value for phosphorus uptake by plants respectively in both seasons. Radwan and Mohamed (٢٠٠٥) found that the application of bio-fertilizer of "phosphorien" gave significant effects on seed yield /fed. and its components (number of branches/plant, number of pods/ plant, seed index, seed yield /plant and straw yield/fed.). Ahmed and El-Abagy (٢٠٠٧) showed that application of phosphorien significantly improved number of branches, number of pods /plant, seed and straw yields /fed. and protein% per seeds. Talaatt and Abdallah (٢٠٠٨) showed that Rhizobium inoculation and VAM inoculation improved plant growth in number of branches/plant at ٦٠, ٩٠ and ١٢٠ days after sowing compared with the uninoculated plants. Fungal infection and Rhizobial inoculation increased number of pods/plant; weight seeds/plant, seed and straw yield/fed. and ١٠٠-seed weight as well as the concentration of protein on both cultivars as compared with uninoculated plants. El-Banna *et al.* (٢٠٠٩) found that most traits under study (number of branches/plant, number of pods/plant, seed yield /plant, seed yield /fed. straw yield/fed. and protein content)

increased significantly due to inoculation treatment. Applications of VA-mycorrhiza inoculation resulted in the highest values of number of pods/plant, straw yield/plant, seed yield /fed. and straw yield/fed. in both seasons and seed yield /plant in the first season. El-Gizawy and Mehasen (٢٠٠٩) indicated that bio-fertilizer with phosphate dissolving bacteria (PDB), increased number of branches and pods/plant, ١٠٠-seed weight, seed yield/plant, seed and straw yields/fed. and protein%. Phosphorus fertilizer levels mixed with PDB significantly affected all studied characters. Rugheim and Abd El-Gani (٢٠٠٩) reported that *Bacillus megatherium var. phosphaticum* inoculation significantly increased seed yield/fed. and crude protein of faba bean seeds. Osman *et al.* (٢٠١٠) showed that Rhizobium inoculation significantly increased yield, crude protein and ١٠٠-seed weight. *Bacillus megatherium var. phosphaticum* inoculation significantly increased crude protein content. On the other hand, Rhizobium and *Bacillus megatherium var. phosphaticum* Co-inoculation significantly increased seed yield, protein content and ١٠٠-seed weight. The objective of the present work is to study the response of three-faba bean varieties to three levels phosphorus fertilization with Bio-fertilization under Assiut conditions.

MATERIALS AND METHODS

Two field Experiments were conducted at the agricultural experimental farm of Al-Azhar Univ. at Assiut, during ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons to study the response of three varieties of faba bean (Misr-١, Giza-٤٢٩ and Giza-٤٠) to application of bio-fertilizers (control and inoculation with phosphorien) and different phosphorus fertilizer rates (١٥.٥, ٣١.٠ and ٤٦.٥ kg P_2O_5 /fed.). The preceding summer crop was maize in both seasons. The experiments were performed in a split-split plot design with four replicates where, faba bean varieties were assigned to the main plot, while phosphorus rates and bio-fertilizers were distributed randomly in the sub and sub-sub plot, respectively. The experimental unit comprised five ridges, each ٣.٥m long and ٠.٦ m wide (١٠.٥ m^2 in area = ١/٤٠٠/ fed.). Seeds were sown on the two sides of ridges, in hills ٢٥ cm apart, and thinned to

two plants/hill. Seed were sown on Oct. ٣٠th ٢٠٠٨ and Oct. ٢٥th ٢٠٠٩, respectively. Phosphorus was added during soil preparation i.e. before sowing. Phosphorus was used in the form of calcium super phosphate (١٥.٥٪ P_2O_5). The sub-sub plots were assigned in relation to two bio-fertilizers treatments {Control treatment (B_0) and inoculation with phosphorien (B_1)}. The Bio-fertilizer phosphorien is a phosphate solublizing bacteria (PSB) *Bacillus megatherium* var. *phosphaticum* and was provided by the biological amendments project Agriculture Research Center, Egypt. The inoculation was performed by coating faba bean seed at the rate of ١ kg/fed. using a sticking substance (Arabic gum ٥٪) just before sowing. All other practices were uniformly applied as recommended for faba bean production in the region. The physical and chemical analyses of the experimental site are presented in Table (١)

Table ١: The mechanical and chemical analysis of soil field experiments

Characteristics			Characteristics		
Mechanical analysis	٢٠٠٨/٢٠٠٩	٢٠٠٩/٢٠١٠	Chemical analysis	٢٠٠٨/٢٠٠٩	٢٠٠٩/٢٠١٠
Sand (%)	٢٤.٥٠	٢٥.٣٠	Organic matter (%)	٠.٩٧	١.٠٢
Silt (%)	٣٩.٠٠	٣٩.٤٠	Available N (ppm)	٧٤.٥٠	٧٦.٣٠
Clay (%)	٣٦.٥٠	٣٥.٣٠	Available P(ppm)	٩.٦٠	١٠.٥٦
Soil texture	Clay loam		Available K (ppm)	٣٥٥.١٥	٣٦٣.٢٥
			pH (s.p. ٦٥)	٧.٧٦	٧.٩٨
			E.C. (ds. m^{-1})	١.١٧	١.١٨
			Total $CaCo_3$ (%)	٢.٨٥	٢.٦٠

Studied attributes:-

A- Yield and yield components:

At harvest samples of ١٠ plants were chosen randomly from the inner ridges and the following characters were recorded:

١- Number of branches / plant.

٢- Number of pods / plant.

٣- Seed yield /plant (gm).

٤- ١٠٠- seed weight (gm): the weight of ١٠٠-seed was calculated as an average of five random samples for each plot. It was weighted in grams.

٥- Seed yield (ard./fed.) (ard = ١٥٥ kg).

٦- Straw yield (ton/fed.). In addition, seed and straw yields were recorded on plot basis. The recorded values were used to estimate the corresponding value per fed.

B- Chemical analysis:

At harvesting, seed samples were ground and kept for chemical analysis.

١- Protein percentage:-

Total nitrogen content in seeds was estimated by using microkjeldahl method as described by **A.O.A.C (١٩٨٠)** and percentage of protein was calculated by multiplying the nitrogen percentage by ٦.٢٥.

٢- Phosphorus percentage:-

Total phosphorus was determined in the plant digests colorimetrically using the spectrophotometer according to the method described by **Chapman and Pratt (١٩٦١)**.

Statistical analysis:-

The results were statistically analyzed according to Gomez and Gomez (١٩٨٤) using the computer MSTAT-C statistical analysis package by Freed *et al.* (١٩٨٩). The least significant differences (LSD) test at probability level of ٠.٠٥ was manually calculated to compare the differences among means.

RESULTS AND DISCUSSION

A- Yield and yield components:-

١- Number of branches / plant:-

It is quite clear from presented data in Table (٢) that number of branches/plant was significantly affected by varieties only in ٢٠٠٨/٢٠٠٩ season. Misr-١ had higher number of branches/plant than Giza-٤٠ and Giza-٤٢٩varieties. The increase was estimated by (٣.٤١٪ comparison Giza-٤٢٩ and ٥.٤٦٪ comparison Giza-٤٠) in the first

season. This may be due to differences in genetic make up between varieties. These results are in agreement with those found by Ahmed and El-Abagy (٢٠٠٧) and El-Banna *et al.* (٢٠٠٩) who reported that number of branches /plant was significantly affected by varieties.

The results revealed that the application of phosphorus fertilizer rates to faba bean plants exerted a significant influence on number of branches/plant in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons. The highest values (٣.٧٣ and ٤.٢٨) were obtained when phosphorus was applied at a rate of ٤٦.٥ kg P_2O_5/ fed. in both seasons, respectively. This may be due to the important role of phosphorus for helping the development of more extensive root system and thus enabling plants to extract water and nutrients form deeper depth. This, in turn could enhance the plants to produce more assimilates which was reflected in high number of branches. These results are in harmony with those obtained by El-Set, Abd-El-Aziz (٢٠٠٥) and El-Gizawy and Mehasen (٢٠٠٩) who reported that number of branches / plant increased by increasing phosphorus rates.

The presented data indicated that application of bio-fertilizer with phosphorien to faba bean plants exerted a significant influence on number of branches/plant as compared to the control in both seasons. These effects may be due to the ability of the microorganisms to produce growth regulator substance i.e., Indole Acetic Acid (IAA), Gibbrelic Acid (GA) and Cytokinones (CK) (Megahed and Mohamed, ٢٠٠١). These growth substances may play an important role in plant growth through promoting photosynthesis, translocation and accumulation of dry matter within different plant organs. It may also be related to the role of the more available phosphorus produced by phosphorus releasing bacteria in plant growth. These results are in agreement with those obtained by Mohamed and Abbas (٢٠٠٥) and El-Banna *et al.* (٢٠٠٩).

The presented data in table (٢) showed that number of branches/plant was significantly affected by the interaction between (P X B) in the first season only, where the highest value (٤.٢٣) was obtained from ٤٦.٥ kg P_2O_5/ fed. and inoculation with phosphorien. The interaction among VXPXB was not significant in both seasons.

Table ٢: Effect of phosphorus and bio-fertilizers on number of branches and number of pods/plant of some faba bean varieties in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons.

characters		Number of branches/plant						Number of pods/plant					
Seasons		٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠			٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠		
Varieties (V)	P-levels (P_2O_5 kg/fed.) (P)	Bio-fertilizer (B)		Mean	Bio-fertilizer (B)		Mean	Bio-fertilizer (B)		Mean	Bio-fertilizer (B)		Mean
		B_0	B_1		B_0	B_1		B_0	B_1		B_0	B_1	
Misr-١	١٥.٥	١.٥٠	٢.٤٠	١.٩٥	١.٨٠	٢.٨٠	٢.٣٠	١٤.٥٠	١٦.٣٠	١٥.٤٠	١٤.٨٠	١٦.٤٠	١٥.٦٠
	٣١.٠	٢.٣٠	٣.٧٠	٣.٠٠	٢.٧٠	٣.٩٣	٣.٣١	١٥.٧٠	١٧.١٠	١٦.٤٠	١٥.٨٠	١٧.٢٠	١٦.٥٠
	٤٦.٥	٣.٣٠	٤.٤٠	٣.٨٥	٣.٨٠	٤.٩٣	٤.٣٦	١٧.٤٠	١٧.٩٠	١٧.٦٥	١٧.٨٠	١٨.٠٠	١٧.٩٠
Mean		٢.٣٧	٣.٥٠	٢.٩٣	٢.٧٧	٣.٨٨	٣.٣٣	١٥.٨٧	١٧.١٠	١٦.٤٨	١٦.١٣	١٧.٢٠	١٦.٦٧
Giza-٤٢٩	١٥.٥	١.٤٠	٢.٣٠	١.٨٥	١.٧٠	٢.٧٠	٢.٢٠	١٤.٤٠	١٦.٢٠	١٥.٣٠	١٤.٧٠	١٦.٣٠	١٥.٥٠
	٣١.٠	٢.٣٠	٣.٦٠	٢.٩٥	٢.٧٨	٤.٠٣	٣.٤٠	١٥.٦٠	١٦.٩٠	١٦.٢٥	١٥.٦٠	١٧.٥٠	١٦.٥٥
	٤٦.٥	٣.٢٠	٤.٢٠	٣.٧٠	٣.٥٠	٤.٨٥	٤.١٨	١٧.٣٠	١٧.٨٠	١٧.٥٥	١٧.٤٠	١٧.٨٠	١٧.٦٠
Mean		٢.٣٠	٣.٣٧	٢.٨٣	٢.٦٦	٣.٨٦	٣.٢٦	١٥.٧٧	١٦.٩٧	١٦.٣٧	١٥.٩٠	١٧.٢٠	١٦.٥٥
Giza-٤٠	١٥.٥	١.٣٠	٢.٢٠	١.٧٥	١.٦٠	٢.٧٠	٢.١٥	١٤.٣٠	١٦.١٠	١٥.٢٠	١٤.٦٠	١٦.٢٠	١٥.٤٠
	٣١.٠	٢.٣٠	٣.٥٠	٢.٩٠	٢.٥٠	٤.١٨	٣.٣٤	١٥.٣٥	١٦.٨٠	١٦.٠٨	١٥.٥٠	١٧.٣٠	١٦.٤٠
	٤٦.٥	٣.٢٠	٤.١٠	٣.٦٥	٣.٥٥	٥.٠٨	٤.٣١	١٧.٢٠	١٧.٧٠	١٧.٤٥	١٧.٣٠	١٧.٨٠	١٧.٥٥
Mean		٢.٢٧	٣.٢٧	٢.٧٧	٢.٥٥	٣.٩٨	٣.٢٧	١٥.٦٢	١٦.٨٧	١٦.٢٤	١٥.٨٠	١٧.١٠	١٦.٤٥
Mean for P-levels (p)	١٥.٥	١.٤٠	٢.٣٠	١.٨٥	١.٧٠	٢.٧٣	٢.٢٢	١٤.٤٠	١٦.٢٠	١٥.٣٠	١٤.٧٠	١٦.٣٠	١٥.٥٠
	٣١.٠	٢.٣٠	٣.٦٠	٢.٩٥	٢.٦٦	٤.٠٤	٣.٣٥	١٥.٥٥	١٦.٩٣	١٦.٢٤	١٥.٦٣	١٧.٣٣	١٦.٤٨
	٤٦.٥	٣.٢٣	٤.٢٣	٣.٧٣	٣.٦٢	٤.٩٥	٤.٢٨	١٧.٣٠	١٧.٨٠	١٧.٥٥	١٧.٥٠	١٧.٨٧	١٧.٦٨
Mean		٢.٣١	٣.٣٧	٢.٨٤	٢.٦٦	٣.٩١	٣.٢٨	١٥.٧٥	١٦.٩٨	١٦.٣٦	١٥.٩٤	١٧.١٧	١٦.٥٦

L.S.D. at ٥٪ for				
Varieties (V)	٠.٠٩	N.S	N.S	N.S
Phosphorus(P)	٠.١٤	٠.١٣	٠.٥٧	٠.٥٥
Bio-fertilizer (B)	Sig.	Sig.	Sig.	Sig.
V X P	N.S	N.S	N.S	N.S
VXB	N.S	N.S	N.S	N.S
PXB	٠.٢٠	N.S	٠.٦٨	٠.٧١
VXPXB	N.S	N.S	N.S	N.S

٢- Number of pods / plant:-

Table (٢) showed that number of pods/plant was not significantly affected by varieties in ٢٠٠٨/٢٠٠٩ and٢٠٠٩/٢٠١٠ seasons. These results agree with those obtained by Bakheit *et al.* (٢٠٠١).

It is clear from the revealed data that varying the applied phosphorus levels had a significant effect on this trait in both seasons. The highest numbers of pods/plant were (١٧.٥٥ and ١٧.٦٨) achieved by plants fertilized with the highest phosphorus level (٤٦.٥ kg P_2O_5/ fed.) in both seasons, respectively. This may be due to that phosphorus fertilizer increased the vegetative growth of faba bean, in addition to the role of phosphorus fertilizer in enhancing photosynthesis process. Furthermore, phosphorus might have encouraged faba bean growth and caused the significant increase in number of pods / plant. The importance of P fertilizer for number of pods in legume had been found by different investigators such as Abd–Allah and Hamed (٢٠٠٦) and El-Habbasha *et al.* (٢٠٠٧).

The presented data showed that significant differences between the treatment of inoculation and non inoculation with P-dissolving bacteria (phosphorien) for number of pods/plant in both seasons. It could be concluded that application of the bio-fertilizer named phosphorien increased number of pods/plant due to that phosphorien enhanced phosphorus solubilization converting immobilized soil P to soluble form that increased plant P uptake and consequently the uptake of other nutrients. Such effects increased plant vegetative growth, with respect to number of pods. The results of bio-fertilizer in number of pods obtained in the study are in agreement with those obtained by Mohamed and Abbas (٢٠٠٥) and Talaatt and Abdallah (٢٠٠٨).

The presented data showed that number of pods/plant was not significantly affected by the interaction between (V x P) and interaction between (V x B) in both seasons. The interaction between (P x B) was significant in both seasons, since the highest value (١٧.٨٠ and ١٧.٨٧) was obtained from ٤٦.٥ kg P_2O_5/fed. and inoculation with phosphorien. The interaction among (V x P x B) was not significant in both seasons.

٣- Seed yield /plant (gm):-

It is quite clear from presented data in table (٣) that seed yield/plant was significantly affected by varieties only in ٢٠٠٨/٢٠٠٩ season. Where Misr-١ had higher seed yield/plant than Giza-٤٠ and Giza-٤٢٩ varieties. However, Misr-١ variety surpassed Giza-٤٢٩ variety by (٠.٧١٪) while; Misr-١ variety surpassed Giza-٤٠ variety by (١.٩٧٪) in ٢٠٠٨/٢٠٠٩ season. This may be due to the rank of one of them or both as the highest variety of number of branches/plant. These results are in harmony with those found by Sharaan *et al.* (٢٠٠٤) and El-Banna *et al.* (٢٠٠٩) who reported that seed yield/ plant were significantly affected by varieties.

The presented data revealed that increasing phosphorus rates increased seed yield/plant significantly in both seasons, since the highest values (٣٩.٥٣ and ٤٠.٥٢ gm) were obtained when phosphorus was applied at a rate of ٤٦.٥ kg P_2O_5/ fed. in both seasons, respectively. These values surpassed treatment (١٥.٥ P_2O_5/fed.) by (٢٢.٥٤٪ and ٢١.٥٩٪) in the first and second seasons, respectively, while, these values exceeded treatment (٣١.٠ kg P_2O_5/fed.) by (١٠.٨٣٪ and ١٠.٦٦٪) in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons, respectively. These results could be explained in light of the beneficial effect of phosphorus fertilizer in increasing number of branches/plant and number of pods per plant which were previously discussed. It is worthy to mention that our results are in good agreement with those obtained by Khalil *et al.* (٢٠٠٤) and Abd El-Aziz (٢٠٠٧).

The presented data indicated that inoculation with phosphorien gave significant effect on seed yield/plant in the first and the second seasons. Seed yield/plant tended to increase when bean seeds were inoculated with phosphorien compared with the control treatment. The inoculation with phosphorien exceeded the non inoculation by (١٢.٤٦٪ and ١٢.٠٦٪) in both seasons, respectively. It could be concluded that application of the bio-fertilizer named phosphorien increased seed yield/plant due to that phosphorien enhanced phosphorus solubilization converting immobilized soil phosphorus to soluble from that increased plant phosphorus uptake and consequently the uptake of other nutrients. Such effects increased plant vegetative growth, with

respect to leaf area index (L.A.I). An increase in LAI means the increase in plant photosynthesis and photoassimilates translocation to seed increasing seed yield/plant. The results are in accordance with those obtained by Radwan and Mohamed (٢٠٠٥) and Talaatt and Abdallah (٢٠٠٨).

Table ٣: Effect of phosphorus and bio-fertilizers on seed yield/plant (gm) and ١٠٠-seed weight (gm) of some faba bean varieties in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons.

characters		Seed yield/plant (gm)						١٠٠-seed weight (gm)					
Seasons		٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠			٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠		
Varieties (V)	P-levels (P_2O_5 kg/fed.) (P)	Bio-fertilizer (B)		Mean	Bio-Fertilizer (B)		Mean	Bio-Fertilizer (B)		Mean	Bio-Fertilizer (B)		Mean
		B_0	B_1		B_0	B_1		B_0	B_1		B_0	B_1	
Misr-١	١٥.٥	٢٧.٩٠	٣٤.٠٠	٣٠.٩٥	٢٩.١٠	٣٥.٢٠	٣٢.١٥	٦٩.٢٠	٧٢.٥٠	٧٠.٨٥	٧٠.٣٠	٧٣.٤٠	٧١.٨٥
	٣١.٠	٣٢.٦٠	٣٧.٥٠	٣٥.٠٥	٣٣.٥٠	٣٨.٣٠	٣٥.٩٠	٧٣.٧٠	٧٥.٨٠	٧٤.٧٥	٧٤.٩٠	٧٦.٠٠	٧٥.٤٥
	٤٦.٥	٣٩.٤٠	٤١.٣٠	٤٠.٣٥	٤٠.٥٠	٤٢.٠٠	٤١.٢٥	٧٤.٨٥	٧٦.١٠	٧٥.٤٨	٧٥.١٠	٧٦.٣٠	٧٥.٧٠
Mean		٣٣.٣٠	٣٧.٦٠	٣٥.٤٥	٣٤.٣٧	٣٨.٥٠	٣٦.٤٣	٧٢.٥٨	٧٤.٨٠	٧٣.٦٩	٧٣.٤٣	٧٥.٢٣	٧٤.٣٣
Giza-٤٢٩	١٥.٥	٢٧.٨٠	٣٣.٥٠	٣٠.٦٥	٢٨.٩٠	٣٤.٤٠	٣١.٦٥	٦٥.٦٠	٦٩.٢٠	٦٧.٤٠	٦٥.٩٠	٧٠.٠٠	٦٧.٩٥
	٣١.٠	٣٢.٢٠	٣٩.٢٠	٣٥.٧٠	٣٣.٤٠	٤٠.١٠	٣٦.٧٥	٧٠.٦٠	٧٣.٦٠	٧٢.١٠	٧١.١٠	٧٣.٢٠	٧٢.١٥
	٤٦.٥	٣٨.١٠	٤٠.٤٠	٣٩.٢٥	٣٩.٠٠	٤١.٥٠	٤٠.٢٥	٧٢.١٠	٧٤.٤٠	٧٣.٢٥	٧٢.٤٠	٧٤.٢٠	٧٣.٣٠
Mean		٣٢.٧٠	٣٧.٧٠	٣٥.٢٠	٣٣.٧٧	٣٨.٦٧	٣٦.٢٢	٦٩.٤٣	٧٢.٤٠	٧٠.٩٢	٦٩.٨٠	٧٢.٤٧	٧١.١٣
Giza-٤٠	١٥.٥	٢٧.٤٠	٣٣.١٠	٣٠.٢٥	٢٨.٧٠	٣٤.٣٠	٣١.٥٠	٦٣.٣٠	٦٧.٥٠	٦٥.٤٠	٦٣.١٨	٦٧.٧٠	٦٥.٤٤
	٣١.٠	٣١.٩٠	٣٨.١٠	٣٥.٠٠	٣٢.٧٠	٣٩.٢٠	٣٥.٩٥	٦٧.٢٠	٧٠.٣٠	٦٨.٧٥	٦٧.٥٠	٧٠.٧٠	٦٩.١٠
	٤٦.٥	٣٧.٩٠	٤٠.١٠	٣٩.٠٠	٣٨.٨٠	٤١.٣٠	٤٠.٠٥	٧٠.١٠	٧١.٣٠	٧٠.٧٠	٧٠.٦٠	٧١.٨٠	٧١.٢٠
Mean		٣٢.٤٠	٣٧.١٠	٣٤.٧٥	٣٣.٤٠	٣٨.٢٧	٣٥.٨٣	٦٦.٨٧	٦٩.٧٠	٦٨.٢٨	٦٧.٠٩	٧٠.٠٧	٦٨.٥٨

Effect of phosphorus and bio-fertilizers on faba bean

Mean for P-levels(P)	١٥.٥ ٣١.٠ ٤٦.٥	٢٧.٧٠ ٣٢.٢٣ ٣٨.٤٧	٣٣.٥٣ ٣٨.٢٧ ٤٠.٦٠	٣٠.٦٢ ٣٥.٢٥ ٣٩.٥٣	٢٨.٩٠ ٣٣.٢٠ ٣٩.٤٣	٣٤.٦٣ ٣٩.٢٠ ٤١.٦٠	٣١.٧٧ ٣٦.٢٠ ٤٠.٥٢	٦٦.٠٣ ٧٠.٥٠ ٧٢.٣٥	٦٩.٧٣ ٧٣.٢٣ ٧٣.٩٣	٦٧.٨٨ ٧١.٨٧ ٧٣.١٤	٦٦.٤٦ ٧١.١٧ ٧٢.٧٠	٧٠.٣٧ ٧٣.٣٠ ٧٤.١٠	٦٨.٤١ ٧٢.٢٣ ٧٣.٤٠
Mean		٣٢.٨٠	٣٧.٤٧	٣٥.١٣	٣٣.٨٤	٣٨.٤٨	٣٦.١٦	٦٩.٦٣	٧٢.٣٠	٧٠.٩٦	٧٠.١١	٧٢.٥٩	٧١.٣٥
L.S.D. at ٥٪ for													
Varieties (V)		٠.٣٣		N.S		٠.٣٢		٠.٤٥					
Phosphorus(P)		٠.٥٦		٠.٥٥		٠.٥٧		٠.٥٢					
Bio-fertilizer (B)		Sig.		Sig.		Sig.		Sig.					
V X P		N.S		N.S		N.S		٠.٩٠					
VXB		N.S		N.S		N.S		N.S					
PXB		٠.٦٧		٠.٧٢		٠.٦٦		٠.٧١					
VXPXB		N.S		N.S		N.S		N.S					

The interaction effect between factors under study was insignificant during the two seasons with the exception of the interaction between phosphorus and bio-fertilizer treatment in the first and second seasons, where the highest values (٤٠.٦٠ and ٤١.٦٠ gm) were obtained from ٤٦.٥ kg P_2O_5/fed. and inoculation with phosphorien.

٤- ١٠٠- seed weight (gm):-

Table (٣) indicated that ١٠٠-seed weight was significantly affected by varieties in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons. Misr-١ had higher ١٠٠-seed weight than Giza-٤٢٩ and Giza-٤٠ varieties in both seasons. The differences between faba bean varieties in ١٠٠-seed weight may be due to the differences in partitioning and migration of photosynthetic products between faba bean varieties and the endogenous hormones content. Results agreed with those obtained by Bakheit *et al*. (٢٠٠١) and Ragab *et al.* (٢٠١٠).

Applications of phosphorus fertilizer to faba bean plants had a significant effect on this trait in both seasons. The highest ١٠٠-seed weight values (٧٣.١٤ and ٧٣.٤٠ gm) were obtained when phosphorus was applied at a rate of ٤٦.٥ kg P_2O_5/ fed. in both seasons, respectively. These results might be attributed to that phosphorus fertilization encouraged growth of plants, pod setting and pod and

seed filling. This might interpret the increase of weight of seed/plant and this might account much for a good seed filling and subsequently higher seed index. The stimulatory effect of phosphorus, also, may be due to its role in enhancing metabolic processes such as photosynthesis, starch synthesis, glycolysis and synthesis of fats and proteins. These results are in accordance with those found by El-Habbasha *et al.* (٢٠٠٧) and Ibrahim (٢٠٠٩).

The presented data observed that application of phosphorien significantly improved ١٠٠-seed weight. Inoculation with phosphorien increased ١٠٠-seed weight compared with uninoculation with phosphorien. This may be due to that inoculation with phosphorien increases the capacity of plant in utilizing light, water, mineral nutrients and carbon dioxide in building great amount of metabolites which are easily translocated from source to sink and finally accumulation in pods and seeds of faba bean plant. The result of bio-fertilizer in ١٠٠-seed weight obtained in the study is in agreement with those obtained by El-Set, Abd-El-Aziz (٢٠٠٥) and El-Gizawy and Mehasen (٢٠٠٩).

The presented data illustrate that ١٠٠-seed weight was significantly affected by the interaction between (V x P) in the second season only, where the highest value (٧٥.٧٠gm) wase obtained from Misr-١ when received ٤٦.٥kg P_2O_5/fed. No significant affection by the interaction between (V x B) in both seasons. The interaction between (P x B) was significant in both seasons, where the highest values (٧٣.٩٣ and ٧٤.١٠gm) were obtained from ٤٦.٥ kg P_2O_5/fed. and inoculation with phosphorien in both seasons, respectively. The interaction between (V x P x B) was no significant in both seasons.

٥- Seed yield (ard./fed.):-

The presented data in table (٤) emphasized that faba bean varieties was significantly differed in seed yield (ard./fed.) in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons. Furthermore, data showed clearly that Misr-١ variety surpassed in seed yield /fed. than Giza-٤٢٩ and Giza-٤٠ varieties in the first and the second seasons. However, Misr-١ variety to excel Giza-٤٢٩ variety by (٢.٨٤٪ and ٢.٨٩٪) while, Misr-١ variety surpassed Giza-٤٠ variety by (٨.١٨٪ and ٨.٠٧٪) in the first and

second seasons, respectively. The differences between faba bean varieties in the production efficiency may be due to the differences in number of formed nodules on the root of the tested variety, consequently, the growth of each variety may depend mainly on nitrogen fixation, also, to the differences in partitioning and migration of photosynthetic between faba bean varieties. These results are in harmony with those found by Talaatt and Abdallah (٢٠٠٨) and El-Banna *et al.* (٢٠٠٩).

It could be concluded that varying the applied phosphorus levels had a significant effect on this trait in both seasons, where the highest seed yield ard./fed. values (١٢.٣٥ and ١٢.٥٢ ard./fed.) were obtained when phosphorus was applied at a rate of ٤٦.٥ kg P_2O_5/ fed. in both seasons, respectively. These values to surpass treatment (١٥.٥ P_2O_5/fed.) by (٢٠.٦٥٪ and ٢٠.٦٩٪) in the first and second seasons, respectively, while, these values surpassed treatment (٣١.٠٠ P_2O_5/fed.) by (٧.٦٩٪ and ٧.٥١٪) in the first and the second seasons, respectively. These results might be attributed to the role of phosphorus as a constituent of all important nucleo-porteins and thus increases the efficiency of root system. Consequently the physiological activities of the plant are enhanced leading to better yield. It is worthy to mention that our results are in good agreement with those obtained by El-Gizawy and Mehasen (٢٠٠٩) and Ibrahim (٢٠٠٩).

The presented data also, illustrated that application of bio-fertilizer with phosphorien to faba bean plants exerted a significant influence on seed yield ard./fed. in both seasons. In general, application of phosphorien produced higher seed yield ard./fed. as compared to the control in the first and the second seasons. The inoculation with P-dissolving bacteria surpassed the non inoculation by (١٠.٠٣٪ and ١٠.٥٣٪) in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons, respectively. Phosphate 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 them available for growing plants. Such effects increased plant vegetative growth, with respect to LAI. An increase in LAI means the increase in plant photosynthesis and photoassimilates

translocation to seed, increasing seed yield/fed. The result of bio-fertilizer in seed yield /fed. in the study is in agreement with those obtained by El-Banna *et al.* (٢٠٠٩) and Osman *et al.* (٢٠١٠).

Results recorded in table (٤) revealed also that there was significant interaction between varieties and phosphorus treatment in the second season only, where Misr-١ variety when received ٤٦.٥kg P_2O_5/ fed. resulted the highest seed yield ard./fed. The other interaction had no significant effect on such criterion at the two seasons.

٦- Straw yield (ton/fed.):-

The presented data in table (٤) illustrated that straw yield (ton/fed.) was significantly affected by varieties in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons. Misr-١ variety had higher straw yield than Giza-٤٢٩ and Giza-٤٠ varieties in both seasons. This may be due to differences in genetic make up between varieties. These results agree with those obtained by Ahmed and El-Abagy (٢٠٠٧) and Talaatt and Abdallah (٢٠٠٨).

The data in the same Table illustrate that varying the applied phosphorus levels had a significant effect on this trait in both seasons, where the highest straw yield values (٢.٣٢ and ٢.٣٨ ton/fed.) were obtained when phosphorus was applied at a rate of ٤٦.٥ kg P_2O_5/ fed. in both seasons, respectively. This may be due to that phosphorus fertilizer encouraged the vegetative growth of faba bean plants for which plant height as well as branching capacity could be taken as good criteria. This might interpret the increased straw yield due to phosphorus application. These results are in accordance with those of El-Gizawy and Mehasen (٢٠٠٩) and Ibrahim (٢٠٠٩).

Concerning the application of bio-fertilizer with phosphorien to faba bean plants exerted a significant influence on straw yield (ton/fed.) in both seasons. In general, application of phosphorien produced higher straw yield (ton/fed.) as compared to the control in both seasons. Phosphate 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 them available for growing plants. Also, may be

due the increase in straw yield (ton/fed.) might be associated with high plant height and number of branches/plant. The results of bio-fertilizer in straw yield obtained in the study are in agreement with those obtained by Mohamed and Abbas (٢٠٠٥) and El-Banna *et al.* (٢٠٠٩).

The presented data showed that straw yield (ton/fed.) was no significantly affected by the interaction between (V x P) and the interaction between (V x B) in both seasons. While, the interaction between (P x B) was significant in the two seasons. Where, the highest values (٢.٣٢ and ٢.٤٠ ton/fed.) were obtained from ٤٦.٥ kg P_2O_5/fed. and inoculation with phosphorien in the first and second seasons, respectively. The second order interaction was not significant in both seasons.

Table ٤: Effect of phosphorus and bio-fertilizers on seed yield (ard./fed.) and straw yield (ton/fed.) of some faba bean varieties in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons.

characters		Seed yield (ard./fed.)						Straw yield (ton/fed.)					
Seasons		٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠			٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠		
Varieties (V)	P-levels (P_2O_5 kg/fed.) (P)	Bio-fertilizer (B)		Mean	Bio-fertilizer (B)		Mean	Biofertilizer (B)		Mean	Biofertilizer (B)		Mean
		B_0	B_1		B_0	B_1		B_0	B_1		B_0	B_1	
Misr-١	١٥.٥	٩.٤٨	١٠.٨٤	١٠.١٦	٩.٥٩	١٠.٩٦	١٠.٢٨	٢.٠٩	٢.٢١	٢.١٥	٢.١٤	٢.٢٩	٢.٢٢
	٣١.٠	١١.١٣	١٢.٦٠	١١.٨٧	١١.٢٧	١٢.٨٧	١٢.٠٧	٢.١٧	٢.٢٦	٢.٢٢	٢.٢٣	٢.٣٦	٢.٢٩
	٤٦.٥	١٢.٢٣	١٣.٣٥	١٢.٧٩	١٢.٣٦	١٣.٥٨	١٢.٩٧	٢.٣٣	٢.٣٤	٢.٣٤	٢.٣٨	٢.٤٣	٢.٤١
Mean		١٠.٩٥	١٢.٢٦	١١.٦١	١١.٠٧	١٢.٤٧	١١.٧٧	٢.٢٠	٢.٢٧	٢.٢٣	٢.٢٥	٢.٣٦	٢.٣١
Giza-٤٢٩	١٥.٥	٩.١١	١٠.٣٥	٩.٧٣	٩.٢٥	١٠.٥٠	٩.٨٨	٢.٠٤	٢.١٦	٢.١٠	٢.٠٩	٢.٢٠	٢.١٥
	٣١.٠	١٠.٩٥	١٢.٢٠	١١.٥٨	١١.٠٥	١٢.٤٣	١١.٧٤	٢.٢١	٢.٢٣	٢.٢٢	٢.٢٧	٢.٣١	٢.٢٩
	٤٦.٥	١٢.١٠	١٢.٩٥	١٢.٥٣	١٢.٢١	١٣.١٤	١٢.٦٧	٢.٣٠	٢.٣٢	٢.٣١	٢.٣٤	٢.٤٠	٢.٣٧
Mean		١٠.٧٢	١١.٨٣	١١.٢٨	١٠.٨٤	١٢.٠٢	١١.٤٣	٢.١٨	٢.٢٤	٢.٢١	٢.٢٣	٢.٣٠	٢.٢٧
Giza-٤٠	١٥.٥	٨.٩٨	١٠.٠٥	٩.٥٢	٩.١٠	١٠.١٦	٩.٦٣	٢.٠٧	٢.١٤	٢.١١	٢.١١	٢.٢٠	٢.١٦
	٣١.٠	١٠.١٠	١١.٤٠	١٠.٧٥	١٠.٢٢	١١.٦٣	١٠.٩٢	٢.١٠	٢.٢١	٢.١٦	٢.١٥	٢.٣٠	٢.٢٣
	٤٦.٥	١١.٢٥	١٢.٢٠	١١.٧٣	١١.٣٧	١٢.٤٣	١١.٩٠	٢.٢٩	٢.٣١	٢.٣٠	٢.٣٣	٢.٣٨	٢.٣٦
Mean		١٠.١١	١١.٢٢	١٠.٦٦	١٠.٢٣	١١.٤١	١٠.٨٢	٢.١٥	٢.٢٢	٢.١٩	٢.٢٠	٢.٣٠	٢.٢٥
Mean for P-levels(P)	١٥.٥	٩.١٩	١٠.٤١	٩.٨٠	٩.٣١	١٠.٥٤	٩.٩٣	٢.٠٧	٢.١٧	٢.١٢	٢.١١	٢.٢٣	٢.١٧
	٣١.٠	١٠.٧٣	١٢.٠٧	١١.٤٠	١٠.٨٥	١٢.٣١	١١.٥٨	٢.١٦	٢.٢٣	٢.٢٠	٢.٢٢	٢.٣٢	٢.٢٧
	٤٦.٥	١١.٨٦	١٢.٨٣	١٢.٣٥	١١.٩٨	١٣.٠٥	١٢.٥٢	٢.٣١	٢.٣٢	٢.٣٢	٢.٣٥	٢.٤٠	٢.٣٨
Mean		١٠.٥٩	١١.٧٧	١١.١٨	١٠.٧١	١١.٩٧	١١.٣٤	٢.١٨	٢.٢٤	٢.٢١	٢.٢٣	٢.٣٢	٢.٢٧

L.S.D. at ٥٪ for				
Varieties (V)	٠.١١	٠.١٢	٠.٠٣	٠.٠٢
Phosphorus(P)	٠.١٨	٠.١٦	٠.٠٤	٠.٠٢
Bio-fertilizer (B)	Sig.	Sig.	Sig.	Sig.
V X P	N.S	٠.٢٩	N.S	N.S
VXB	N.S	N.S	N.S	N.S
PXB	N.S	N.S	٠.٠٥	٠.٠٣
VXPXB	N.S	N.S	N.S	N.S

B- Chemical analysis:-

١- Protein percentage:-

Illustrated data in table (٥) clearly indicated that varieties had significantly affected the abovementioned trait in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons. Where, Misr-١ variety achieved the highest protein percentage in both seasons. It exceeded the Giza-٤٢٩ variety by (٤.١٠٪ and ٣.٤٢٪) in the first and the second seasons, respectively. While, it exceeded the Giza-٤٠ variety by (٦.٠١٪ and ٧.٢٢٪) in the first and the second seasons, respectively. These results are in line with those found by Ahmed and El-Abagy (٢٠٠٧) and El-Banna *et al.* (٢٠٠٩).

Table ٥: Effect of phosphorus and bio-fertilizers on protein and phosphorus percentage of some faba bean varieties in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons.

characters		Protein percentage						phosphorus percentage					
Seasons		٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠			٢٠٠٨/٢٠٠٩			٢٠٠٩/٢٠١٠		
Varieties (V)	P-levels (P_2O_5 kg/fed.) (P)	Bio-Fertilizer (B)		Mean	Bio-Fertilizer (B)		Mean	Bio-fertilizer (B)		Mean	Bio-fertilizer (B)		Mean
		B.	B١		B.	B١		B.	B١		B.	B١	
Misr-١	١٥.٥	٢٠.٢٥	٢٢.٤٠	٢١.٣٣	٢١.٦٠	٢٤.٢٠	٢٢.٩٠	٠.٤٢	٠.٤٦	٠.٤٤	٠.٤٣	٠.٤٧	٠.٤٥
	٣١.٠	٢٤.٦٠	٢٦.١٠	٢٥.٣٥	٢٥.٦٠	٢٨.٣٠	٢٦.٩٥	٠.٤٨	٠.٥٣	٠.٥١	٠.٤٩	٠.٥٥	٠.٥٢
	٤٦.٥	٢٧.٣٠	٣٠.٢٠	٢٨.٧٥	٢٧.٤٠	٣٠.٩٠	٢٩.١٥	٠.٥٤	٠.٥٨	٠.٥٦	٠.٥٥	٠.٥٩	٠.٥٧
Mean		٢٤.٠٥	٢٦.٢٣	٢٥.١٤	٢٤.٨٧	٢٧.٨٠	٢٦.٣٣	٠.٤٨	٠.٥٢	٠.٥٠	٠.٤٩	٠.٥٤	٠.٥١
Giza-٤٢٩	١٥.٥	١٨.٨٠	٢٢.٦٠	٢٠.٧٠	٢٠.٣٠	٢٢.٩٠	٢١.٦٠	٠.٤١	٠.٤٥	٠.٤٣	٠.٤٠	٠.٤٧	٠.٤٤
	٣١.٠	٢٣.٤٠	٢٤.٩٠	٢٤.١٥	٢٥.٢٠	٢٧.٢٠	٢٦.٢٠	٠.٤٧	٠.٥٣	٠.٥٠	٠.٤٩	٠.٥٥	٠.٥٢
	٤٦.٥	٢٦.٣٣	٢٨.٦٥	٢٧.٤٩	٢٧.٣٠	٢٩.٧٠	٢٨.٥٠	٠.٥٤	٠.٥٩	٠.٥٧	٠.٥٦	٠.٦١	٠.٥٨
Mean		٢٢.٨٤	٢٥.٣٨	٢٤.١١	٢٤.٢٧	٢٦.٦٠	٢٥.٤٣	٠.٤٧	٠.٥٢	٠.٤٩	٠.٤٩	٠.٥٤	٠.٥١

Effect of phosphorus and bio-fertilizers on faba bean

Giza-٤٠	١٥.٥	١٨.٦٠	٢٠.٧٠	١٩.٦٥	١٩.٤٠	٢١.٨٠	٢٠.٦٠	٠.٤١	٠.٤٥	٠.٤٣	٠.٤٢	٠.٤٧	٠.٤٥
	٣١.٠	٢٣.١٠	٢٥.٣٠	٢٤.٢٠	٢٤.٣٠	٢٦.٤٠	٢٥.٣٥	٠.٤٨	٠.٥٤	٠.٥١	٠.٤٩	٠.٥٥	٠.٥٢
	٤٦.٥	٢٥.٩٠	٢٨.٢٠	٢٧.٠٥	٢٦.٢٠	٢٨.٥٠	٢٧.٣٥	٠.٥٤	٠.٥٨	٠.٥٦	٠.٥٤	٠.٦٠	٠.٥٧
Mean		٢٢.٥٣	٢٤.٧٣	٢٣.٦٣	٢٣.٣٠	٢٥.٥٧	٢٤.٤٣	٠.٤٨	٠.٥٢	٠.٥٠	٠.٤٨	٠.٥٤	٠.٥٠
Mean for P-levels (P)	١٥.٥	١٩.٢٢	٢١.٩٠	٢٠.٥٦	٢٠.٤٣	٢٢.٩٧	٢١.٧٠	٠.٤١	٠.٤٥	٠.٤٣	٠.٤٢	٠.٤٧	٠.٤٥
	٣١.٠	٢٣.٧٠	٢٥.٤٣	٢٤.٥٧	٢٥.٠٣	٢٧.٣٠	٢٦.١٧	٠.٤٨	٠.٥٣	٠.٥١	٠.٤٩	٠.٥٥	٠.٥٢
	٤٦.٥	٢٦.٥١	٢٩.٠٢	٢٧.٧٦	٢٦.٩٧	٢٩.٧٠	٢٨.٣٣	٠.٥٤	٠.٥٨	٠.٥٦	٠.٥٥	٠.٦٠	٠.٥٧
Mean		٢٣.١٤	٢٥.٤٥	٢٤.٣٠	٢٤.١٤	٢٦.٦٦	٢٥.٤٠	٠.٤٨	٠.٥٢	٠.٥٠	٠.٤٩	٠.٥٤	٠.٥١

L.S.D. at ٥٪ for				
Varieties (V)	٠.٧٧	٠.٢٠	N.S	N.S
Phosphorus(P)	٠.٧٢	٠.٣١	٠.٠٣	٠.٠١
Bio-fertilizer (B)	Sig.	Sig.	Sig.	Sig.
V X P	N.S	N.S	N.S	N.S
VXB	N.S	N.S	N.S	N.S
PXB	N.S	N.S	N.S	N.S
VXPXB	N.S	N.S	N.S	N.S

The data indicated that phosphorus fertilizer levels had significantly increased protein percentage in both seasons. The highest values (٢٧.٧٦ and ٢٨.٣٣ %) were obtained when phosphorus was applied at a rate of ٤٦.٥ kg P_2O_5/fed. during ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons, respectively. These results might be due to the beneficial effect of phosphorus fertilizer on leguminous crops due to its role in activation the microbial population in nodules to fix more N_2 that used by plants in protein synthesis (Bhadoria *et al.* ١٩٩٧). These results are in accordance with those found by El-Habbasha *et al.* (٢٠٠٧) and Rugheim and Abd El-Gani (٢٠٠٩).

The data showed that inoculation with P-dissolving bacteria had significantly increased protein content in faba bean seeds compared with uninoculated control plants. The beneficial effects of phosphorien on protein percentage often related to the increase of nutrients uptake. These results are in line with those found by El-Set, Abd-El-Aziz (٢٠٠٥) and Osman *et al.* (٢٠١٠) who reported that protein content was significantly affected by bio-fertilizer.

The presented data revealed that protein percentage was not significantly affected by all possible interactions.

٢- Phosphorus percentage:-

Presented data in table (٥) revealed that the three studied varieties did not differ significantly for this character in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons. Same conclusion was found by Khalil *et al*. (٢٠٠٤).

The data indicated that applying phosphorus fertilizer levels had significantly affected phosphorus percentage in seeds in the two growth seasons. However, the highest values (٠.٥٦٪ and ٠.٥٧٪) were obtained when phosphorus was applied at a rate of ٤٦.٥ kg P_2O_5/fed. in both seasons, respectively. The response of faba bean plants to the super phosphate application may be due to the increase of available (P) in soil. These results are in accordance with those found by Talaatt and Abdallah (٢٠٠٨) and Ibrahim (٢٠٠٩).

The data indicated that inoculation with phosphorien had significantly increased phosphorus percentage in faba bean seeds compared with uninoculated control plants. The inoculation with phosphorien bacteria surpassed the uninoculation by (٧.٦٩٪ and ٩.٢٦٪) in ٢٠٠٨/٢٠٠٩ and ٢٠٠٩/٢٠١٠ seasons, respectively. This may be due to converting immobilized soil phosphorus to soluble from increased plant phosphorus uptake and consequently, the uptake of other nutrients, such effects increased phosphorus percentage in seeds. The results of bio-fertilizer in phosphorus uptake obtained in the study are in agreement with those obtained by Mohamed and Abbas (٢٠٠٥).

All studied interactions had no significant effect on such character in the two seasons.

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Effect of phosphorus and bio-fertilizers on faba bean

تأثير التسميد الفوسفاتي والحيوي علي إنتاج وجودة بعض أصناف الفول البلدي

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أقيمت تجربتان حقليتان بمزرعة كلية الزراعة – جامعة الأزهر بأسيوط خلال موسمي ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ لدراسة استجابة ثلاث أصناف من الفول البلدي (مصر–١، جيزة – ٤٢٩ و جيزة– ٤٠) للتسميد بمعدلات مختلفة من السماد الفوسفاتي (١٥.٥، ٣١ و ٤٦.٥ كجم فو٢أ٥/ فدان) والمعاملة بالتسميد الحيوي (كنترول والتلقيح بالفوسفورين) وأثر ذلك علي المحصول وجودته. وقد استخدم تصميم القطاعات المنشقة مرتين في أربع مكررات حيث وزعت الأصناف في القطع الرئيسية بينما وزعت معدلات التسميد الفوسفاتي و الحيوي عشوائيا علي القطع المنشقة و المنشقة مرتين علي الترتيب.

وقد أظهرت النتائج المتحصل عليها اختلافاً معنوياً بين أصناف الفول البلدي في وزن ١٠٠بذرة و محصولي البذور والقش/فدان و النسبة المئوية للبروتين في البذور في كلا الموسمين ، بينما كان الاختلاف معنويا في عدد الأفرع و وزن البذور/ نبات في الموسم الأول فقط ، أما بالنسبة لعدد القرون/نبات و النسبة المئوية للفوسفور في البذور فكانت الفروق غير معنوية. تفوق الصنف مصر–١ علي جيزة–٤٠ و جيزة– ٤٢٩ في كل الصفات المدروسة.

أدي زيادة معدلات التسميد الفوسفاتي من ١٥.٥ ، ٣١ إلي ٤٦.٥ كجم فو٢أ٥/ فدان إلي زيادة معنوية في كل الصفات تحت الدراسة في كلا الموسمين.

أدي اللقاح البكتيري بالفوسفورين إلي زيادة معنوية في عدد الأفرع و عدد القرون و وزن البذور/ نبات و وزن ١٠٠بذرة و محصولي البذور والقش/فدان و النسبة المئوية للبروتين والفوسفور في البذور في كلا الموسمين .

أدي التفاعل بين التسميد الفوسفاتي والحيوي إلي تأثير معنوي في صفة عدد القرون محصول البذور/نبات ، وزن ١٠٠بذرة و محصول القش/فدان في كلا الموسمين ، و عدد الأفرع /نبات في الموسم الأول فقط ، كما أدي التفاعل بين ألأصناف والتسميد الفوسفاتي إلي تأثير معنوي في صفة وزن ١٠٠بذرة و محصول البذور/فدان في الموسم الثاني فقط.

وبصفة عامة توصي الدراسة بزراعة الصنف مصر-١ وإضافة سماد السوبر فوسفات بمعدل٤٦.٥ كجم فو٢ا٥ /فدان والمعاملة بالسماد الحيوي (الفوسفورين) وذلك لتحقيق أعلي محصول من نباتات الفول البلدي تحت ظروف اسيوط.