COMPARATIVE STUDIES OF USING CHEMICAL AND BIO-FERTILIZERS ON THE GROWTH AND YIELD OF TWO SNAP BEAN CULTIVARS
1. FRESH YIELD AND ITS COMPONENTS

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Abstract

This study was conducted in the two successive seasons of 1999/2000 and 2000/2001 at a private farm at Dahrout, Maghagha, Minia, Egypt. The present study aimed to investigate the effect of chemical fertilizers (Nitrogen and Phosphorus), biofertilizers (*Rhizobium*, biogene and phosphorein) and their interaction on the some growth characters and fresh yield and its components of two snap bean (*Phaseolus vulgaris*, L.) cultivars i.e, "Bronco" and "Giza 3".

The obtained results indicated that "Bronco" cultivar was superior in plant height, number of branches, number of fresh pods per plant and total fresh yield (ton/fed.), while cv. Giza 3 was superior in weight of fresh pods/plant and average fresh pod weight. Bio-fertilizer treatments significantly increased most studied characters when compared with the uninoculated plants. Inoculation with *Rhizopium* produced the highest values followed by those of the biogene treatments. Most studied characters were significantly affected by the chemical fertilizers (N+P) treatments. The interaction among the studied factors had significant effects on most studied characters. Finally the obtained results showed that it may be recommended to grow plants of cv. " Bronco" after inoculation with the biofertilizers of N and P with about 50% of the recommended chemical fertilizer dose.

INTRODUCTION

Snap bean (*Phaseolus vulgaris* L.) is one of the most important economic vegetable crops. It is grown for the production of green pods (snap beans) and as pulse legume dry beans. Green pods, produced during winter and spring, are considered to be the main vegetable exportated to Europe.

The major problem facing the farmer is the high cost of chemical fertilizers. Furthermore, chemical fertilizer production and utilization are considered to be an air, soil and water polluting agent. Therefore, the utilization of biostimulants and biofertilizers are considered today by many scientists as a promising alternative, particularly for developing countries.

Many workers reported that the genotypes of plants differed in their response to inoculation with bio-organisms, whereas out of 684 genotypes of *Phaseolus vulgaris* which examined to their ability to form effective symbiosis, only three genotypes were found to form effective nitrogen fixing symbiosis with *Rhizobium ferdii* strains (Sodowsk *et al.*, 1988). Also, nodulation was reported to be depended mainly on strain type, Martinez and Rosenblueth (1990) indicated, that, the competitive abilities of different types of *Rhizobium* strains capable of nodulating *Phaseolus vulgaris* L. Also, Sanoria and Yadav (1993) reported that plant growth, seed yield nodulation were improved depended on the type of microorganisms strain. In the meantime, Upadhyay and Dhar (1994) indicated that cultivars x strain interaction for nodulation plant dry weight and yield, were apparent. Also, Buttery *et al.* (1997) found that nodulation potential, maturity growth, and most measured characteristics were more affected by the interaction between 17 cultivars of *Phaseolus vulgaris* and 10 genetically diverse strains. *Rhizobium* inoculants were superior to other microorganisms inoculation, i.e., *Azosprillum* (Kundu *et al.*, 1993).

With increasing N rate to 120 kg/ha most growth characters, fresh yield and its components were increased (Nleya, 1985, Suresh *et al.*, 1997 and Ravi and Prasad 1998).

Phosphorus was also found to affect the vegetative growth and yield components of *P. vulgaris*. This was clear in the studies of Buttery *et al.* (1987), Perira (1988) and Ahlwat (1996).

Therefore, the aim of this study was to evaluate the role of different bio-fertilizer inoculated symbiotic and non-symbiotic nitrogen fixing and different rates of mineral nitrogen and phosphorus fertilizers as well as their interactions on growth parameters, fresh yields and yield components of two snap bean cultivars under EL-Minia Governorate growing conditions.

MATERIALS AND METHODS

This study was conducted in the two successive winter seasons of 1999/2000 and 2000/2001 to evaluate the effect of biofertilizers (*Rhizobium*, biogen and phosphorein) and chemical fertilizers (Nitrogen and Phosphorus) as well as their interaction on the plant growth and yield components of snap bean (*Phaseolus vulgaris*, L.).

All experiments were carried out in a private farm at Dahrout, Maghagha, El-Minia Governorate.

Soil samples were randomly taken before sowing in both seasons and used to determine some physical and chemical properties of the soil. Particle size distribution and organic matter content were determined according to the methods described by Piper (1950). Total nitrogen was determined by semi-Microkjeldah technique as described by Black *et al.* (1965). Available phosphorus was determined according to Olsen method as described by Black *et al* (1965). Soil physical and chemical properties are presented in Table 1.

Inoculation procedures:

Rhizobium and *Azotobacter* isolates were obtained from the Department of Genetics, Faculty of Agriculture, El-Minia University. Phosphorein commercial was obtained from the Ministry of Agriculture, Cairo, Egypt.

Snap bean seeds of the two cultivars "Bronco" and "Giza 3" were soaked in liquid culture of the inoculum for one hour before sowing. Arabic gum solution (40%) was used as an adhesive material at the rate of 10 ml/1 kg seeds. Uninoculated seeds were soaked in tap water. The treated seeds were sown at one side of the ridges when field soil reached an appropriate moisture content on the 1st and 6th of September in 1999 and 2000, respectively. Three weeks later, growing plants were thinned to one plant per hill.

Treatments were arranged in a split split plots design with three replicates.

The two tested cultivars (factor A) were randomly distributed in the main plots whereas, the biofertilizers (factor B) were randomly distributed in the sub-plot as follows,

1- Control (No inoculation)
2- Inoculated with *Rhizobium* isolate
3- Inoculated with Biogen isolate (*Azotobacter* isolate)
4- Inoculated with Phosphorein isolate (Phosphate dissolving bacteria (*Bacillus megatherium*)

Table 1. Mechanical and chemical analysis of experimental soil.

Season	Particle size analysis			Texture grade	pH 1:2.5	E C mmhos/cm 1:2.5	$CaCO_3$ %	Total N (ppm)	OM %	Available P (ppm)	Exchangeable K (ppm)
	Sand %	Silt %	Clay %								
1999/2000	24.81	29.30	46.61	Silty clay	7.86	1.02	4.00	30	1.83	2.90	520
2000/2001	28.53	27.92	42.37	Silty clay	7.99	1.11	4.80	40	1.86	2.86	480

5- Inoculated with Commercial Phosphorein

Finally, combination treatments of N and P chemical fertilizers (factor C) were applied in sub sub plots as follows:

1- Control, no fertilizers were added

2- 20 kg N + 15 kg P_2O_5/ Fed.

3- 20 kg N + 30 kg P_2O_5/ Fed.

4- 40 kg N + 15 P_2O_5/Fed.

5- 40 kg N + 30 kg P_2O_5/ Fed. (Recommended dose of chemical fertilizers).

Nitrogen was applied in the form of urea (46.5% N) and phosphorus was applied in the form of calcium super phosphate (15% P_2O_5). Fertilizers were divided into two equal doses and applied after 20 and 40 days from sowing.

Each experimental plot consisted of 6 ridges each of 5 m long and 65 cm wide (19.5 m^2). Three ridges in each experimental plot were used to measure the fresh yield parameters and the other 3 ridges were used to determined the dry yield parameters.

I- Plant growth parameters

Data of the vegetative growth characters, i.e. plant height and number of branches/plant were recorded from 15 plants taken at random from each experimental plot at the end of the growing season.

II- Fresh yield parameters

Harvesting green pods was started on the 10th and 16th of November in 1999 and 2000, respectively. Fresh pod yield of each experimental plot was harvest 4 times a week in both seasons and fresh pod yield per Feddan was calculated. Twenty pods were taken at random from each experimental plot from the second harvest in both seasons and the following characters were determined.

Average fresh pod weight, g, number of pods/plant, fresh weight of pods /plant and fresh yield /feddan in addition, fertility percentage were recorded using the following formula :

$$\text{Fertility \%} = \frac{\text{Number of seeds/pod}}{\text{Number of ovules/pod}}$$

Statistical analysis

Data were subjected to the statistical analysis and treatment means were compared using the L.S.D. method according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

I- Growth parameters

Plant height

The data presented in Table 2 showed that no significant differences in plant height were found between the two cultivars in both seasons. The plants inoculated with biofertilizers increased significantly plant height compared with uninoculated plants in both seasons. These results are in agreement with these obtained by Wang *et al.* (1996) and Chandra *et al.* (1987). Among the different biofertilizers *Rhizobium* treatment had the highest plant height (57.8 and 58.0 cm) in the first and second season, respectively. The increase in plant height with *Rhizobium* was significant in both seasons compared with other treatments except with biogene treatment. The varying inoculation effect on plant height with different isolates of organisms was previously reported by Burdman *et al.* (1997).

The highest rate of both nitrogen and phosphorus (40/30 kg N/P showed the highest significant effect on plant height in both seasons. The increase in plant height with increasing nitrogen rate was reported by Chandra *et al.* (1987). On the other hand, the role of phosphorus alone in increasing plant height was also reported by Chandra *et al.* (1987).

The interaction between cultivars and biofertilizers in both seasons showed that cv. Giza 3 X *Rhizobium* and cv. Branco X *Rhizobium produce the highest values for plant height with no* significant differences between them.

Number of branches/plant

Data presented in Table 3 showed that significant differences in number of branches/plant were found between the two cultivars in both seasons. "Branco cv." showed higher values for number of branches compared to the cv. Giza 3, in both seasons. Plants inoculated with biofertilizers produced significantly higher number of branches/ plant compared with uninoculated plants in both seasons. These results are in agreement with those obtained by Rebleto *et al.* (1998). Among the different biofetilizers, the inoculated plants with *Rhizobium* produced significantly more number

of branches compared with other treatments. The varying inoculation effect on number of branches with different isolates of microorganisms was previously reported by Wang *et al.* (1996).

Also, data in Table 3 showed that the number of branches were affected significantly by the rate of chemical fertilizers added to the plants. The highest values of this trait was obtained with 20/30 kg/fed of N and P respectively. These results are in agreement with those reported by Chandra *et al.* (1987).

The interaction between cultivars and biofertilizers had significant effect whereas the treatment (Branco cv X *Rhizobium*) inoculation showed the highest value of branch number/plant in both seasons. Also the interaction between bio-and chemical fertilizers were significant in both seasons. The fertilized plants with (20/30 kg N/P/ fed. and inoculation of those plants with *R. phaseoli* showed the highest values of branch number/plant (8.9 and 8.6) in the first and second season, respectively.

II- Fresh yield and its component

Number of fresh pods/plant

The data presented in Table 4 showed that cv. "Branco" had significantly higher values for number of fresh pods/plant compared to cv. Giza 3. The plant inoculated with biofertilizers increased significantly in number of fresh pods/plant compared with uninoculated plants in both seasons. These results are in agreement with those obtained by Abd El-Mageed *et al.* (2001) on cowpea. *Rhizobium* treatment produced the highest number of fresh pods/plant compared to uninoculated plants in both seasons. The varying inoculation effect on number of fresh pods/plant with different isolates of organisms was previously reported by Wang *et al.* (1996).

The highest rate of both nitrogen and phosphorus 20/30 kg N/P showed the highest significant values of number of fresh pods/plant in both season. Increasing N-rate increased number of fresh pods/plant. This increase was reported by Guvenc (1996). On the other hand, the role of phosphorus alone in increasing number of fresh pods/plant was also reported by Srivivas and Naik (1988).

The interaction effects on number of fresh pods/plant were significant in both seasons. Regarding the interaction between cultivars and biofertilizers the treatment (Branco cv. x *Rhizobium*) inoculation showed the highest value of number of fresh pods/plant in both seasons. The highest values were 41.2 and 42.8 were obtained in

the first and second season, respectively. On the other hand the interaction between bio-and chemical fertilizers were significant in both seasons. The highest values were 39.5 and 40.4, which obtained after inoculation with *Rhizobium phasleoli* and fertilized with 20/30 N/P in the first and second seasons, respectively.

Fresh weight of pods/plant (g)

The data presented in Table 5 showed that significant differences in fresh weight of pods/plant were found between the two cultivars in both seasons. However, "Giza 3" cultivar showed higher values for this character compared to the "Branco" cv. The plants inoculated with biofertilizers showed significantly higher fresh weight pods/plant compared to uninoculated plants in both seasons. These results are in the same line with the data obtained by Crespo *et al.* (1987). *Rhizobium* treatment produced the highest fresh weight of pods/plant compared to other treatments in both seasons. The varying inoculation effect on weight of fresh pods/plant with different isolates of organisms was previously reported by Valaquez *et al.* (1988).

The rate 20/30 kg/fed. of both nitrogen and phosphorus respectively showed the highest significant values of this trail in both seasons. Increasing N-rate increased fresh pod weight/plant. This increase was reported by Kalyano *et al.* (1996). On the other hand, the role of phosphorus alone in increasing weight of fresh pods/plant was reported by Stalin *et al.* (1989).

The interaction between cultivars and biofertilizers showed that Giza 3 inoculated with *Rhizobium* showed the highest weight of fresh pods/plant in both seasons. On the other hand the interaction of bio- and chemical fertilizers was significant in both seasons. The highest values (271.3 and 284.3 kg/plant in the first and second season, respectively), were obtained with plants inoculated with *R. phaseoli* and fertilized with 0 kg of N and 30 kg of P_2O_5 per feddan.

Average fresh pod weight

Data presented in Table 6 showed that significant differences in average fresh pod weight were found between the two cultivars in both seasons. Cultivar "Giza 3" showed higher values for average fresh pod weight compared to the cv. Branco.

The plants inoculated with biofertilizers gave significantly higher average fresh pod weight compared to uninoculated one in both seasons. These results are in agreement with those obtained by Robleto *et al.* (1998). Among the different biofertilizers, *Rhizobium* treatment produced markedly more average fresh pod weight when compared to other treatments in both seasons. The varying inoculation effect on

average fresh weight with different isolates of organisms was previously reported by Duque *et al.* (1985).

The rate 20/30 of both nitrogen and phosphorus respectively showed the highest significant values of average fresh pod weight in both seasons. The increase in average fresh pod weight with nitrogen fertilization was reported by Crespo *et al.* (1987). Also increasing average fresh pod weight after phosphorus fertilization was reported by Stalin *et al.* (1989).

The interaction effects on average fresh pod weight were significant in both seasons where the interaction between cultivars and biofertilizers (Giza 3 X *Rhizobium* inoculation) showed the highest average fresh pod weight in both seasons. Also high values of average fresh pod weight were obtained with adding 20 and 30 kg of N and P_2O_5, respectively, per feddan when plants were inoculated with *R. phaseoli*.

Total yield of fresh pod

Data presented in Table 7 showed that a significant effect on fresh pod yield was found between the two cultivars in both seasons. Branco cultivar showed higher values for fresh pod yield compared to the cv. Giza 3. The plants inoculated with biofertilizers increased significantly in the fresh pod yield compared with uninouclated plants in both seasons. These results are in agreement with those obtained by Wang *et al.* (1996). *Rhizobium* treatment produced markedly more fresh pod yield compared to other treatments of biofertilizers in both seasons. The varying inoculation effect on fresh pod yield with different isolates of organisms was previously reported by Duque *et al.* (1985) and Rebleto *et al.* (1998).

The addition of both nitrogen and phosphorus at 20/30 kg N/P respectively, showed the highest significant values of fresh pod yield in both seasons. However, the increase in fresh pod yield with increasing nitrogen rate was clearly noted. This increase was also reported by Srinivas and Nik (1990) and Ravi and Prasad (1998). On the other hand, the role of phosphorus alone in increasing fresh pod yield was also reported by Stalin *et al.* (1989) and Jasrotia and Sharma (1999).

All the interactions had significant effects on fresh pod yield in both seasons. The interaction between cultivars and biofertilizers, (Branco X *Rhizobium*) showed the highest fresh pod yield in both seasons. Also the inoculation of plants with *R. phaseoli* together with fertilization with 20 and 30 kg/fed of nitrogen and phosphorus respectively showed the highest values of fresh pod yield in both seasons.

Fertility percentage

Data presented in Table 8 showed that no significant differences between cultivars were obtained, although the Branco cultivar had the higher values of this trait in both seasons. Also, data in Table 8 show that there were no significant differences between inoculated and uninoculated plants. Among the different biofertilizers, *Rhizobium* treatment had the highest fertility percentage (96.0 and 97.1) in both seasons but the differences among these isolates were not significant. The differences among nitrogen and phosphorus rates were not significant effect. As for the interaction between cultivars and biofertilizers, the treatment Branco cultivar X *Rhizobium* inoculation showed the highest value of fertility percentage in both seasons. Regarding the interaction of bio- and chemical fertilizers, a high fertility percentage can be obtained by inoculation with *R. phaseoli* and fertilization with the highest rate (40 and 30 kg/fed N/P) in both seasons.

CONCLUSION

In general data showed that cultivar "Bronco" was superior over "Giza 3" cultivar in most vegetative growth characters and fresh yield components. This variance between two cultivars may be depended on true genetical variation and its interaction with environmental conditions

Also data showed that the inoculation of snap bean with the studied biofertilizers improved most studied characters when compared with uninoculated plants. This improvements may be as a result for the important roles of these microorganisms in improving soil fertility and plant development via nitrogen fixation, and releasing certain nutrient elements (P, Fe, Zn, Mn and K) in addition to contributing with some plant hormones such as gibbenellins, auxins and cytokinins (Tien *et al.*, 1979).

In the meantime, both chemical nitrogen and phosphorus fertilizers had great effect on growth and yield of snap bean (Tables 3-7). Also, data indicated that growth responsibility and yield quantity were differed in depending on the rate of these chemical fertilizers and this may be as a result for their functions on plant growth process and plant metabolism.

The interactions between bio and chemical fertilizers had significant effects on most studied characters and this may be due to the reactions of microorganisms and both chemical nitrogen and phosphorus elements rizosphere of plant roots.

REFERENCES

1. Abd El-Mageed Y. T., S. A. Elshoboky and O. F. Dakhly. 2001. Effect of inoculation with *Rhizobium* mutants and foliar spray with orthophosphoric acid on cowpea growth and yield. The fifth Arabic Conf. Ismailia, Egypt. 24-28 March 2001 pp 75-86.

2. Ahlwat I. P. S. 1996. Response of French bean (*Phaseolus vulgaris*) varieties to plant density and phosphorus level. Indian J. Agric. Sci. 66(6): 338-342.

3. Black, G. A., D.D. Evans, L.E. Ersmingor, J. L. White and F. E. Clarck. 1965. Methods of soil Analysis Amer. Soc. Agron. Inc. Bull. Madison, Wisconsin, USA pp 891-1400

4. Burdman S., J. Kigel and Y. Okon. 1997. Effects of *Azospirillium brasilense* on nodulation and growth of common bean (*Phaseolus vulgaris*). Soil Biol. and Biochem. 29(5-6): 923-929.

5. Buttery B. R., S. J. Park and W. I. Findlay. 1987. Growth and yield of white bean (*Phaseolus vulgaris*) in response to nitrogen, phosphorus and potassium fertilizer and to inoculation with *Rhizobium*. Canadian J. Plant Sci. 67(2): 425-432.

6. Chandra R., C. B. S. Rajput, K. P. Singh and S. J. P. Singh. 1987. A note on the effect of nitrogen, phosphorus and *Rhizobium* culture on the growth and yield of French bean (*Phaseolus vulgaris* L.) cv. contender. Haryana J. Horti.Sci. 16(1-2): 145-147.

7. Crespo G. M., R. Kluson and E. C. Senroder. 1987. Nitrogen levels and *Rhizobium* inoculation and yields of native white bean (*Phaseolus vulgaris* L.). J. Agric. Univ. of Puerto Rico. 71(1): 1-6.

8. Duque F. F., M.C.P. Neves, A. A. Franco., R. L. Victoria and R. M. Boddey. 1985. The response of field grown (*Phaseolus vulgaris*) to *Rhizobium* inoculation and the quantification of N_2 fixation using N15. Plant and Soil 88(3): 333-343.

9. Guvenc I. 1996. Effect of foliar application of urea on pods properties, pod yield and mineral contents of snap beans (*Phaseolus vulgaris* L.). Anodolu 6(2): 112-119. (C. F. Hort. Abst. Vol. 509 No. 4039).

10. Jasrotia R. S. and C. M. Sharma. 1999. Productivity and quality of French bean as affected by integrated phosphorus management in acid soil. Fertilizer News 44(11): 59-61 (C.F. Hort. Abst. Vol. 783 No. 5926).

11. Kalyano, M. N., Singh, R.N. Singh, J. S. Bohra and K.S. Singh. 1996. Fertilizer and irrigation studies on yield economy and NPK uptake of French bean (*Phaseolus vulgaris*). Fertilizer News 41(5): 39-42.

12. Kundu B. S., M.S. Kuhad and A.S. Nandwal. 1993. Nodulation, nitrogen fixation and biomass of rajmash (*Phaseolus vulgaris* L.) as influenced by *Azospirillium* and *Rhizobium* inoculants. Envir. and Ecolo. 11(3): 581-583.

13. Martinez R. E. and M. Rosenblueth. 1990. Increased bean (*Phaseolus vulgaris* L.) nodulation competitiveness of genetically modified *Rhizobium* strains. Appl. and Environ. Microbiol. 56(8): 2384-2388.

14. Nleya T. M. 1989. Response of dry beans (*Phaseolus vulgaris*) to varying levels of nitrogen, phosphorus and potassium fertilizers. J. Agric. Res. 27(2): 149-151.

15. Perira P. A. A. 1988. Improvement of N_2 fixation in common bean (*Phaseolus vulgaris*) at different level of available phosphorus. Dissertation. Abst. Inter. B. Sci. and Engineering 48(9): 2505.

16. Piper, S. G. 1950. Soil and plant analysis Inter-Science publishers, New York. pp 680.

17. Ravi, N. and U. K. Prasad. 1998. Effect of irrigation and nitrogen on growth yield, nitrogen uptake and water use efficiency of French bean (*Phaseolus vulgaris*). Indian J. Agric. Sci. 68(2): 75-80.

18. Robleto E. A., K. Kmiecik, E. S. Cplinger, J. Nienis and E. W. Triplett. 1998. Trifolitoxin production increase nodulation competitiveness of *Rhizobium etli* CEZ under agricultural conditions. Applied and Environ. Microbiol. 64(7): 2630-2633.

19. Sanoria C. L. and J. Yadav. 1993. Testing of strains of *Rhizobium phaseoli* on French bean (*Phaseolus vulgaris*) under greenhouse and field conditions. Indian J. Agron. 38(1): 28-32.

20. Sodowsk M. J., P. B. Cregan and H. H. Keyser. 1988. Nodulation and nitrogen fixation efficacy of *Rhizobium fredii* with (*Phaseolus vulgaris*) genotypes. Applied and Environ. Microbiol. 54(8): 1907-1910.

21. Srinivas K. and L. B. Naik. 1988. Response of vegetable French bean (*Phaseolus vulgaris*) to nitrogen and phosphorus fertilization. Indian J. Agric. Sci. 58(9): 707-708.

22. Srinivas K. and L. B. Naik. 1990. Growth yield and nitrogen uptake in vegetable French bean (*Phaseolus vulgaris* L.) as influenced by nitrogen phosphorus fertilization. Haryana J. Horti. Sci. 19(1-2): 160-167.

23. Stalin P., K. Shammugam, S. Thamburaj and S. Ramadas. 1989. Response of bus type French bean (*Phaseolus vulgaris*) to phosphorus fertilization in sheuroys. Indian. Hort. 37(1): 28-33.

24. Steel, R. G. D. and J. H. Torrie. 1980. Principles and procedures of statistics A Biometrical Approach Mc. Graw Hill Book Company (2nd Ed) N. Y. 631 P.

25. Suresh K., G. D. Sharma, J. J. Shakna and S. Kumar. 1997. Response of rajmsh varieties to nitrogen under dry temperate high hills. Legume Rese. 20(2): 101-103.

26. Tien, T. M., M. H. Gaskins and D. H. Hubble. 1979. Plants growth substances produced by *Azospirillum parasilense* and their effects on the growth of plants. Appl. Environ. Microbiol., 37: 1016-1024.

27. Upadhyay K. K. and B. Dhar. 1994. Nodulation and yield of (*Phaseolus vulgaris*) inoculations with two strains of *Rhizobium leguminosarum* bivar *phaseoli*. Crop. Res. Hisar 8(1): 17-22.

28. Velaquez Y. A., R.A. Kluson and E. C. Schroder. 1988. Rhizobium inoculation of (Phaselous vulgaris) in Lajas, Puerto Rico J. Agric. Unive. Purerto Rico 72(3): 427-436.

29. Wang S. S., M.S. Karkeli, J. D. Patil and B. B. Meher. 1996. Effect of rhizobial inoculation and fertilizer nitrogen on French varieties. J. Soils and crops. 6(2): 132-135.

Table 2a. Effect of chemical and biofertilizers on plant height (cm) of the two studied Snap bean cultivars in the two seasons 1999/2000 and 2000/2001.

Cultivars "A"	Biofertilizers "B"	FIRST SEASON							SECOND SEASON						
		Chemical fertilizers (N/P kg/fed.) "C"					Mean A xB	Mean	Chemical fertilizers (N/P kg/fed.) "C"					Mean A1 xB1	Mean
		0/0	20/15	20/30	40/15	40/30			0/0	20/15	20/30	40/15	40/30		
	Uninoculation	45.1	45.9	47.3	48.5	48.7	47.1		48.2	47.7	49.1	49.7	50.1	48.9	
	R. phaseoli	55.7	57.5	59.1	59.6	59.1	58.1		56.1	57.6	58.2	59.7	58.4	58.0	
Bronco	Biogen	53.8	55.4	56.3	58.8	59.5	56.8	53.4	54.7	55.7	58.7	58.3	59.6	52.4	54.1
	B. m. var phospha	49.9	54.7	53.4	53.6	55.0	53.3		51.1	52.8	54.2	55.5	56.4	54.0	
	Phosphorien	47.9	49.9	51.0	54.6	55.5	51.8		49.8	50.5	53.1	54.8	52.8	52.2	
A_1 x C		50.5	52.7	53.4	55.0	55.6			52.0	52.8	54.6	55.6	55.4		
	Uninoculation	41.7	44.3	46.0	48.6	48.6	45.9		45.6	46.0	47.6	49.8	50.1	47.8	
	R. phaseoli	54.2	56.4	59.1	59.2	57.8	57.4		55.5	57.7	58.3	59.4	59.7	58.1	
Giza 3	Biogen	52.9	55.5	58.0	57.8	57.2	56.3	52.7	53.5	56.0	59.1	58.4	58.8	57.1	53.8
	B. m. var phospha	47.9	51.9	50.0	55.0	55.8	53.3		50.2	52.7	53.1	54.2	56.2	53.4	
	Phosphorien	46.7	50.2	52.3	54.8	54.9	51.8		48.3	51.4	50.8	56.0	56.7	59.6	
A_2 x C		48.7	51.7	53.1	55.1	54.9			50.6	52.7	53.8	55.7	56.2		
Mean " C"		49.6	52.1	53.2	55.0	55.2			51.3	52.8	54.2	55.6	55.8		
Mean "B" :	B1= 46.5	B2=81.8		B3=56.5		B4=52.7	B5= 57.8		B1=48.4		B2=58.0		B3=57.2	B4=53.7	B5=52.4

Table 2b. Effect of the interaction (biofertilizers x chemical fertilizers) on plant height (cm) in the two seasons.

Biofertilizers	FIRST SEASON					SECOND SEASON				
	Chemical fertilizers N / P kg / fed. "C"					Chemical fertilizers N / P kg / fed. "C"				
	0/0	20/15	20/30	40/15	40/30	0/0	20/15	20/30	40/15	40/30
Uninoculation	43.4	45.1	46.7	48.6	48.7	46.9	46.8	48.4	49.7	50.1
R. phaseoli	55.0	57.0	59.1	59.4	58.5	55.8	57.6	58.2	59.5	59.0
Biogen	53.4	55.5	57.2	58.3	58.4	54.1	55.9	58.9	58.3	59.0
B. m. var. phosphat	49.0	53.3	51.7	54.3	55.5	50.6	52.7	53.6	55.1	56.3
Phosphorien	47.4	50.0	51.7	54.7	55.2	49.0	50.9	51.9	55.4	54.7

Table 2c. LSD values at 5% level for the experimental factors and their interactions.

			Season (1999/2000)	Season (2000/2001)
1	Cultivars	A	N.S	N.S
2	Biofertilizers	B	1.34	1.73
3	Chemical fertilizers	C	0.62	0.70
4		AxB	1.89	2.45
5		AxC	1.23	1.01
6		BxC	1.94	1.60
7		AxBxC	2.75	2.93

Table 3a. Effect of chemical and biofertilizers on number of branches/plant of the two studied Snap bean cultivars in the two seasons 1999/2000 and 2000/2001.

Cultivars "A"	Biofertilizers "B"	FIRST SEASON							SECOND SEASON						
		Chemical fertilizers (N/P kg/fed.) "C"					Mean	Mean	Chemical fertilizers (N/P kg/fed.) "C"					Mean	Mean
		0/0	20/15	20/30	40/15	40/30	A x B		0/0	20/15	20/30	40/15	40/30	A1 xB1	
	Uninoculation	4.9	6.0	6.3	6.4	6.5	6.0		4.3	5.4	6.0	6.2	6.2	5.6	
	R. phaseoli	8.0	9.1	9.2	8.6	8.7	8.7		8.0	8.8	8.9	8.4	8.4	8.5	
Bronco	Biogen	7.8	9.1	9.2	8.7	8.2	8.6	7.6	7.2	8.7	8.9	8.2	7.9	8.8	7.3
	B. m. var phospha	6.4	8.0	7.7	7.5	7.3	7.4		6.5	7.8	7.5	7.4	7.0	7.2	
	Phosphorien	6.4	7.7	7.5	7.7	6.9	7.1		6.1	7.3	7.2	7.1	6.5	6.8	
A_1 x C		6.7	8.0	8.0	7.7	7.5			6.4	7.6	7.7	7.4	7.2		
	Uninoculation	4.8	5.7	5.8	5.9	6.1	5.7		4.5	5.2	5.4	5.7	6.0	5.4	
	R. phaseoli	7.2	8.6	8.7	7.7	7.8	8.0		6.9	8.1	8.3	7.2	7.3	7.5	
Giza 3	Biogen	7.2	8.2	8.5	8.3	7.8	8.0	7.1	6.8	7.8	8.1	8.0	7.2	7.6	6.7
	B. m. var phospha	6.7	7.3	7.2	7.4	7.0	7.1		6.4	7.1	6.9	7.1	6.6	6.8	
	Phosphorien	6.0	7.2	7.2	7.0	6.8	6.8		5.7	6.7	6.5	6.5	6.3	6.3	
A_2 x C		6.4	7.4	7.5	7.3	7.1			6.0	7.0	7.6	6.9	6.7		
Mean " C"		6.5	7.7	7.8	7.5	7.3			6.2	7.3	7.3	7.2	6.9		
Mean "B" : B1= 5.9 B2=8.4 B3=8.3 B4=7.2 B5= 7.0									B1=5.5 B2=8.0 B3=7.9 B4=7.0 B5=6.6						

Table 3b. Effect of the interaction (biofertilizers x chemical fertilizers) on number of branches/plant in the two seasons.

	FIRST SEASON					SECOND SEASON				
Biofertilizers	Chemical fertilizers N / P kg/ fed. "C"					Chemical fertilizers N / P kg /fed. "C"				
	0/0	20/15	20/30	40/15	40/30	0/0	20/15	20/30	40/15	40/30
Uninoculation	4.8	5.8	6.0	6.1	6.3	4.4	5.3	5.7	5.9	6.1
R. phaseoli	7.6	8.8	8.9	8.1	8.2	7.4	8.4	8.6	7.8	7.8
Biogen	7.5	8.7	8.8	8.5	8.0	7.0	8.3	8.5	8.1	7.5
B. m. var phosphat.	6.5	7.6	7.4	7.5	7.1	6.4	7.4	7.2	7.2	6.8
Phosphorien	6.2	7.4	7.3	7.1	6.8	5.9	7.0	6.8	6.8	6.4

Table 3c. LSD values at 5% level for the experimental factor and their interactions

			Season (1999/2000)	Season (2000/2001)
1	Cultivars	A	0.091	0.25
2	Biofertilizers	B	0.174	0.199
3	Chemical fertilizers	C	0.097	0.13
4		AxB	0.176	0.28
5		AxC	0.22	0.32
6		BxC	0.35	0.38
7		AxBxC	0.49	0.55

Table 4a. Effect of chemical and biofertilizers on number of fresh pods/plant of the two studied Snap bean cultivars in the two seasons 1999/2000 and 2000/2001.

Cultivars "A"	Biofertilizers "B"	FIRST SEASON							SECOND SEASON						
		Chemical fertilizers (N/P kg/fed.) "C"					Mean A x B	Mean	Chemical fertilizers (N/P kg/fed.) "C"					Mean A1 xB1	Mean
		0/0	20/15	20/30	40/15	40/30			0/0	20/15	20/30	40/15	40/30		
	Uninoculation	35.0	36.4	36.8	37.1	37.2	36.5		36.1	36.9	37.4	37.5	37.9	37.1	
	R. phaseoli	40.3	41.6	41.8	41.2	41.3	41.2		42.4	42.9	43.0	42.9	43.1	42.8	
Bronco	Biogen	39.8	41.0	41.3	40.4	41.6	40.8	39.5	41.4	42.5	42.8	42.9	42.7	42.5	40.4
	B. m. var phospha	38.9	40.5	38.4	39.3	40.1	39.5		39.6	40.1	40.8	40.9	40.3	40.3	
	Phosphorien	37.2	39.4	40.4	39.9	40.1	39.4		38.6	39.2	39.9	40.0	40.0	39.5	
A_1 x C		38.2	39.89	39.8	39.6	40.0			39.6	40.3	40.8	40.8	40.8		
	Uninoculation	28.1	31.4	31.4	32.2	31.3	30.9		28.8	30.9	31.9	32.4	33.1	31.4	
	R. phaseoli	34.8	37.1	37.1	36.7	37.5	46.6		36.5	37.1	37.8	37.6	38.6	37.4	
Giza 3	Biogen	34.2	37.1	37.9	36.1	37.0	36.5	34.4	35.8	36.8	38.0	37.4	37.8	37.1	35.3
	B. m. var phospha	33.1	34.7	35.3	36.3	34.1	34.7		34.6	35.0	36.4	35.5	36.4	35.6	
	Phosphorien	31.8	33.1	33.6	33.9	33.6	33.2		34.2	34.6	35.4	35.6	35.7	35.1	
A_2 x C		32.4	34.7	35.0	35.0	34.7			34.0	34.9	35.9	35.7	36.2		
Mean " C"		35.3	37.2	37.4	37.3	37.4			36.8	37.6	38.3	38.3	38.5		
Mean "B" : B1=33.7 B2= 38.9 B3= 38.6 B4= 37.1 B5=36.3									B1=34.5 B2=40.1 B3=39.8 B4=37.9 B5=37.3						

Table 4b. Effect of the interaction (biofertilizers x chemical fertilizers) on number of fresh pods/plant in the two seasons.

	FIRST SEASON					SECOND SEASON				
Biofertilizers	Chemical fertilizers N / P kg/fed. "C"					Chemical fertilizers N / P kg/fed. "C"				
	0/0	20/15	20/30	40/15	40/30	0/0	20/15	20/30	40/15	40/30
Uninoculation	31.6	33.9	34.1	34.6	34.2	32.4	33.9	34.6	34.9	35.5
R. phaseoli	37.5	39.4	39.5	38.9	39.4	39.4	40.0	40.4	40.3	40.5
Biogen	37.0	39.1	39.6	38.3	39.3	38.6	39.6	40.4	40.1	40.2
B. m. var phosphat.	36.0	37.6	37.1	37.8	37.1	37.1	37.6	38.6	38.2	38.3
Phosphorien	34.5	36.2	37.0	36.9	36.8	36.4	36.9	37.6	37.8	37.8

Table 4c. LSD values at 5% level for the experimental factor and their interactions.

			Season (1999/2000)	Season (2000/2001)
1	Cultivars	A	1.55	1.40
2	Biofertilizers	B	0.984	0.50
3	Chemical fertilizers	C	0.399	0.35
4		AxB	1.39	0.97
5		AxC	0.745	0.40
6		BxC	0.89	1.4
7		AxBxC	1.26	0.90

Table 5a. Effect of chemical and biofertilizers on weight of fresh pods/plant (g) of the two studied Snap bean cultivars in the two seasons 1999/2000 and 2000/2001.

Cultivars "A"	Biofertilizers "B"	FIRST SEASON							SECOND SEASON						
		Chemical fertilizers (N/P kg/fed.) "C"					Mean A x B	Mean	Chemical fertilizers (N/P kg/fed.) "C"					Mean A1 xB1	Mean
		0/0	20/15	20/30	40/15	40/30			0/0	20/15	20/30	40/15	40/30		
Bronco	Uninoculation	178.6	188.2	187.5	194.9	199.7	189.8	223.3	184.2	193.5	193.3	201.6	203.7	195.3	232.1
	R. phaseoli	244.7	249.4	255.5	252.2	247.8	249.9		255.7	261.1	267.0	263.8	259.6	261.4	
	Biogen	248.3	254.2	248.3	255.4	247.1	250.7		259.0	262.3	260.3	267.2	258.4	261.4	
	B. m. var phospha	200.7	219.0	220.1	229.3	219.1	217.6		212.6	225.4	229.5	238.5	229.4	227.0	
	Phosphorien	198.1	204.6	206.9	219.8	214.6	208.8		204.5	212.2	212.3	226.3	220.6	215.2	
A_1x C		214.1	223.1	223.6	230.3	225.7			223.2	230.9	232.5	239.5	234.3		
Giza 3	Uninoculation	201.9	201.1	210.8	221.5	226.7	212.8	249.1	208.9	208.8	217.4	225.8	233.5	218.9	260.7
	R. phaseoli	272.8	283.3	287.1	282.5	273.1	279.7		286.5	296.8	301.7	296.2	286.8	2936	
	Biogen	262.9	274.2	271.7	264.7	260.6	266.8		276.6	287.2	285.0	278.2	273.8	280.2	
	B. m. var phospha	243.1	248.6	253.7	254.1	246.2	249.1		255.9	261.9	267.1	267.5	258.5	262.2	
	Phosphorien	233.1	234.9	243.0	239.3	236.8	237.4		243.3	247.0	253.5	252.2	246.8	248.6	
A_2x C		242.8	248.4	253.2	252.4	248.6			254.2	260.3	264.9	264.0	259.9		
Mean " C"		228.4	235.7	238.4	241.4	237.2			238.7	245.6	248.7	251.7	247.1		
Mean "B" : B1=201.1 B2=264.8 B3=258.7 B4=233.4 B5=223.1									B1=207.1 B2=277.5 B3=270.8 B4=244.6 B5=231.9						

Table 5b. Effect of the interaction (biofertilizers x chemical fertilizers) on weight of fresh pods/plant (g) in the two seasons.

Biofertilizers	FIRST SEASON					SECOND SEASON				
	Chemical fertilizers N / P kg/fed. "C"					Chemical fertilizers N / P kg/fed. "C"				
	0/0	20/15	20/30	40/15	40/30	0/0	20/15	20/30	40/15	40/30
Uninoculation	190.2	194.6	199.1	208.2	213.2	196.6	201.1	205.1	213.7	218.6
R. phaseoli	258.7	266.4	271.3	267.4	260.4	271.1	279.0	284.3	280.0	273.2
Biogen	255.6	264.2	260.0	260.0	253.8	267.8	274.8	272.6	272.7	266.1
B. m. var phosphat.	221.9	233.8	236.9	241.7	232.6	234.2	243.6	248.3	253.0	243.9
Phosphorien	215.6	219.7	224.9	229.5	225.7	223.9	229.6	232.9	239.2	233.7

Table 5c. LSD values at 5% level for the experimental factor and their interactions.

			Season (1999/2000)	Season (2000/2001)
1	Cultivars	A	6.4	6.6
2	Biofertilizers	B	3.6	3.5
3	Chemical fertilizers	C	2.4	2.4
4		AxB	5.1	4.9
5		AxC	4.9	4.5
6		BxC	7.7	7.1
7		AxBxC	10.9	10.07

Table 6a. Effect of chemical and biofertilizers on average fresh pod weight (g) of the two studied Snap bean cultivars in the two seasons 1999/2000 and 2000/2001.

Cultivars "A"	Biofertilizers "B"	FIRST SEASON							SECOND SEASON						
		Chemical fertilizers (N/P kg/fed.) "C"					Mean A x B	Mean	Chemical fertilizers (N/P kg/fed.) "C"					Mean A1 xB1	Mean
		0/0	20/15	20/30	40/15	40/30			0/0	20/15	20/30	40/15	40/30		
Bronco	Uninoculation	4.5	4.9	5.1	5.3	5.3	5.0	5.5	4.9	5.1	5.1	5.2	5.4	5.1	5.6
	R. phaseoli	5.8	5.9	6.2	6.1	6.0	6.0		6.0	6.0	6.1	6.2	6.1	6.0	
	Biogen	5.8	5.9	5.9	6.0	6.1	5.9		6.0	6.1	5.9	6.1	6.2	6.1	
	B. m. var phospha	5.0	5.4	5.4	5.7	5.4	5.4		5.1	5.5	5.5	5.8	5.4	5.5	
	Phosphorien	4.8	5.5	5.6	5.3	5.4	5.3		5.2	5.3	5.6	5.5	5.3	5.4	
A_1 x C		5.2	5.6	5.6	5.7	5.6			5.4	5.6	5.7	5.6	5.7		
Giza 3	Uninoculation	5.8	6.0	6.0	6.3	6.0	6.0	6.6	5.6	5.8	5.8	6.1	5.8	5.8	6.7
	R. phaseoli	6.9	7.1	7.3	7.2	7.0	7.1		6.9	7.3	7.4	7.5	7.1	7.2	
	Biogen	6.7	6.9	6.9	6.7	6.6	6.7		6.9	7.2	7.4	7.1	6.9	7.1	
	B. m. var phospha	6.4	6.6	6.8	6.6	6.6	6.6		6.7	6.9	7.1	7.0	6.8	7.1	
	Phosphorien	6.5	6.4	6.6	6.3	6.4	6.4		6.6	6.5	6.7	6.4	6.5	6.3	
A_2x C		6.5	6.6	6.7	6.6	6.5				6.5	6.7	6.9	6.8	6.5	
Mean " C"		5.8	6.0	6.2	6.1	6.0			6.0	6.2	6.2	6.3	6.1		
Mean "B" : B1=5.5 B2= 6.5 B3= 6.3 B4= 5.9 B5=5.4									B1=5.5 B2=6.6 B3=6.6 B4=6.2 B5=5.9						

Table 6b. Effect of the interaction (biofertilizers x chemical fertilizers) on average fresh weight (g) in the two seasons.

Biofertilizers	FIRST SEASON					SECOND SEASON				
	Chemical fertilizers N / P kg/fed. "C"					Chemical fertilizers N / P kg/fed. "C"				
	0/0	20/15	20/30	40/15	40/30	0/0	20/15	20/30	40/15	40/30
Uninoculation	5.2	5.4	5.5	5.8	5.6	5.2	5.4	5.4	5.7	5.6
R. phaseoli	6.3	6.5	6.7	6.6	6.5	6.5	6.6	6.7	6.8	6.6
Biogen	6.2	6.4	6.4	6.3	6.3	6.4	6.7	6.7	6.6	6.5
B. m. var phosphat.	5.7	6.0	6.1	6.1	6.0	5.9	6.2	6.3	6.4	6.1
Phosphorien	5.6	5.9	6.1	5.8	5.9	5.9	5.9	6.1	6.0	5.9

Table 6c. LSD values at 5% level for the experimental factor and their interactions.

			Season (1999/2000)	Season (2000/2001)
1	Cultivars	A	0.22	0.31
2	Biofertilizers	B	0.18	0.12
3	Chemical fertilizers	C	0.07	0.08
4		AxB	0.25	0.17
5		AxC	0.15	0.17
6		BxC	0.23	0.27
7		AxBxC	0.33	0.39

Table 7a. Effect of chemical and biofertilizers on fresh pod yield (t/Fed.) of the two studied Snap bean cultivars in the two seasons 1999/2000 and 2000/2001.

Cultivars "A"	Biofertilizers "B"	FIRST SEASON							SECOND SEASON						
		Chemical fertilizers (N/P kg/fed.) "C"					Mean A x B	Mean	Chemical fertilizers (N/P kg/fed.) "C"					Mean A1 xB1	Mean
		0/0	20/15	20/30	40/15	40/30			0/0	20/15	20/30	40/15	40/30		
Bronco	Uninoculation	4.135	4.202	4.240	4.240	4.361	4.237	4.666	4.096	4.213	4.233	4.261	4.304	4.221	4.773
	R. phaseoli	4.702	4.912	5.009	4.829	4.887	4.868		4.850	5.094	5.152	4.985	5.037	5.024	
	Biogen	4.685	4.906	4.979	4.844	4.857	4.854		4.833	5.053	5.125	4.970	5.00	4.960	
	B. m. var phospha	4.656	4.693	4.736	4.830	4.783	4.739		4.788	4.760	4.868	4.960	4.927	4.861	
	Phosphorien	4.433	4.609	4.548	4.829	4.729	4.630		4.833	4.761	4.660	4.939	4.909	4.766	
A_1 x C		4.522	4.664	4.202	4.716	4.723	4.625		4.625	4.776	4.808	4.828	4.835		
Giza 3	Uninoculation	3.416	3.568	3.606	3.706	3.800	3.619	3.873	3.453	3.720	3.644	3.809	3.883	3.702	3.974
	R. phaseoli	3.752	4.009	4.087	3.999	4.014	3.972		3.872	4.146	4.229	4.150	4.160	4.111	
	Biogen	3.709	4.006	4.075	3.996	4.005	3.958		3.819	4.131	4.195	4.136	4.131	4.083	
	B. m. var phospha	3.687	3.903	3.985	4.049	3.999	3.925		3.804	4.005	3.888	4.200	4.147	4.009	
	Phosphorien	3.540	4.007	3.936	4.000	3.968	3.890		3.697	4.000	3.857	4.155	4.108	3.963	
A_2x C		3.621	3.899	3.938	3.950	3.957			3.729	4.000	3.963	4.090	4.086		
Mean " C"		4.072	4.281	4.320	4.333	4.340			4.177	4.388	4.385	4.457	4.461		
Mean "B" : B1=3.928 B2= 4.420 B3= 4.406 B4= 4.332 B5=3.260									B1=3.962 B2=4.568 B3=4.540 B4=4.435 B5=4.364						

Table 7b. Effect of the interaction (biofertilizers x chemical fertilizers) on fresh pod yield (t/Fed.) in the two seasons.

Biofertilizers	FIRST SEASON					SECOND SEASON				
	Chemical fertilizers N / P kg/fed. "C"					Chemical fertilizers N / P kg/fed. "C"				
	0/0	20/15	20/30	40/15	40/30	0/0	20/15	20/30	40/15	40/30
Uninoculation	3.776	3.885	3.923	3.977	4.081	3.775	3.67	3.939	4.035	4.093
R. phaseoli	4.227	4.461	4.548	4.414	4.450	4.361	4.620	4.691	4.567	4.598
Biogen	4.197	4.456	4.527	4.420	4.431	4.326	4.592	4.660	4.553	4.567
B. m. var phosphat.	4.171	4.298	4.360	4.439	4.391	4.296	4.383	4.378	4.580	4.537
Phosphorien	3.986	4.308	4.242	4.414	4.348	4.128	4.381	4.258	4.547	4.509

Table 7c. LSD values at 5% level for the experimental factor and their interactions.

			Season (1999/2000)	Season (2000/2001)
1	Cultivars	A	0.03	0.05
2	Biofertilizers	B	0.02	0.05
3	Chemical fertilizers	C	0.02	0.03
4		AxB	0.03	0.08
5		AxC	0.05	0.03
6		BxC	0.08	0.06
7		AxBxC	0.12	0.08

Table 8a. Effect of chemical and biofertilizers on fertility percentage (%) of the two studied Snap bean cultivars in the two seasons 1999/2000 and 2000/2001.

Cultivars "A"	Biofertilizers "B"	FIRST SEASON							SECOND SEASON						
		Chemical fertilizers (N/P kg/fed.) "C"					Mean A x B	Mean	Chemical fertilizers (N/P kg/fed.) "C"					Mean A1 xB1	Mean
		0/0	20/15	20/30	40/15	40/30			0/0	20/15	20/30	40/15	40/30		
Bronco	Uninoculation	95.1	95.6	97.3	94.6	93.6	95.3	95.6	96.8	97.3	97.2	95.8	97.3	96.9	96.6
	R. phaseoli	94.3	96.4	96.7	94.8	97.4	95.7		95.8	97.0	96.8	97.8	97.9	97.0	
	Biogen	95.5	96.0	95.7	96.9	96.8	96.2		95.8	96.7	97.2	94.4	97.9	96.4	
	B. m. var phospha	96.1	96.0	94.6	97.2	97.9	96.3		97.4	97.1	96.7	96.2	96.8	96.8	
	Phosphorien	94.5	94.7	94.9	93.8	93.2	94.2		97.4	95.1	93.8	98.0	94.8	95.8	
A_1x C		95.1	95.7	95.9	95.5	95.8			96.6	96.7	96.3	96.4	96.9		
Giza 3	Uninoculation	88.3	95.1	95.5	93.6	95.1	93.5	95.3	96.7	97.8	97.2	97.7	97.3	97.3	96.8
	R. phaseoli	93.5	96.1	94.2	97.9	99.0	96.1		96.1	98.6	96.7	95.7	96.8	97.1	
	Biogen	96.8	96.8	94.6	95.3	98.4	96.4		94.2	96.9	97.0	96.3	97.5	96.3	
	B. m. var phospha	94.4	94.0	94.7	92.7	95.4	94.2		97.9	97.1	95.7	96.2	96.8	96.7	
	Phosphorien	95.9	95.5	97.7	96.4	96.3	96.5		95.0	96.9	97.3	98.1	96.3	96.8	
A_2x C		93.8	95.5	95.4	95.2	96.8			96.0	97.5	96.8	96.7	97.3		
Mean " C"		94.4	95.6	95.7	95.3	96.3			96.3	97.0	96.6	96.7	97.1		
Mean "B" : B1=94.4 B2= 96.0 B3= 96.0 B4= 96.4 B5=95.3									B1=96.3 B2=97.1 B3=96.4 B4=96.8 B5=96.3						

Table 8b. Effect of the interaction (biofertilizers x chemical fertilizers) on fertility percentage (%) in the two seasons.

Biofertilizers	FIRST SEASON					SECOND SEASON				
	Chemical fertilizers N / P kg/fed. "C"					Chemical fertilizers N / P kg/fed. "C"				
	0/0	20/15	20/30	40/15	40/30	0/0	20/15	20/30	40/15	40/30
Uninoculation	91.7	95.3	95.5	94.1	94.4	96.8	97.6	97.2	96.7	97.3
R. phaseoli	93.9	96.2	95.2	96.3	98.2	95.9	97.9	96.7	96.8	98.1
Biogen	96.2	96.4	95.1	96.1	97.6	95.0	96.8	97.1	95.3	93.7
B. m. var phosphat.	95.2	95.0	94.2	94.0	96.6	97.6	97.1	96.2	96.3	96.8
Phosphorien	95.2	95.0	96.4	95.1	94.8	96.2	96.0	95.5	98.0	95.7

Table 8c. LSD values at 5% level for the experimental factor and their interactions.

			Season (1999/2000)	Season (2000/2001)
1	Cultivars	A	N.S	N.S.
2	Biofertilizers	B	N.S	N.S.
3	Chemical fertilizers	C	N.S	N.S.
4		AxB	2.12	1.04
5		AxC	2.24	1.01
6		BxC	3.55	2.54
7		AxBxC	5.03	3.67

دراسات مقارنة على استخدام الأسمدة الكيميائية والحيوية على نباتات الفاصوليا

١- المحصول الاخضر ومكوناته

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أجريت تجربتان حقليتان فى موسمى الزراعة المتعاقبين ١٩٩٩/٢٠٠٠ و ٢٠٠٠ / ٢٠٠١ وذلك لدراسة المقارنة بين إستخدام الأسمدة الكيميائية والحيوية على النمو والمحصول الطازج ومكوناته لصنفين من الفاصوليا هما برونكو و جيزة ٣

و تهدف هذه الدراسة الى بحث أثر التسميد الحيوى من مصادر التسميد الحيوى المثبتة للآزوت تكافليا (البكتريا العقدية) وحرة التثبيت [الازوتوباكتر (البيوجين)] كذلك البكتريا المذيبة للتسميد الفوسفاتى (الفوسفورين) وعلاقة ذلك بنمو ومحصول الفاصوليا

كذلك بحث استجابة نباتات الفاصوليا للمعدلات المختلفة من التسميد الازوتى والفوسفاتى (صفر / صفر ، ٢٠ / ١٥ ، ٢٠ / ٣٠ ، ٤٠ / ١٥ ، ٣٠/٤٠ كجم نيتروجين / فو٢أ٥ / للفدان) وعلاقة التفاعلات بين التسميد الحيوى والكيماوى والمعدلات المختلفة منه ودراسة إمكانية الاستغناء عن او الاقلال من التسميد الكيماوى الازوتى والفوسفاتى باستخدام الحيوى وتم اخذ بيانات النمو والمحصول الطازج ومكوناته.

واشارت النتائج المتحصل عليها الى تفوق الصنف برونكو على الصنف جيزة ٣ فى معظم الصفات التى تم دراستها بينما تفوق الصنف جيزة ٣ فى متوسط وزن القرن الأخضر كذلك كان للتلقيح بمصادر التسميد الحيوى المختلفة اثره الايجابى والمعنوى على الصفات التى تمت دراستها وداخل هذه المعاملات تفوق التلقيح بالريزوبيوم متبوعا بالتلقيح بالبيوجين وبدون فروق معنوية فى معظم الصفات .

أما بالنسبة لمعاملات التسميد الكيماوى فكان المعدل الأعلى ٤٠ كجم نيتروجين مع ٣٠ كجم فوسفور هو الأفضل للحصول على أحسن النتائج فى حالة عدم التلقيح الحيوى فى حين أن إستخدام التسميد الحيوى أدى إلى خفض هذا المعدل للحصول على نفس النتائج إلى ٢٠ كجم نيتروجين ، ٣٠ كجم فو٢أ٥ /للفدان وطبقا لنتائج الدراسة يمكن التوصية بزراعة الصنف برونكو للحصول على المحصول الأخضر بعد تلقيحه بالمخصبات الحيوية النيتروجينية والفوسفورية واستخدام معدل منخفض من التسميد الكيماوى ٢٠ كجم نيتروجين ٢٠ ، ٤٠ كجم فو٢أ٥ مع تقسيم هذه الكمية الى دفعتين تضاف بعد ٢٠ ، ٤٠ يوم من الزراعة.