Zagazig J.Agric. Res., Vol. 30 No.(3) 2003 *651 - 675*

INFLUENCE OF RHIZOBIAL INOCULATION AND NITROGEN, PHOSPHORUS BIO-CHEMICAL FERTILIZATION REGIMES ON GROWTH AND NODULATION OF TWO FABA BEAN CULTIVARS

El-Khawaga, A.A.H; El-M.M El-Naggar;
A.A. A Assey and Yousrya, S.A.Metwally.
Agronomy Dept. Fac. Agric. Zagazig Univ.

Received 30 / 3 / 2003 *Accepted 5 / 4 / 2003*

ABSTRACT: **The present investigation was conducted during two winter successive seasons, 1997/98 and 1998/99, to study the influence of rhizobium inoculation as well as nitrogen - phosphorus bio-chemical fertilization regimes on growth and nodulation of two faba bean cultivars (Giza-3 and Giza-714).**

Faba bean cultivar Giza-3 surpassed Giza-714 in leaf area (Dm^2/plant) at the four sampling dates in both seasons; total dry weight (g/plant) at 75 days after sowing (DAS) in the second season; total number of nodules/plant at all growth stages in both seasons, with the exception of 45 and 60 DAS at first and second seasons, respectively; and dry weight of nodules (mg/plant) at 75 DAS in the second season;

Inoculation of faba bean with rhizobia caused significant increments in leaf area and total dry weigth (g/plant) at 30, 45, 60, 75 DAS in both seasons; total number of nodules formed on root system/plant, at 30 and 60 DAS in first season as well as at all growth stages in second one: and dry weight of nodules (mg/plant) at 30 DAS in first season and at 45 and 75 DAS in second one.

Supplying faba bean plants with any of the ten bio-chemical fertilization regimes induced significant increments in leaf area /plant, total dry weight/plant and most of nodulation characteristics. Available of nitrogen and/or phosphorus in either chemical or biological form conduced heavier dry weight of nodules and more number of nodules on faba bean root system.

INTRODUCTION

Faba bean (*Vicia faba L.*) is considered as the major food legume crop in Egypt. Also, it is considered as one of the basic sources of protein in the Egyptian diet with relatively low price. So it seems important to optimize it's fertilization regimes to obtain maximum yields. The role of using the effective chemical N-P fertilizer which can play significant role in increasing agricultural production, is fully recognized. However, in recent years, many constraints had been raised due to their adverse impacts on the health hazards, environmental problems, such as ground water pollution, eutrophication of streams and lakes, destruction of the stratospheric ozone layer, soil acidification, etc. Consequantly, considerable attention had been paid to solve these problems by developing effective application of biofertilizers. The microbial inoculation aims to minimize the amount of applied chemical fertilizers and reduce the production costes and enviromental pollution.

Varietal differences in leaf area was avered by Mwafy (1995) in Egypt, as he reported that faba bean cultivar Giza-461 surpassed Giza-2 in leaf area/plant. Also, Metwally Yousrya, (1995) in Egypt, recorded significant varietal differences respecting to plant leaf area in favour of Reina-Blanka faba bean cultivar compared with Giza-2. Many investigators in Egypt, came to similar conclusions like Hossny Bahia (1997), Ahmed *et al.*, (1997) as well as Abdel - Aziz El-Set and Shalaby (1999). Whereas, Hassan and Hafiz (1998) found insignificant differences among faba bean cultivars in leaf area/plant.

Varietal differences in dry matter accumulation was detected by Dawwam and Abdel-Aal (1991); Silim and Saxena (1992); Edris (1994); Ahmed *et al.*, (1997) as well as Zeidan and Abd El-Lateef (2001). However, Saad and El-Kholy (2000), Concluded that, the difference between Giza-Blanka and Giza-402 faba bean cultivars in dry weight/plant, was insignificant.

Knaak *et al.*, (1992) in Egypt, showed varietal variation among five faba bean cultivars (Assiut 102, 103, 104, 982 and Giza-402), where. Assiut group cultivars produced significant higher values of both numbers and dry weight of nodules, than Giza-

402. Also, El-Dsouky (1995) came to the same result. As well, varietal differences in nodulation were reported by Mahmoud (1995), El-Karamity (1996), Ahmed *et al.*, (1997).

The effect of rhizobium inoculation on leaf area/plant was studied by Gewaily *et al.*, (1996) and Arisha *et al.*, (1998) on pea as well as El-Mansi *et al.*, (2000) on faba bean. The results revealed significant increase in leaf area/plant due to rhizobium inoculation compared with uninoculation.

Mahmoud (1995); Armanios *et al.*, (1996); Hussein *et al.*, (1997); El-Awag (1998); Hanna (1999) and Hussein *et al.*, (1999) detected that rhizobial inoculation increased both number of nodules and nodule dry weight/plant. Superiority of nodules number and their dry weight/plant, due to inoculation with rhizobium was also exhibited by El-Mansi *et al.*, (2000). Also, Saleh *et al.*, (2000) recorded that rhizobium inoculation for faba bean grown in sandy soil without fertilization, led to increases in both number and dry weight of nodules by 15.6 and 23.5% over the uninoculated plants, respectively, El-Banna *et al.*, (2000) as well as El-Banna and Elwan (2001) working with soybean, came to similar results.

Respecting to the effect of bio-chemical fertilization regimes, El-Khawaga and Zeiton (1986); Elliathy (1993); Zeidan and Abd El-Lateef (2001) Stated that raising nitrogen fertilizer level increased plant leaf area. In addition, faba bean leaf area, exhibted significant response to phosphorus fertilization as reported El-Khawaga and Zeiton (1986), Mwafy (1995) and Hossny Bahia (1997). The meliorate role of N fertilizers on faba bean plant dry weight, was deduced by Monib *et al.*, (1994); Tarrad and Saleh (1995); Hussein *et al.*, (1999), and Hussein *et al.*, (2002-a). Regarding to N_2-fixers effect on leaf area, Ompal *et al.*, (1997) cleared that, the inoculated wheat plants with nitrogen fixing bacteria, had larger leaf area than the uninoculated ones. El-Hawary *et al.*, (1998) and Abd El-Hameed (2002) came to similar findings. In view of Phosphorus disolving bacteria (PDB), Ompal *et al.*, (1997) deduced that the inoculated wheat plants with (PDB), significantly surpassed the uninoculated ones in their leaf area.

The application of nitrogen and/or phosphorus led to increase

both number and dry weight of nodules of faba bean plants (El-Awag, 1998; Hussein *et al.*, 1999 and Hamissa *et al.*, 2000). The marked increase in ooth number of nodules and their dry weight/plant due to rhizobial inoculation was observed by Hussein *et al.*, (1997), Hanna (1999), Hamissa *et al.*, (2000), Saleh *et al.*, (2000) as well as Hussein *et al.*, ((2002 a and b). Likewith. Inoculation of faba bean seeds with (PDB) caused significant increments in number and nodule weight Armanios *et al.*, 1996; Ragab, 1998, Hanna, 1999; Hamissa *et al.*, (2000) as well as El-Banna and Elwan (2001).

MATERIALS AND METHODS

Two field experiments were carried out in an administration field at Sharanis village, Kiwisna District; Monoufiya Governorate, during two winter successive seasons 1997/98 and 1998/99. The research work aimed to study the influence of rhizobial inoculation as well as nitrogen -phosphorus bio-chemical fertilization regimes on growth and nodulation of two faba bean cultivars. The expermiental field soil was sandy in texture. The two faba bean (*Vicia faba. L*) cultivars used were Giza-3 and Giza-714, rhizobium inoculation treatments were 1-control (uninoculated plants) 2- inoculated plants, where specialist Rhizobacterin (*Rhizobium leguminosarum* bv. *Viceae)* for faba bean inoculation was used with the recommended level. The third factor studied was bio-chemical fertilization regimes, included the following 11 treatments.

1- Control
2-20.6 kg N/fad.
3- Microbeen
4- Phosphorin
5- 46.5 kg P_2O_5/fad.
6- 20.6 kg N/fad. +Microbeen
7-20.6 kg N/fad. + Phosphorin
8-20.6 kg N/fad. + 46.5 kg P_2O_5/fad.
9- Microbeen + Phosphorin
10- Microbeen+46.5 kg P_2O_5/fad.
11- Phosphorin + 46.5 kg P_2O_5/fad

Fertilization at the rate of 300kg/fad. of calcium super phosphate (15.5% P_2O_5) i.e. 46.5kg P_2O_5/fad., as well as 50kg/fad. of potassium sulphate (48.5% K_2O) i.e 24.25kg K_2O/fad., were applied befor sowing. Nitrogen fertilizer, Ammonium sulphate (20.6& N/ at the rate of 100 kg/fad., (i.e 20.6 kg N/fad.) was applied, just befor the first

irrigation after sowing (7 and 15 days after sowing), in first and second seasons, respectively. Regarding to the biological fertelizers, "Microbeen" as a nitrogen fixer bactera (*Azotobacter sp+ Azospirillium sp)* at the rate of 500 g/seeds/fad. was used as an inoculant just befor sowing. "Phosphorin" as a phosphate dissolving bacteria "PDB" *(Bacillus megaterium* var. *Phosphaticum*) at the rate of 500 g/seeds/fad. was used as an inoculant just befor sowing.

Split-split-plot design with 3 replicates was used, the main plots were occupied by the two faba bean cultivars, the sub-plots were devoted to rhizobium inoculation treatments. The eleven bio-chemical fertilization regimes were randomly allotted to the sub-sub-plots. Each sub-sub-plot area was $9m^2$ (3x3m).

Sowing took place on November 11^{th} in both seasons, while harvest was after 157 and 176 days from sowing for the two cultivars in the 1^{st} and 2^{nd} seasons, respectively. Each sub-sub plot included five ridges, 60 cm apart. Bean seeds were sown in hills, 20 cm in between on both sides of the ridge, each hill included two plants.

During the vegetative growth, and after 30, 45, 60 and 75 day after sowing (DAS); samples, each of 4 plants were randomly taken from the second ridge to estimate: 1-leaf area (dm^2/plant) 2-Total dry weight (g/plant) 3-Total number of nodules/plant and 6-Dry weight of total noduls (mg/plant).

RESULTS AND DISCUSSION

A-Growth attributes and nodulation:

A-1-Leaf area (Dm^2/plant)

Leaf area of the two faba bean cultivars as influenced by rhizobium inocualtion and the bio-chemical fertilization regimes at 30, 45, 60 and 75 DAS in the two seasons are shown in Table (1).

A-1-1 Varietal differences:

The two faba bean cultivars, significantly differed in leaf area at the four sampling dates, in both seasons. Faba bean cultivar Giza-3 produced larger leaf area compared with Giza-714. Varietal differences in leaf area was deduced by Edris 1994; Mwafy 1995; Metwally Yousrya, 1995; Ahmed *et al.*, 1997 as well as Abdel-Aziz El-Set and Shalaby 1999).

A-1-2- Rhizobium inoculation:

Data presented in Table (1) indicate that, rhizobial inoculated plants were usually superior in their leaf area over the uninoculated plants, this was true in both seasons at all growth stages. Results reported by Gewaily *et al.,* (1996) and Arisha *et al.,* (1998) on pea as well as El-Mansi *et al.,* (2000) on faba bean, revealed significant increase in leaf area/plant due to rhizobum inoculation compared with uninoculation.

A-1-3-Bio-Chemical fertilization regimes:

Supplying faba bean plants with any of the ten bio-chemical fertilization regimes induced significant increments in leaf area/plant relative to the unfertilized plants (Control), in both seasons and at the four sampling dates.

Data of the first season exhibited that the largest leaf area/plant obtained when the bio-chemical regime (20.6 kg N/fad. + Phosphorin) was applied as could be noticed at 45, 60 and 75 DAS. Also, supplying of the bio-chemical regime (Microbeen + 46.5 kg P_2O_5/fad.) produced the largest. Leaf area/plant at 30 DAS. Concerning the second season, results revealed that plants supplied with bio-chemical regimes of (20.6 kg N/fad. + Microbeen), (20.6 kg N/fad. + Phosphorin) and (Microbeen + 46.5 kg P_2O_5/fad.), produced the largest. leaf area at the sampling dates of (30, 60 and 75 DAS), (45 and 75 DAS) as well as (45 and 60 DAS), in respective order. The favourable effect of NP fertilization on leaf area/plant was reported by El-Khawaga and Zeiton (1986), Elliathy (1993), Mwafy (1995), Hossny Bahia (1997) as well as Zeidan and Abd El-Lateef (2001). Also, in the literature, several workers documented the importance of both N_2-fixers and P-disolving organsmis in promoting leaf area/plant (Ompal *et al.,* 1997;El-Hawary *et al.,* 1998 and Abd El-Hameed, 2002).

A-1-4- Effect of interactions:

Interaction effect between cultivars and rhizobium inoculation, significantly affected leaf area/plant at 60 DAS in the first season and at 75 DAS in the second one. The interaction effect was similar to the main effect of both faba bean cultivars and rhizobium inoculation.

Results of the interaction between faba bean cultivars and

bio-chemical fertilization regimes (Tables 1-a and 1-b) show that, in general and over all the four samples in the two seasons, faba bean cultivar Giza-3 was mostly superior in leaf area relative to Giza-714 under most of the bio-chemical fertilization regimes. The most promoting fertilization regime to enlarge the leaf area of both cultivars was fluctuated from sample to another in both seasons.

A-2- Total dry weight (g/plant)

Table (2) shows the results concerning the influence of rhizobium inoculation and nitrogen, phosphorus bio-chemical regimes on dry weight (g/plant) at 30, 45,60 and 75 DAS of two faba bean cultivars during both seasons.

A-2-1 Varietal differences:

Slight and insignificant increase in dry weight/plant in favour of Giza-3 cultivar was observed at all growth stages of both seasons, afterward at 75 DAS in the second season, that increase was significantly avered.

The superiority of Giza-3 faba bean cultivar over Giza-714 dry weight of plant could be expounded by it's superiority leaf area. Varietal differences in dry matter accumulation was detected by Edris (1994); Metwally Yousrya (1995); Ahmed *et al.*, (1997); Hossny Bahia (1997) as well as Abdel Aziz El-Set and Shalaby (1999). However Saad and El-Kholy (2000) in Egypt concluded that, the difference between Giza-blanka and Giza-402 faba bean cultivars in dry weight/plant, was insignificant.

A-2-2 Rhizobium inoculation:

It's obvious from the data regarding the effect of rhizobial inoculation that, the heavier dry weight/plant produced in all growth stages in both seasons, was obtained by rhizobial inoculation. The result followed the same pattern of leaf area in Table (1). Similar results were reported by Armanios *et al.*, (1996), El-Karamity (1996), Hussein *et al.*, (1999), El-Mansi *et al.*, (2000), El-Banna *et al.*, (2000) as well as El-Banna and Elwan (2001).

A-2-3 Bio-chemical fertilization regimes:

Data recorded in both seasons at all growth stages demonstrate that, fertilization by nitrogen and phosphorus (single or in combined), either in chemical or biological type, significantly

increased total dry weight/plant, such like supplying of (20.6 kg N/fad.) at 30 DAS, and (20.6 kg N/fad.+ Microbeen) at 45, 60 and 75 DAS in the first season. And such as applying of (20.6 kg N/fad. + Phosphorin) 30 DAS, (Microbeen + 46.5 kg P_2O_5/fad.) at 45 DAS, (20.6 kg N/fad.) at 60 DAS as well as (Microbeen + Phosphorin) at 75 DAS in the second season. It is worth to mention that dry matter accumulation appeared to be significantly increased due to the application of any bio-chemical fertilization regimes compared to the control.

Regarding the favourable effect of nitrogen fertilization on each of leaf area, and total dry weight/plant, it could be ascribed to the role of nitrogen in stimulating cell divison and enlargment, consequently leaf surface area extension, also it could be attributed to the role of nitrogen in protoplasm formation and all proteins e.g. amino acids, nucleic acid, many enzymes and energy transfer materials (ADP and ATP).

As well, Phosphorus is known to play a key role in the energetic of metabolism and bilosynthetic reactions since it is found in plants as a constituent of nucleic acids, phospholipids, the coenzymes NAD and NADP, ATP and other high-energy compounds (Devlin and Wiltham, 1986).

Respecting to the benefical effects of biofertilization on faba bean plant growth, it could be attributed to the additve available amounts of nutrients (aerial fixed N_2 or solublized P) broght to plant rhizosphere, which in turn contribute in more plant growth. Other investigators thought that the improving effects of biofertilizers are due to that, the inoculation micro-organisms may produce growth-promoting substances such as auxins, gibbrellins and cytokinins, such substances may improve plant growth and stimulate the microbial development (Abd El-Hameed, 2002).

B Nodulation characteristics

B-1 Total nodule number /plant.

The results of total number of nodules/plant as affected by two faba bean cultivars, rhizobium inoculation and bio-chemical fertilization regimes are shown in Table (3).

B-1-1 Varietal differences:

Data of total nodule number formed on faba bean root system reflect obvious superiority for faba bean cultivar Giza-3 over Giza-714 at all growth stages in both seasons, with the exception of

growth stages 45 DAS in first season and 60 DAS in second one.

It is worth to mention tnat faba bean cultivar Giza-3 was also superior in leaf area. Knaak *et al.*, (1992), El- Dsouky (1995), Mahmoud (1995), El- Karamity (1996) and Ahmed *et al.*, (1997) obtained varietal variations in nodule number.

B-1-2 Rhizobium inoculation:

Rhizobial inoculated plants, significantly outnumbered the uninoculated ones regarding total nodule number formed on root system, that could be observed at growth stages 30, 60 and 75 DAS in the first season and at all growth stages in the second one. Also, inoculated plants had larger leaf area (Table 1), and heavier dry weight (Table 2).

Increasing of nodule number due to inoculation with rhizobium was also exhibited by Mahmoud (1995); Armanios *et al.*, (1996); Hussein *et al.*, (1997); El-Awag (1998); Hanna (1999); El-Mansi *et al.*, (2000), Saleh *et al.*, (2000); El-Banna *et al.*, (2000); El-Banna and Elwan (2001), Hussein *et al.*, (2002-a) as well as Hussein ***et al.***, (2002-b).

B-1-3 Bio-chemical fertilization regimes:

Available of nitrogen and or phosphorus in either chemical or biological form, conduced to form more number of nodules on faba bean root system as ascertained by the following regimes in the first season, (20.6 kg N/fad. + 46.5 kg P_2O_5/fad.) at 30 DAS; (Phosphorin + 46.5 kg P_2O_5/fad.) at 45 DAS; (20.6 kg N/fad. + Microbeen) or (20.6 kg N/fad. + Phosphorin) at 60 DAS as well as (46.5 kg P_2O_5/fad.) at 75 DAS; and as in the following regimes in the second season, (20.6 kg N/fad.) at 30 DAS, (20.6 kg N/fad. + Microbeen) at 45 DAS, (46.5 kg P_2O_5/fad.) at 60 DAS as well as (Microbeen + Phosphorin) at 75 DAS.

Chemical nitrogen, generally inhibits legume nodulation, but in a small quantities it can have a benifical effect as a result of improved vigor (Tarrad and Saleh, 1995). The application of chemical nitrogen led to increases in number of nodules/plant as recorded by Tarrad and Saleh, 1995, El-Awag, 1998; Hussein *et al.*, 1999 as well as Hussein *et al.*, 2002-a). In view of the effect of chemical phosphorus application on

nodulation, it has been reported that raising phosphorus level, significantly increased number of nodules (Hussein *et al.*, 1997; Hamissa *et al.*, 2000 as well as Hussein *et al.*, 2002-b). Inoculation with phosphate dissolving bacteria (PDB) and/or phosphate dissolving fungi (PDF) caused a significant increase in number of nodules/plant (Armanios, 1996; Ragab, 1998; Hanna, 1999; Hamissa *et al.*, 2000 as well as El-Banna and Elwan, 2001). As well, the meliorative effect of the bio-chemical fertilization on number of nodules/plant was detected by Hussein *et al.*, (1997); Hanna (1999), Hamissa *et al.*, (2000) as well as Saleh *et al.*, (2000).

B-1-4 Effect of interactions:

The intraction effect of faba bean cultivars x rhizobium inoculation on total nodule number/plant was significant at 30 and 45 DAS in the second season as observed in Table (3-a).

ars	30 DAS		45 DAS	
	inoculated	uninoculated	inoculated	uninoculated
Giza-3	A 58.429 a	B 46.136 a	A 111.554 a	B 95.077 a
Giza-714	A 48.721 b	B 44.504 b	A 86.186 b	B 81.902 b

Both faba bean cultivars affected emphatically by rhizobial inoculation whereas, inoculated plants remarkdly exceled the uninoculated ones in their number of nodules/plant. On the other hand, either the plants were inoculated or uninoculated, the faba bean cultivar Giza-3 outnumbered Giza-714 cultivar in nodules/plant, this was valid at 30 and 45 DAS.

Total nodule number as influenced by the interaction between faba bean cultivars and bio-chemical fertilization regimes are presented in Table (3-b).

The above mentioned interaction effect was significant only at 30 and 45 DAS in first season as well as at 45 DAS in the second one. Under most of the bio-chemical fertilization regimes, superiority in total nodule number/plant was in favour of faba bean Giza-3 over Giza-714 at 30 and 45 DAS in 1st season and at 45 DAS in 2nd one. On the other diraction, both cultivars responsed similarly at 30 DAS in the first season whereas the lowest number of nodules/plant was

corresponding to the control (unfertilized) regime, while the highest number of nodules/plant was corresponding to the fertilization regime (20.6kg N/fad. + 46.5 kg P_2O_5/fad.) But, at 45 DAS in 1st season superiority of both cultivars in total number of nodules was due to the application of the fertilization regime (Phosphorin + 46.5 kg P_2O_5/fad.)

Regarding to the second season and at 45 DAS, application of (Microbeen + 46.5 kg P_2O_5/fad.) to the faba bean cultivar Giza-3 produced the highest number of nodules/plant. But, when the cultivar Giza-714 was planted, supplying of (20.6 kg N/fad. + Microbeen) produced the highest number of nodules/plant.

B-2- Dry weight of nodules (mg/plant)

Table (6) illustrates the influence of rhizobium inoculation and nitrogen, phosphorus bio-chemical fertilization regimes on dry weight of nodules (mg/plant) of two faba bean cultivars.

B-2-1 Varietal differences:

The results respecting the dry weight of nodules (mg/plant), reveal insignificant varietal differences in both seasons at all grwoth stages excluding at 75 DAS in the second season, whereas, nodules formed on Giza-3 root system were heavier than those formed on Giza-714 root system. In general, dry weight of nodules (mg/plant) of the two faba bean cultivars, gradually increased with age advancing in both seasons.

B-2-2 Rhizobium inoculation:

Inoculated plants formed nodules with heavier dry weight compared to the uninoculated plants, this finding could be ascertained at 30 DAS in first season as well as at 45 and 75 DAS in second one. Inoculated plants also had larger leaf area (Table-1), heavier dry weight (Table-2), more numbers of nodules/plant), (Table -3),

B-2-3 Bio-chemical fertilization regimes:

In first season and at 30, 60 and 75 DAS, applying of the bio-chemical fertilization regime (20.6 kg N/fad., + Microbeen) caused in heavier dry weight of nodules/plant relative to the other bio-chemical fertilization regimes. The percentage increase valued as 22.41, 28.59 and 39.00% compared to the control at 30, 60 and 75 DAS, respectively. In the second season, the heaviest dry

weight of nodules (mg/plant) were produced when the following fertilization regimes (20.6 kg N/fad. + Phosphorin), (Microbeen + Phosphorin), (46.5 kg P_2O_5/fad.) and (20.6 kg N/ fad. + Microbeen) were applied at 30, 45, 60 and 75 DAS.

The interaction effect was similar to the main effect of both faba bean cultivars and rhizobium inoculation, whereas Giza-3 surpassed Giza-714 in dry weight of nodules/plant, whatever plants were rhizobial inoculated or uninoculated. The inoculated plants produced heavier nodules/plant relative to the uninoculated plants under the two faba bean cultivars planted.

B-2-4 Effect of the interactions:

Results of the interaction effect between faba bean cultivars and bio-chemical fertilization regimes on dry weight of nodules (mg/plant) (Table 4-b) were significant at 30 DAS in the first season and at 45 DAS in the second one. Faba bean cultivar Giza-3 was mostly superior in dry weight of nodules/plant relative to Giza-714 under most of the bio-chemical fertilization regimes at 30 DAS in 1st season and at 45 DAS in 2nd season. On the other diraction, the most promoting fertilization regime to increase dry weight of nodules/plant at 30 DAS in the first season was (20.6 kg N/fad. + Microbeen) when faba bean cultivar Giza-3 was planted, while application any of the fertilization regimes (20.6 kg N/fad. + Microbeen), (20.6 kg N/fad. + 46.5 kg P_2O_5/fad.) and (Phosphorin + 46.5 kg P_2O_5/fad.) Produced the heaviest dry weight of nodules/plant under planting of Giza-714 faba bean cultivar. As well, the best fertilization regime in increasing the dry weight of nodules/plant at 45 DAS in the second season was, (Phosphorin + 46.5 kg P_2O_5/fad.) when faba bean cultivar Giza-3 was sown, while supplying the fertilization regime (Microbeen + Phosphorin) produced the heaviest dry weight of nodules/plant under planting of Giza-714 faba bean cultivar.

REFERENCES

Abdel Aziz El-set. A and F.H. Shalaby (1999): Physiological studies on response of new released faba bean varieties to different plant populations. Zagazig. J. Agric. Res., 26 (5): 1229-1244.

Abd- El-Hameed, I.M. (2002): Effect of some agronomic practices on wheat. Ph. D

Thesis, Fac. of Agric. Zagazig Univ., Egypt.

Ahmed, M.A; M.S. Hassanein, and Nabila, M. Zaki, (1997): Yield capacity of some faba bean varieties (*Vicia faba L.*). Egypt. J. Appl. Sci; 12 (1): 134-154.

Arisha, H.M.; A. Bardisi and H.I. Abd El-Fattah. (1998): Effect of Rhizobium inoculation and sulfur application on pea plant yield and sulfur oxidizing microorganisms in sandy soil. Zagazig. J. Agric. Res. 25 (6): 1051-1072.

Armanios, R.R.; Y. B. Besada and R.Y. Rizk. (1996): The potentiality of the two symbionts (Rhizobium and VA-mycorrhizae) on the growth of faba bean. Egypt. J. Appl. Sci.; 11 (11).

Dawwam, H.A. and S.M. Abd El-Aal, (1991): Variation in some faba bean varieties *(Vicia faba L.)* Egypt J. of Agron., 16 (1-2): 125-136.

Devlin, R.M. and F.H.Wiltham, (1986): Plant physiology (first Indian Edition). PWS Publishers, A division of Wadsworth, Inc., U.S.A. CBS. Publishers and Distributors, 485 Jain Bhawa, Bhola Nath. Nagar, Shahdara, Delhi 110-032. (India).

Edris, A.S.A. (1994): Effect of plant density and distribution on yield and yield attributes of some field bean cultivars. Egypt. J. Appl. Sci., 9 (1): 166-179.

El-Awag, T. L. (1998): Effect of soil moisture levels, Rhizobium inoculation and nitrogen application on broad bean yield. Journal of Agric. Sci. Mansoura Univ., 23 (10): 4695-4704.

El-Banna, A.A.; A.KH. Ahmed and A.M.A. Ali (2000): The effectiveness of nodulation of soybean and its relation to inoculation, N. and P application Egypt. J. Appl. Sci; 15 (4).

El-Banna A.M. and I.M Elwan (2001): Effect of dual inoculation with Rhizobium and VA. Mycorrhiza on soybean plant growth grown under field conditions. Egypt. J. Appl. Sci; 16 (10).

El-Dsouky, M.M. (1995): Response of broad bean cultivars to inoculation with some strains of Rhizobium leguminosarum. Assiut J. of Agric., Sci. 26 (4).

El-Hawary, F.I.; I. Ibrabim and F. Hamouda (1998): Effect of integrated bacterial fertilization on yield components of wheat

in sandy soil. Journal of Agric. Sci. Mansoura Univ., (23): 1951-1957.

El-Karamity, A.E. (1996): Response of some lentil cultivars to inoculation and spraying with molybdenum. Proc. 7th. conf. Agron., 9-10 sept., : 215-228.

El - Khawaga, A.A.H and O.A.A. Zeiton (1986): Response of faba bean (*Vicia faba* L.) to four levels of nitrogen and phosphorus fertilization: II - Growth analysis. Egypt. J. Appl. Sci.

Elliathy, S. El-Badwy. A. (1993): Fertilization of broad bean (*Vicia faba,* L.) M. Sc. Thesis, Fac. of Agric., Mansoura Univ., Egypt.

El-Mansi, A.A.; A. Bardisi and S.A. El-Atabany (2000): Effect of rhizobium inoculum and soil plastic mulch on nodulation, plant growth and yield of pea under sandy soil conditions. Zagazig J. Agric. Res. 27 (4).

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

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

Hanna A.M. (1999): Response of faba bean (*Vicia faba L.*) to VAM, rhizobium inoculation and N-fertilization. Zagazig J. Agric. Res. 26 (1): 229-237.

Hassan, A.A and S.I. Hafiz (1998): Agronomic characterististics, yield and its components of some field bean cultivars as affected by planting methods and plant spacing. proc. 8th conf. Agron., Suez Canal. Univ., Ismailia, Egypt. 28-29.

Hossny. Bahia, S. (1997): Response of some faba bean varieties to different agronomic treatments under north coast conditions. Ph. D. Thesis, Fac. of Agric., Ain shams Univ., Egypt.

Hussein, A.H.A.; S.A. Saleh, M.A. El-Deeb and W. Kadry (1997): Effect of Rhizobium inoculation, phosphorus and potassium fertilization on growth, nodulation and yield of faba bean cultivated in the

newly reclaimed soils of middle Egypt. Bull. Fac. Agric., Univ., Cairo, 48: 201-214.

Hussein, A.H.A.; S.M. Abd El-Wahab; M.A. El-Deeb and S.A. Saleh (1999): Effect of phosphorus - dissolving bacteria on soil phosphorus viability to faba bean plants in newly reclaimed soil. Icarda/EU. Food legumes. Egypt Annual National Coordination Meeting Cairo, 5-9 September.

Hussein, A. H.; S.A. Saleh, M.A. El-Deeb; A.A. Ragab; A.A. Abou- El-Soud and K.H. El-Yamani. (2002-a): Response of faba bean to biofertilization under newly reclamed soils. Report of National annual coordination meeting. Cairo, 22. 23 September 2002.

——————— (2002-b): Response of faba bean to inoculation with *Rhizobium leguminosarum* bv. *viceae* and plant growth promoting rhizobiacteria (PGPR) under newly reclaimed soils, Report of National annual coordination meeting Cairo, 22-23-September, 2002.

Knaak, C.; P. Roskothen and G. Robbelen. (1992): Symbiotic efficiency of (*Vicia faba L.*) genotypes after field inoculation with different strains of Rhizobium leguminosarum pre selected in greenhouse tests. Journal plant physiol. 141:49-53.

Mahmoud, S.M. (1995): Effect of inoculation of faba bean with four genetically marked strains of Rhizobium leguminosarum on nodulation, nodule occupancy and yield. Assiut J. of Agric. Sci., 26 (4).

Metwally Yousrya, S.A. (1995): Response of faba bean to some agronomic treatments. M. Sc., Thesis, Fac of Agric., Zagazig Univ. Egypt.

Monib M.; A. Higazy; M.E. Hassan and A.A. Ragab (1994): Possibility of magnifying broad bean productivity in fertile Nile valley soils. Annals Agric Sci., Ain-shams Univ., Cairo 39 (1): 53-63.

Mwafy, S.A. (1995): Studies on faba bean (*Vicia faba L.*) M. Sc. Thesis, Fac. of Agric., Zagazig Univ. Egypt.

Ompal, S.; J.D.S. Panwar and O. Singh (1997): Effect of nitrogen fixing and phosphorus solubilizing bacteria on nutrient uptake and yield of wheat. Indian. Plant physiol., 2 (3): 211-213.

Ragab A.A. (1998): Integration of microbial inoculation and mineral fertilization for better soybean - Environment management. Ph. D Thesis, Fac. of Agric., Cario Univ., Giza, Egypt.

Saad. A.O.M, and M.A. El-Kholy. (2000): Response of some faba bean cultivars to phosphorus and magnesium fertilization. Egypt. J. Agron., 22: 19-38.

Saleh, S.A; M.A. El-Deep and A.A. Ragab. (2000): Response of faba bean (*Vicia faba L.*) to Rhizobium inoculation as affected by nitrogen and Phosphorus fertilization. Bull. Fac. Agric., Cairo Univ., 51: 17-30.

Silim, S.N. and Saxena (1992): Comparative performance of some faba bean (*Vicia faba L.*) cultivars of contrasting plant types. 2-Growth and development in relation to yield. Journal of Agric. Sci., comb. 118 (3): 333-342.

Tarrad, A.M. and S.A. Saleh (1995): Effect of Rhizobium inoculation, starter nitrogen and micronutrients on growth, nodulation and nitrogen uptake by soybean. Bull. Fac. Agric. Univ., Cairo, 46: 391-402.

Zeidan, M.S. and E.M. Abd El-Lateef. (2001): Response of determinate and indeterminate faba bean (*Vicia faba L.*) to nitrogen and phosphorus levels. Egypt. J. Appl. Sci.; 16. (1).

Table (1) Influence of rhizobium inoculation and nitrogen, phosphorus bio-chemical fertilization regimes on leaf area (Dm^2/plant) at 30, 45, 60 and 75 DAS. of two faba bean cultivars.

Main effects and interactions	Days after sowing (DAS)							
	30		45		60		75	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Faba bean cultivars (C)								
Giza - 3	5.510	6.637	8.169	13.407	12.598	17.267	17.625	21.521
Giza - 714	5.399	6.506	8.020	12.821	12.106	16.285	17.296	20.982
F. test	**	*	*	**	**	**	**	**
L.S.R 5%	0.006	0.009	0.013	0.011	0.030	0.034	0.015	0.014
Rhizobium inoculation (I)								
Uninoculated	5.230	6.358	7.892	12.805	12.104	16.499	17.153	20.931
Inoculated	5.679	6.784	8.297	13.423	12.600	17.053	17.769	21.573
F. test	**	**	**	**	**	**	**	**
L.S.R 5%	0.015	0.026	0.016	0.033	0.019	0.033	0.043	0.015
Bio-chemical fertilization regimes (F)								
Control	4.110 d	5.283 f	6.976 I	11.570 h	11.235 e	13.104 h	14.420 e	17.358 g
20.6 Kg N/fad.	5.347 c	6.345 de	8.537 b	13.237 cde	12.802 a	17.045 def	18.050 b	20.566 f
Microbeen	5.379 c	7.041 a	7.687 gh	13.462 bc	11.902 d	15.795 g	18.118 b	20.191 f
Phosphorin	5.321 c	6.529 c	8.485 bc	13.658 ab	12.249 bc	17.200 de	18.270 b	22.304 ab
46.5 Kg P_2O_5/ fad.	5.595 b	7.037 a	8.320 cd	12.887 f	12.819 a	16.937 ef	17.371 c	22.408 a
20.6 Kg N/ fad. + Microbeen	5.270 c	7.008 a	8.175 de	12.425 g	12.179 c	17.820 ab	18.033 b	22.104 abc
20.6 Kg N/ fad. + Phosphorin	5.541 b	6.475 cd	8.955 a	13.737 a	12.940 a	16.866 f	19.008 a	22.120 abc
20.6 Kg N/ fad. + 46.5 Kg P_2O_5 / fad.	5.569 b	6.795 b	7.584 h	13.058 ef	12.898 a	17.300 cd	17.629 c	21.541 de
Microbeen + Phosphorin	5.655 b	6.912 ab	8.438 bc	13.129 de	12.133 cd	17.591 bc	16.359 d	21.379 e
Microbeen + 46.5 Kg P_2O_5 / fad.	6.068 a	6.570 c	7.850 fg	13.741 a	12.487 b	17.891 a	16.680 d	21.841 cd
Phosphorin + 46.5 Kg P_2O_5/ fad.	6.145 a	6.287 e	8.033 ef	13.350 cd	12.229 bc	16.987 ef	18.133 b	21.958 bcd
F. test	**	**	**	**	**	**	**	**
L.S.R 5%	0.158	0.143	0.209	0.237	0.275	0.300	0.324	0.426
Interactions								
C X I	N.S.	N.S.	N.S.	N.S.	*	N.S.	N.S.	**
C X F	*	**	*	**	**	**	**	*
I X F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S., * and ** indicate insignificant and significant at 0.05 and 0.01 levels, respectively.

Table (1-a) Interaction effect between faba bean cultivars and bio-chemical fertilization regimes on leaf area/plant in the first season at 30, 45, 60 and 75 DAS

Bio-chemical fertilization regimes	Days after sowing (DAS)							
	30		45		60		75	
	Giza-3	Giza-714	Giza-3	Giza 714	Giza-3	Giza- 714	Giza-3	Giza-714
Control	B 3.958 d	A 4.263 g	A 7.151 g	B 6.801 c	A 11.305 e	A 11.165 d	A 14.961 f	B 13.880 g
20.6 Kg N/fad.	A 5.380 c	A 5.315 e	B 8.388 cd	A 8.686 ab	A 13.078 b	B 12.526 b	A 19.251 a	B 16.848 ef
Microbeen	A 5.698 c	B 5.060 f	A 8.493 bc	B 6.881 f	A 12.270 c	B 11.535 d	A 19.056 a	B 17.180 e
Phosphorin	A 5.685 b	B 4.956 f	A 8.728 ab	B 8.241 cd	A 13.111 b	B 11.386 d	A 18.123 bc	A 18.418 b
46.5 Kg P_2O_5/fad.	A 5.796 b	B 5.393 de	B 8.050 e	A 8.591 b	A 13.401 ab	B 12.236 bc	A 17.580 d	A 17.163 e
20.6 Kg N/fad. + Microbeen	A 5.250 c	A 5.291 e	A 8.066 e	A 8.283 c	A 13.041 b	B 11.316 d	B 17.808 cd	A 18.258 bc
20.6 Kg N/fad. + Phosphorin	B 5.406 c	A 5.676 c	A 8.953 a	A 8.956 a	A 13.556 a	B 12.325 bc	A 19.101 a	B 18.915 a
20.6 Kg N/fad.+46.5 Kg P_2O_5/fad.	A 5.741 b	B 5.396 de	A 7.586 f	A 7.581 e	B 12.460 c	A 13.336 a	A 17.491 d	A 17.766 d
Microbeen+Phosphorin	A 5.763 b	A 5.546 ed	B 8.270 cde	A 8.606 b	A 12.290 c	B 11.976 c	B 16.020 e	B 16.698 f
Microbeen+46.5 Kg P_2O_5/fad.	A 6.158 a	B 5.978 b	A 8.095 de	B 7.605 e	B 11.810 d	A 13.165 a	B 16.156 e	A 17.205 e
Phosphorin + 46.5 Kg P_2O_5/fad.	B 5.775 b	A 6.516 a	A 8.083 e	B 7.983 d	A 12.258 c	A 12.200 bc	A 18.333 b	B 17.933 cd

Capital and small letters were used for comparison between means in rowss and columns, respectively.

Table (1-b) Interaction effect between faba bean cultivars and bio-chemical fertilization regimes on leaf area /plant in the second season at 30, 45, 60 and 75 DAS

Bio-chemical fertilization regimes	Days after sowing (DAS)							
	30		45		60		75	
	Giza-3	Giza-714	Giza-3	Giza 714	Giza-3	Giza- 714	Giza-3	Giza- 714
Control	A 5.408 f	B 5.158 h	A 11.558 f	A 11.583 e	B 12.916 f	A 13.291 f	A 18.008 g	B 16.708 f
20.6 Kg N/fad.	A 6.441 d	A 6.250 f	A 14.283 a	B 12.191 d	A 17.791 bc	B 16.300 cd	B 20.150 f	A 20.983 cd
Microbeen	B 6.750 c	A 7.333 b	A 14.166 ab	B 12.758 c	A 15.866 e	A 15.725 e	A 20.425 f	B 19.958 e
Phosphorin	A 6.750 c	B 6.308 ef	A 13.600 cd	A 13.716 b	A 18.166 ab	B 16.233 cd	A 23.083 a	B 21.525 bc
46.5 Kg P_2O_5/fad.	A 7.433 a	B 6.641 d	A 13.533 cd	B 12.241 d	A 18.225 a	B 15.650 e	A 22.783 ab	B 22.033 ab
20.6 Kg N/fad. + Microbeen	A 7.550 a	B 6.466 de	A 12.541 e	A 12.308 d	A 17.866 ab	A 17.775 a	B 22.375 bcd	B 21.833 ab
20.6 Kg N/fad. + Phosphorin	A 6.491 d	A 6.458 de	A 13.833 bc	A 13.641 b	A 17.283 d	B 16.450 c	B 21.833 de	A 22.408 a
20.6 Kg N/fad.+46.5 Kg P_2O_5/fad.	A 6.733 c	A 6.858 c	B 12.566 e	A 13.550 b	A 17.441 cd	A 17.158 b	A 22.008 cde	B 21.075 cd
Microbeen+Phosphorin	B 6.233 e	A 7.591 a	A 13.733 cd	B 12.525 cd	A 18.233 a	B 16.950 b	A 22.008 cde	B 20.750 d
Microbeen+46.5 Kg P_2O_5/fad.	B 6.166 e	A 6.975 c	B 13.416 d	A 14.066 a	A 18.116 ab	B 17.666 a	A 22.558 abc	B 21.125 cd
Phosphorin + 46.5 Kg P_2O_5/fad	A 7.050 b	B 5.525 g	A 14.250 a	B 12.450 cd	A 18.033 ab	B 15.941 de	B 21.508 e	A 22.408 a

Capital and small letters were used for coparison between means in rows and coulmns, respectively.

Table (2): **Influence of rhizobium inoculation and nitrogen, phosphorus bio-chemical fertilization regimes on dry weight (g/plant) at 30, 45, 60 and 75 DAS. of two faba bean cultivars.**

Main effects and interactions	Days after sowing (DAS)							
	30		45		60		75	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Faba bean cultivars (C)								
Giza - 3	1.373	2.630	3.950	4.700	8.526	10.223	12.728	17.811
Giza - 714	1.372	2.637	3.605	4.469	8.401	9.811	12.483	14.539
F. test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**
L.S.R. 5%	-	-	-	-	-	-	-	0.039
Rhizobium inoculation (I)								
Uninoculated	1.310	2.582	3.673	4.468	8.325	9.858	12.165	15.766
Inoculated	1.435	2.685	3.883	4.701	8.602	10.177	13.046	16.584
F. test	*	*	*	*	*	**	**	**
L.S.R. 5%	0.045	0.028	0.054	0.082	0.154	0.059	0.076	0.137
Bio-chemical fertilization regimes (F)								
Control	0.839 g	2.365 f	3.159 e	4.168 f	7.288 h	8.726 I	8.796 h	11.842 g
20.6 Kg N/fad.	1.771 a	2.674 b	3.916 b	4.389 de	8.789 cd	11.530 a	12.563 d	15.815 e
Microbeen	1.215 e	2.620 bcd	3.330 d	4.662 c	7.526 gh	9.870 ef	11.216 f	15.584 ef
Phosphorin	1.524 d	2.643 bc	4.118 a	4.813 b	8.556 de	9.805 fg	11.658 ef	15.555 ef
46.5 Kg P_2O_5/ fad.	0.975 f	2.642 bc	3.345 d	4.411 de	8.114 f	11.121 b	12.003 de	17.729 e
20.6 Kg N/ fad. + Microbeen	1.611 c	2.588 cd	4.134 a	4.718 bc	9.745 a	10.081 de	15.983 a	16.321 d
20.6 Kg N/ fad. + Phosphorin	1.683 bc	3.070 a	4.134 a	4.332 e	9.304 b	10.122 d	15.122 b	16.330 d
20.6 Kg N/ fad. + 46.5 Kg P_2O_5 / fad.	1.750 ab	2.560 de	4.209 a	4.466 d	8.770 cde	9.629 g	15.043 b	18.393 b
Microbeen + Phosphorin	0.990 f	2.656 b	3.600 c	4.734 bc	7.601 g	9.230 h	10.590 g	19.735 a
Microbeen + 46.5 Kg P_2O_5 / fad.	1.049 f	2.633 bc	3.451 d	4.995 a	8.505 e	9.693 fg	11.276 f	15.202 f
Phosphorin + 46.5 Kg P_2O_5/ fad.	1.691 abc	2.519 e	4.154 a	4.743 bc	8.902 c	10.385 c	14.413 c	15.450 ef
F. test	**	**	**	**	**	**	**	**
LS.R. 5%	0.086	0.062	0.136	0.124	0.267	0.236	0.611	0.444
Interactions								
C X I	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
C X F	N.S.	N.S	N.S	N.S	N.S	N.S	N.S	N.S
I X F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S

N.S., * and ** indicate insignificant and significant at 0.05 and 0.01 levels, respectively.

Table (3): Influence of rhizobium inoculation and nitrogen, phosphorus bio-chemical fertilization regimes on total nodule number/plant of two faba bean cultivars.

Main effects and interactions	Days after sowing (DAS)							
	30		45		60		75	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Faba bean cultivars (C)								
Giza - 3	9.448	52.282	21.905	103.315	32.347	111.603	46.455	125.135
Giza - 714	8.493	46.567	20.077	84.044	26.906	108.790	44.250	119.156
F. test	*	**	N.S.	**	*	N.S.	*	*
L.S.R. 5%	0.091	0.357	-	0.779	0.659	-	0.351	0.615
Rhizobium inoculation (I)								
Uninoculated	8.020	45.320	20.466	88.490	26.431	107.487	42.987	117.753
Inoculated	9.921	53.529	21.517	98.870	32.823	112.906	47.717	126.539
F. test	**	**	N.S.	*	*	**	*	**
L.S.R. 5%	0.121	0.172	-	1.058	2.925	0.580	0.779	1.264
Bio-chemical fertilization regimes (F)								
Control	6.746 g	57.732 c	16.603 ef	91.137 f	14.692 f	89.574 I	29.241 h	97.126 g
20.6 Kg N/fad.	10.297 d	62.988 a	17.995 e	78.898 j	28.769 c	128.320 a	45.683 de	127.551 c
Microbeen	4.715 h	39.306 g	22.145 c	93.261 e	19.854 e	103.533 g	35.278 g	123.932 d
Phosphorin	10.998 c	44.064 f	15.544f g	87.365 h	25.442 d	112.522 e	40.704 f	124.870 d
46.5 Kg P_2O_5/ fad.	7.311 f	54.725 d	15.979f g	90.000 g	21.229 e	129.580 a	66.900 a	128.950b c
20.6 Kg N/ fad. + Microbeen	12.071 b	46.432 e	26.120 b	108.814 a	42.800 a	82.001 j	59.491 b	129.740 b
20.6 Kg N/ fad. + Phosphorin	11.050 c	46.264 e	25.856 b	84.157 I	43.005 a	101.225 h	45.429 e	110.658 f
20.6 Kg N/ fad. + 46.5 Kg P_2O_5 / fad.	14.575 a	44.625 f	20.150 d	92.095 f	39.133 b	106.166 f	36.708 g	115.007 e
Microbeen + Phosphorin	4.565 h	32.063 h	14.535 g	103.095 c	24.445 d	116.210 d	36.104 g	152.655 a
Microbeen + 46.5 Kg P_2O_5 / fad.	7.583 f	55.927 d	20.937 cd	104.438 b	29.160 c	124.470 b	48.529 d	109.145 f
Phosphorin + 46.5 Kg P_2O_5/ fad.	8.766 e	59.548 b	35.025 a	97.219 d	37.366 b	118.564 c	54.808 c	123.970 d
F. test	**	**	**	**	**	**	**	**
L.S.R. 5%	0.389	1.251	1.610	1.128	1.993	1.953	2.940	1.961
Interactions								
C X I	N.S.	**	N.S.	*	N.S.	N.S.	N.S.	N.S.
C X F	**	N.S	**	**	N.S	N.S	N.S	N.S
I X F	**	**	**	**	N.S.	N.S.	N.S.	N.S

N.S., * and ** indicate insignificant and significant at 0.05 and 0.01levels, respectively.

Table (3-b) Total nodule number at 30 and 45 DAS in first season as well as at 45 DAS in the second one, as influenced by the interaction between faba bean cultivars and bio-chemical fertilization regimes.

Bio-chemical fertilization regimes	First season				Second season	
	30 DAS		45 DAS		45 DAS	
	Giza-3	Giza-714	Giza-3	Giza-714	Giza-3	Giza-714
	A	B	B	A	B	A
Control.	8.355 f	5.138 h	13.291 f	19.915 de	84.023 h	98.251 b
	A	B	A	B	A	B
20.6 Kg N/fad.	11.986 c	8.608 d	19.208 e	16.783 g	87.421 g	70.375 i
	A	B	A	B	A	B
Microbeen.	5.505 h	3.925 i	30.083 b	14.208 h	110.396 d	76.126 g
	B	A	A	B	A	B
Phosphorin.	10.391 d	11.605 c	20.430 de	10.658 i	105.521 e	69.210 i
	A	A	B	A	A	B
46.5 Kg P_2O_5/fad.	7.308 g	7.315 f	10.541 g	21.416 cd	93.688 f	86.313 de
	B	A	A	B	A	B
20.6 Kg N/fad. + Microbeen.	10.566 d	13.576 b	29.791 b	22.450 c	112.690 c	104.921 a
	A	B	A	A	A	B
20.6 Kg N/fad. + Phosphorin.	12.983 b	9.116 d	25.921 c	25.841 b	85.063 h	83.251 f
	B	A	A	B	A	B
20.6 Kg N/fad.+46.5 Kg P_2O_5/fad.	14.216 a	14.935 a	21.975 d	18.325 efg	110.625 d	73.565 h
	B	A	B	A	A	B
Microbeen+Phosphorin.	3.758 i	5.371 h	9.988 g	19.083 ef	116.356 b	89.835 c
	A	A	A	B	A	B
Microbeen+46.5 Kg P_2O_5/fad.	9.208 e	5.958 g	24.416 c	17.458 f	121.063 a	87.813 d
	A	B	A	A	A	B
Phosphorin + 46.5 Kg P_2O_5/fad.	9.650 e	7.883 e	35.366 a	34.683 a	109.625 d	84.813 ef

Capital and small letters were used for comparison between means in rows and coulmns, respectively.

Tabie (4): Influence of rhizobium inoculation and nitrogen, phosphorus bio-chemical fertilization regimes on dry weight of nodules (mg/plant) of two faba bean cultivars.

Main effects and interactions	Days after sowing							
	30		45		60		75	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Faba bean cultivars (C)								
Giza - 3	439	587	443	695	546	1010	728	1299
Giza - 714	431	583	443	679	535	972	716	1116
F. test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*
L.S.R. 5%	-	-	-	-	-	-	-	16.00
Rhizobium inoculation (I)								
Uninoculated	429	578	438	677	535	970	716	1163
Inoculated	440	593	448	697	546	1011	729	1253
F. test	**	N.S.	N.S.	**	N.S.	N.S.	N.S.	**
L.S.R. 5%	1.500	-	-	3.000	-	-	-	6.000
Bio-chemical fertilization regimes (F)								
Control	406 e	598 c	402	655 f	514 e	771 g	623 g	1089 f
20.6 Kg N/fad.	461 c	577 h	442	661ef	501 ef	1000 d	738cd	1238 e
Microbeen	410 e	590 e	426	656 f	455 g	894 f	665 f	1242de
Phosphorin	469 c	570 j	473	698 cd	599 b	1008 d	656 f	1323 b
46.5 Kg P_2O_5/ fad.	381 f	575 I	397	669 e	490 f	1185 a	772 b	1276 cd
20.6 Kg N/ fad. + Microbeen	497 a	583 f	485	669 e	661 a	788 g	866 a	1455 a
20.6 Kg N/ fad. + Phosphorin	428 d	610 a	492	694 d	580 c	1136 b	724 d	957 h
20.6 Kg N/ fad. + 46.5 Kg P_2O_5 / fad.	479 b	601 b	462	712 b	533 d	928 e	729cd	1298 bc
Microbeen + Phosphorin	375 f	562 k	417	727 a	495 f	924 ef	743 c	1259 de
Microbeen + 46.5 Kg P_2O_5 / fad.	410 e	593 d	405	710 b	540 d	1059 c	739 cd	1045 g
Phosphorin + 46.5 Kg P_2O_5/ fad.	465 c	580 g	472	709 b	579 c	1211 a	692 e	1103 f
F. test	**	**	N.S.	**	**	**	**	**
L.S.R. 5%	10.000	2.000	-	12.000	19.000	31.000	19.000	37.000
Interactions								
C X I	N.S.	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
C X F	**	N.S	N.S.	**	N.S	N.S	N.S	N.S
I X F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S

N.S., * and ** indicate insignificant and significant at 0.05 and 0.01 levels, respectively.

Table (4-a) The interaction between faba bean cultivars and rhizobium inoculation, significnatly affected dry weight of nodules (mg/plant) at 30 DAS in the second season as show in the following.

Cultivars	30 Days after sowing	
	inoculated	uninoculated
Giza-3	A 595.8 a	B 579.6 a
Giza-714	A 590.9 b	B 577.7 b

Table (4-b) The interaction effect between faba bean cultivars and bio-chemical fertilization regimes on dry weight of nodules (mg/plant) at 30 DAS in first season as well as at 45 DAS in the second season.

Bio-chemical fertilization regimes	Fist season		Second season	
	Days after sowing (DAS)		Days after sowing (DAS)	
	30		45	
	Giza-3	Giza-714	Giza-3	Giza-714
Control.	B 397.5 e	A 415.0 d	A 655.3 g	A 654.8 f
20.6 Kg N/fad.	A 466.3 bc	A 455.6 b	A 668.5 fg	B 654.1 f
Microbeen.	A 463.3 c	B 358.3 f	A 702.3 cd	B 610.8 g
Phosphorin.	B 459.0 c	A 480.0 a	A 712.8 b	B 683.8 cd
46.5 Kg P_2O_5/fad.	A 376.6 f	A 386.6 e	B 652.3 g	A 685.8 cd
20.6 Kg N/fad. + Microbeen.	A 519.0 a	B 476.1 a	A 674.0 ef	B 664.1 ef
20.6 Kg N/fad. + Phosphorin.	B 421.5 d	A 435.5 c	A 692.8 de	A 695.5 bc
20.6 Kg N/fad.+46.5 Kg P_2O_5/fad.	A 479.6 b	A 479.3 a	A 730.0 ab	B 695.0 dc
Microbeen+Phosphorin.	A 370.0 f	A 380.0 e	B 710.3 cd	A 744.5 a
Microbeen+46.5 Kg P_2O_5/fad.	A 420.0 d	B 401.6 d	A 713.0 bc	A 708.6 b
Phosphorin + 46.5 Kg P_2O_5/fad.	B 456.1 c	A 474.0 a	A 743.8 a	B 674.5 de

تأثير التلقيح بالريزوبيا ونظم سمادية بيوكيمائية للنتروجين والفوسفور على النمو والعقد الجذرية لصنفين من الفول البلدى

عبد الستار عبد القادر حسن الخواجه - السيد مصطفى محمد النجار
أحمد أحمد على عاصى - يسرية سعيد عبد الشافى متولى
جامعة الزقازيق - كلية الزراعة - قسم المحاصيل

تم تنفيذ هذا البحث خلال موسمى الزراعة الشتويين المتتالين ١٩٩٧/١٩٩٨، ١٩٩٨/١٩٩٩ لدراسة تأثير التلقيح بالريزوبيا بالأضافة إلى بعض نظم التسميد البيوكيمائية للنتروجين والفوسفور على النمو وتكوين العقد الجذرية وذلك لصنفى الفول البلدى (جيزة ٣، جيزة ٧١٤) وقد أوضحت النتائج تفوق صنف الفول البلدى جيزة-٣ على الصنف جيزة ٧١٤ فى كل من الصفات التالية:

١-مساحة الأوراق /نبات (ديسمتر مربع) وذلك فى مراحل النمو الاربعة فى كلا الموسمين.
٢-الوزن الجاف الكلى/نبات (جم) وذلك عند عمر ٧٥ يوم من الزراعة فى الموسم الثانى.
٣-العدد الكلى للعقد الجذرية/نبات. وذلك فى جميع مراحل النمو فى كلا الموسمين فيما عدا العمر ٤٥، ٦٠ يوم من الزراعة فى الموسم الأول والثانى على التوالى.
٤-الوزن الجاف الكلى للعقد الجذرية/مليجرام/نبات وذلك بعد ٧٥ يوم من الزراعة فى الموسم الثانى.

• تلقيح الفول البلدى ببكتريا الريزوبيا تسبب فى زياده معنويه فى كل من
١- مساحة الأوراق والوزن الجاف/نبات فى الأعمار ٣٠، ٤٥، ٦٠، ٧٥ يوماً من الزراعة فى كلا الموسمين.
٢- العدد الكلى للعقد الجذرية المتكونة على المجموع الجذرى/نبات وذلك عند ٣٠، ٦٠ يوماً من الزراعة فى الموسم الأول بالاضافة إلى العينات الأربعه فى الموسم الثانى
٣- الوزن الجاف للعقد الجذريه (مليجرام/نبات) عند عمر ٣٠ يوم من الزراعة فى الموسم الأول بالاضافة إلى ٤٥، ٧٥ يوماً من الزراعة فى الموسم الثانى.

** إمداد نباتات الفول البلدى بأى من نظم التسميد البيوكميائى العشرة سببت زيادات معنوية فى كل من مساحة الأوراق/نبات، والوزن الجاف الكلى للنباتات ومعظم الصفات الخاصة بالعقد الجذرية.

* وفرة النتروجين،/ أو الفوسفور أما فى الصورة الكيماوية أو الحيوية تسبب فى زيادة وزن العقد الجذرية وكذلك زيادة اعدادها المتكونة على المجموع الجذرى لنبات الفول البلدى.