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The Effects of Different Bio-organic, Chemical Fertilizers and their Combination on Yield, Macro and Micro Nutrition Content of Dry Bean (*Phaseolus vulgaris* L.)

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Abstract: The study was done in order to understand the effects of bio-organic (FYM, AM and RZ) and chemical fertilizers in single, dual, triple and quadruple combinations on dry bean under field conditions in 2003 and 2004. The treatments included: 1. Control, 2. Mycorrhiza (AM), 3. *Rhizobium* (RZ), 4. Farm Yard Manure (FYM), 5. Ammonium Sulphate (AS), 6. AM + RZ, 7. AM + FYM, 8. AM + AS, 9. RZ + FYM, 10. RZ + AS, 11. FY + AS, 12. AM + RZ + FYM, 13. AM + RZ + AS, 14. AM + FYM + AS, 15. RZ + FYM + AS, 16. AM + RZ + FYM + AS. The experiments were conducted in randomize blocks design with three replicates. Yield component, micro and macro elements content were significantly increased with all inoculations and fertilizer applications. Single and dual applications were more effectively found than mixed applications on yield and yield component. On the other hand, mixed treatments weren't more effective on micro and macro nutrients accumulations than single and dual applications on both leaf and seed of dry bean. The highest number of pods per plant was obtained from AM+FYM treatments (39.7 pods/plant) and AM+RZ application in both years (39.00 pods/plant). However, the highest plant yield among treatments was derived from AM+FY+AS yield applications during the years 2003 and 2004. The highest average number of seeds per plant was recorded from AM+FYM treatments as 160 and recorded from Ammonium Sulphate 156 in both years with significant variations ($p<0.05$) between the years. The highest biological yield per unit area was obtained from AM+RZ application with 11821 kg ha^{-1}. While the highest average thousand seed weight was obtained from FYM application (412 g), grain yield per area was similar to the biological yield per area. Treatments increased grain yield per area in both years. The average of both years, application with bio-organic fertilizer increased N, P and K concentrations of dry bean leaf control. The effect of the bio-organic fertilizers on protein, P, K amounts in the grain was significant ($p<0.05$). Also the effect of the applications on Fe, Zn, Cu and Mn amounts in the dry bean grain were significant ($p<0.05$). The beneficial effects of the bio-organic fertilizer on plant growth varied significantly depending on environmental conditions, bacterial strain and plant and soil conditions.

Key words: Bio-fertilizers, bio-organic farming, dry bean, farm yard manure, mycorrhizae, *Rhizobium*

Introduction

The dry bean (*Phaseolus vulgaris* L.) is the most important pulse crop in many developing countries and provides one of the major sources of dietary protein with a production about 18 million tones in 2002 (0.245 million tones of which was produced in Turkey) (FAO, 2003). Production areas are limited today; so we have to improve, the yield per unit area in the world. Many scientists have studied to improve dry bean seed yield and applied many agriculture methods (Elsheikh and Elzidany, 1997; Alonso *et al*., 1998; Abdul Wahid and Mehana, 2000; Abdelhamit *et al*., 2004; Yağmur and Kaydan, 2004).

Patidar and Mali, a field study in 2004, conducted during the rain season of 1997 and 1998 to assess the effect of farmyard manure, fertility levels and bio-fertilizers and their combined effect on the productivity and quality of sorghum (*Sorghum bicolor* L.). Application of 10 tons FYM ha^{-1} significantly increased leaf area index, chlorophyll content at flowering, plant height, dry matter accumulation, grain yield and protein content in grain over the control. Fertilizer application at different rates enhanced flowering as well as improved various growth component, plant height, dry matter accumulation, leaf area index and chlorophyll content in the leaves over the control. Inoculation of *Azospirillum* alone and in combination with phosphate solubilizing bacteria increased grain yield to the extent of 5 to 7%. Bio fertilizers (i.e., *Azospirillium* + PSB with tone FYM ha^{-1}) significantly increased grain yield of sorghum over their individual effects.

Singh (2001), reported that combined inoculation of Azotobacter and phospho-inoculant culture together significantly increased the tuber yield. Meanwhile when these bio-fertilizers inoculated separately *Azotobacter* gave 7.9% and phosphoto-inoculant gave 8.6% higher tuber yield significantly up to maximum level.

Recently, there was source of interest in bio-organic fertilizers as part of sustainable agricultural practices to alleviate drawbacks of intensive farming practices. Organic matter is an important soil component in improving physical, chemical and biological properties of soils as well as nutrient. N_2-fixing bacteria and uptake of P, Zn accelerating AM are important in plant nutrition increase N and P uptake by the plants and playing a significant role as plant growth–promoting *Rhizobacteria* in the bio-fertilization of crops. This is essential to sustain the productivity of soils particularly in semi-arid regions where there is low input of organic matter. A number of studies have indicated the beneficial effects of organic matter on improving both soil properties and plant growth.

Gomaa *et al*. (2002), reported the effects of the application of certain bio-organic treatments on nodulation, growth and yield component of vetch as a leguminous forage crop. The maximum root nodule numbers were recorded with farmyard manure + *Rhizobium* + *Klebsiella* treatments. Researchers found that the combined inoculums associated with either chicken or farmyard manure could be applied to get reasonable productivity when the bio-organic farming was taken into consideration.

Scientists (Igbasan *et al*., 1996; Elizondo *et al*., 1999) from many countries found that inoculation with *Rhizobium* increased nodulation and yield. Also they observed the effect of *Rhizobium* inoculation and they selected the variety which performs well agro climatic conditions. Application of compost significantly increased growth, yield, yield components and end total crude protein of the bean plants. The benefits derived from compost without chemical fertilizers demonstrated the validity and possibility of sustainable agronomic performances of the faba bean using locally available recycled organic materials.

Increasing realization of the effects of long sustained, exclusive use of chemical fertilizers and consistent growing demand from the consumers quality, coupled with unsustainable productivity of citrus, have fostered experimentation with some alternative cultural practices. Use of organic materials such as farmyard manure, cakes of plant origin, vermicompost and microbial bio-fertilizer on one hand and exploiting the synergism between citrus-vesicular arbuscular mycorrhizal fungus on the other hand, are important components of the bio-organic concept of citrus cultivation. *Mycorrhizae* was observed to be highly effective in low fertility, coarse textured soils (Srivastava *et al*., 2002). On the other hand the same researcher found that Mycorrhizal-treated trees had better plant growth and uptake of nutrients like P, Ca, Zn, Cu, Fe compared to non mycorrhizal trees.

Singh *et al*. (2000) conducted a field study to determine the response of guinea grass (*Panicum maximum* L.) to bio-fertilizers inoculation and nitrogen under rain fed conditions. The results show that seed inoculation with Vesicular Arbuscular Mycorrhiza (VAM) produced the highest green forage, dry matter and crude protein of guinea grass. Response to nitrogen fertilization was significant up to 75 kg ha^{-1} for green frage, dry-matter and crude protein yields.

The legume seeds are widely consumed around the world and their adaptability depends on the climatic conditions in the area. In Turkey, beans (*Phaseolus vulgaris* L.) are the most consumed legume supplying considerable amounts of nutrients to the diet of the undernourished people. In addition, legume plants improve the fertility of the soil via providing a substantial input of N_2 fixation. Thus, legume cultivation under application of organic fertilizers has the potential to increase crop production and soil sustainable (Abdelhamit *et al*., 2004).

It has been obvious by now that the excessive use of nitrogen and phosphorus fertilizers bring about severe damage to our environment. Fertilizers wash out and collect in our ground and surface waters, rivers, lakes causing their high content of nitrates, distributing their fundamental biological balance. In modern plant production the importance of bio organic fertilizer has been acknowledged, since these methods reduce or even eliminate the need for chemical fertilizers. In addition, there are a few reports on the effect of bio-organic fertilizers bacterial on dry bean. Therefore, this study was planned to reveal the effect of bioorganics, chemical fertilizers and their combination on yield and yield component in macro and micro nutrition content dry bean.

Materials and Methods

Field trail was conducted in 2003-2004 the growing season in randomize complete block design of 1×16×3: soil × fertilizer × replication, 48 plots at the Research Station of the Rural Services Research Institute in Konya (Turkey). The experiment field is located in Konya plain (Latitude 37 55 N, longititute 32 47 E and altitude 1010 m above sea level) where the climate varies from arid to semi-arid. The weather is usually cool during winter months and rainfall is rare. According to long term data, the annual average temperature, relative humidity, evaporation and precipitation are 10.8°C, 61.3%, 1114 and 326 mm, respectively. Total rainfalls during the two growing seasons were 139.3 mm in 2003 and 49.5 mm in 2004. Seasonal average temperatures and average relative air humidity were 19, 9°C and 47, 2% (2003) and 20, 7°C and 38, 4% (2004). Some characteristics of soil used in the experiment are shown in Table 1. As shown that the soil of the experiment plot was a sandy loam with a pH value 8.64, organic matter 1.4 %, available phosphorus 18.84 mg kg^{-1}, total nitrogen 0.06%. Treatments used were: Control, Ammonium Sulphate (AS), *Mycorrhiza* (AM), *Rhizobium* (RZ), Farm Yard Manure (FYM), AM + RZ, AM+ FYM, AM + AS, RZ + FYM, RZ + AS, FY + AS, AM + RZ + FYM, AM + RZ + AS, AM + FYM + AS, RZ + FYM + AS, AM + RZ + FYM + AS.

The respective organic manure was applied to the soil before cultivation then irrigated (analysis of organic manures was shown in Table 1). A week later, seeds of Yunus 90 (adapted local cultivator that registered by Anadolu Agricultural Research Institute, Eskişehir, Turkey) were sown per plots

Table 1: Some characteristics of soil and cattle manure used in the experiments

Characteristics	Soil	Farm yard manure
Sand (%)	51.60	
Clay (%)	24.70	
Silt (%)	23.70	
pH (1:5 s:w)	8.60	7.20
EC (dS m^{-1})	0.12	7.00
$CaCO_3$ (%)	20.72	
Organic matter (%)	1.41	68.10
N (%)	0.06	1.81
Olsen-P(mg kg^{-1})	18.84	0.78
Fe (mg kg^{-1})	122.00	1075.00
Cu (mg kg^{-1})	48.40	8.80
Mn (mg kg^{-1})	569.00	247.00
Zn (mg kg^{-1})	26.70	44.00
Organic carbon (%)	0.82	39.50
C/N	13.60	21.80

(2.5 m wide and 3 m long with 5 rows). Inoculation of seeds was done with a peat culture (4×10^{-7} cell g^{-1}) of *Rhizobium legumunaserium* that was maintained at 4°C on yeast extraction Mannitol Agar (YMA) slopes. Inoculation of *Glomus mossea* (isolated from Rothamsed, UK), 1000 spores/plant mix of source (soil, sand and organic mater mix) chopped roots and Mycorrhiza spores were placed 50 mm below the cloves (Sari *et al*., 2002)

The land used in the experiment was prepared by deep ploughing, harrowing and leveling. Then the area was ridged and divided into 2.5×3 m plots. Seeds were sown on 15.05.2003 and 15.05.2004. Each plot was seeded by hand. Weeds were controlled by hand. In both years, anthracnose (*Colletotrichum lindemuthianum* Sacc. et Magn) was controlled Combi 76 WP over pod formation, while in the second year Primor 50 WG was used to control a migrating generation of bean aphid (*Aphis fabea* Scop). The plots were sprinkle irrigated at 7-8 day intervals. Plots were harvested by hand both years on September 10 from an internal area, after removing two outer rows at each plot. This area was designated as the harvest area.

Chemical Analysis of Soil and Farm Yard Manure

The pH and electrical conductivity were measured in a aqueous extract (1/5 s/w) (Richards, 1954); available P was extracted with sodium bicarbonate (Olsen *et al*., 1954) and determined by the method of available K (extracted with ammonium acetate) was measured by flame photometry (Knudsen *et al*., 1982). Total N was determined by the Kjeldahl method (Bremner, 1965), $CaCO_3$ % by Hizalan and Ünal (1965) and organic matter was extracted as described by Jackson (1973), texture was obtained by the hydrometer method (Bouyoucos, 1951). In addition, N, P, K, Zn, Fe, Mn contents of the soil and farmyard manure were determined using the samples treated with the H_2SO_4 and H_2O_2 by ICP-AES (Soltanpour and Workman, 1981).

Physical and Chemical Analysis of Dry Bean

Plant height, pods per plant and seeds per plant were measured on 10 randomly selected plants per plot at maturity so that grain yield and biological yield was determined using all of the plants in the harvested area. The thousand seed weight was calculated by mean of three separate 500 seed weight, multiplied by 2. Harvest index was calculated as grain yield/biomass × 100 (Akçin, 1974). Seeds were cleaned to remove foreign material before protein analysis. Protein content was calculated using the Kjeldahl method, N×5.7 as a percentage. During the pod formation phase, 30 leaves of each plot were combined as one sample, washed with water and were then oven dried at 70°C for 48 h before dry weights measured. Samples were finely ground and 0.5 g plant material was digested with concentrate HNO_3 in a Microwave system. The Fe, Zn, Cu and Mn in extracts were analyzed by ICP-AES (Soltanpour and Workman, 1981).

Statistical Analysis

All data collected for various studies was subjected to the analysis of variance appropriate to the design. The test of significance of the treatment differences was done on the basis of the F-test. The significant differences between treatments were compared with the critical difference at 5% level of probability by the Duncan's tests (Düzgüneş *et al*., 1987).

Results

Yield and Yield Component

Seed yield character was examined in this experiment, results of seed yield were tested in variance analysis and means were grouped in Duncan Multiple Comparison Test that was given

Table 2: The effect of bio-organic fertilizers application yield and yield component of dry bean (average of 2003 and 2004 mean±SE n = 3)

Treatment		Plant height (cm)	Podsper plant	Seeds per plant	Thousand seed weight
Control		43.6±5.16b	29.1±5.79c	123±32.00b	371±13.29e-g
Mycorrhiza (AM)		53.1±5.35a	32.0±4.60bc	126±18.86b	384±34.40c-f
Rhizobium (RZ)		49.1±4.22a	34.0±2.97a-c	136±1.87ab	390±19.92b-e
Farm Yard Manure (FYM)		52.0±6.60a	34.8±5.78a-c	139±23.11ab	412±28.00a
Ammonium sulphate (AS)		53.6±4.55a	39.1±4.40a	156±17.60a	395±18.88a-d
AM+RZ		50.0±5.62a	39.0±7.24a	156±9.10a	382±40.30c-f
AM+FYM		51.6±4.23a	39.7±6.00a	160±26.70a	384±34.00c-f
AM+AS		51.2±3.82a	34.5±4.42a-c	138±17.66ab	385±13.81c-f
RZ+FYM		50.0±4.15a	37.1±4.22ab	148±16.86ab	393±19.95a-d
RZ+AS		48.8±0.41a	32.0±3.85bc	134±10.93ab	361±32.50g
FYM+AS		50.0±3.74a	31.8±7.22bc	127±28.20b	403±6.70a-c
AM+RZ+FYM		50.3±3.01a	31.5±4.52bc	126±18.37b	368±17.77fg
AM+RZ+AS		53.3±4.13a	35.3±3.33a-c	141±13.31ab	381±33.80d-f
AM+FYM+AS		53.1±3.82a	38.5±1.87a	154±7.48a	403±26.70a-c
RZ+FYM+AS		53.3±4.94a	35.1±4.47a-c	144±16.78ab	395±18.74a-d
AM+RZ+FYM+AS		50.3±4.63a	33.6±2.34a-c	136±9.24ab	406±23.90ab
Average		50.8±2.51	34.8±3.16	140±11.87	388±14.72
Source	DF				
Treatment (T)	15	*	*	*	*
Year (Y)	1	*	*	*	*
T × Y	15	NS	NS	NS	*
Error	64				
Total	95				

Treatments		Biological yield (kg ha^{-1})	Harvest index (%)	Grain yield (kg ha^{-1})
Control		7736±219d	48.9±15.43	3640±93c
Mycorrhiza (AM)		8223±273cd	47.9±10.70	3766±66bc
Rhizobium (RZ)		9043±321b-d	50.8±14.50	4243±49a-c
Farm Yard Manure (FYM)		9901±317a-d	52.6±9.94	4616±99a
Ammonium sulphate (AS)		10336±424a-c	54.3±23.96	4970±76a
AM+RZ		11821±442a	42.3±6.16	4835±139a
AM+FYM		10888±491ab	49.8±14.81	4968±116a
AM+AS		8176±213cd	55.5±18.42	4246±52a-c
RZ+FYM		9700±390a-d	56.1±26.60	4670±56a
RZ+AS		10673±506a-c	42.4±12.73	4110±93a-c
FYM+AS		9441±301a-d	46.6±9.30	4228±87a-c
AM+RZ+FYM		8186±264cd	48.2±11.49	3705±52bc
AM+RZ+AS		9571±307a-d	47.7±10.84	4305±62a-c
AM+FYM+AS		10641±471a-c	56.0±26.70	4953±11a
RZ+FYM+AS		11600±602a	47.1±21.79	4543±52ab
AM+RZ+FYM+AS		10108±474a-d	53.6±27.10	4428±36a-c
Average		9753±124	50.0±4.44	4389±44
Source	DF			
Treatment (T)	15	*	NS	*
Year (Y)	1	*	*	*
T×Y	15	*	*	*
Error	64			
Total	95			

Means followed with the same letter within each column are not significant different (Duncan's Multiple Range Test = 0.05); *significant at 0.05 probability level, NS: Not Significant

Table 2. Both treatments and years had significant ($p<0.05$) effects on the seed yield and yield parameters of dry bean as average of both years (Table 2). Two years of trials under field conditions showed that treatments including bacterial seed AM inoculation inorganic fertilizer applications significantly affected the parameters investigated compared with control in dry bean depending on the year. Organic, biologic and inorganic fertilizer applications gave the highest plant heights of dry bean in both years representing increases over control (Table 2). All of these application increased plant heights 50.3 cm in both years compared to the control plots. The average of both years treatment with

FYM, AS, AM, *Rhizobium* inoculations and altogether of these applications increased the plant high compared with control (Table 2). The results for the effect of organic, biologic and inorganic fertilizers on plant developmental characteristics are shown in Table 2. There were significant differences ($p<0.05$) between years and treatments with respect to overall mean plant high (Which ranged from 43.6 cm (Control) to 53.6 cm (AS)). Also the average of the two years was 50.8 cm. However, the highest plant height among treatments was derived from AM+FYM+AS applications in average of the years 2003 and 2004.

Biological, organic and inorganic applications also significantly affected the number of pods per plant according to control in both years. In the dry bean as an average the highest number of pods per plant was derived from *Rhizobium* + FYM treatments (37.1 pods/plant) as the average of two years, the highest number of pods per plant was obtained as 39.7 pods/plant.

The highest average number of seeds per plant was recorded from AM + FYM treatments as 160 and found from AM+RZ and AS 156, respectively, with significant variations ($p<0.05$) between the years and treatments but the interaction between year and treatments were found insignificant. Since the number of seeds/plant is related to the number of pods/plant, the plots have higher number of pods per plant, which gave the higher seeds inevitable and natural results.

The average of both years, the lowest biological yield per unit area was derived from control plots (7736 kg ha^{-1}). That is, the organic, inorganic and chemical fertilizer applications increased significantly the biological yield compared to control plots. The highest biological yield per unit area was derived from mixed (AM+RZ) application with 11821 kg ha^{-1}. Second year of the study, biological yield was generally lower than first year applications (data's not shown). When compared with control of two years average, all of applications increased the biological yield. In addition, comparing the effects of bio-organic fertilizers on biological yield, generally the higher biological yield was derived from mixed applications rather than only applications (Table 2).

The weight of 1000-seeds showed significant ($p<0.05$) variations between the years. The bio-organic fertilizer applications TSW was affected by fertilizer applications, changed between 371 and 412 g in average both years. However the lowest TSW was determined from control plots. In general, a higher thousand seed weight was obtained in 2003 than FYM applications in 2004 (data's not shown), while the highest average thousand seed weight was obtained from FYM applications (412 g). In summary, the highest mean (2 years) TSW was obtained from organic + inorganic + biological applications.

Grain yield per area was found to be similar the biological yield per area. Treatments increased grain yield per area as compared with control plots in both years. The highest grain yield per area was obtained from AS and AM + FYM application (4970 and 4968 kg ha^{-1}) in average of the both years. On the average of two years the lowest grain yield per unit area was obtained from control plots as 3640 kg ha^{-1}.

All of the application also increased harvest index. The average harvest index changed between 42.3 and 56.1%. The highest harvest index was obtained from FYM+RZ and AM+FYM+AS applications (56.1%) respectively in both years. However, the higher harvest index was found in 2004 (not 2003 (data's not shown). The lowest harvest index was obtained from AM+RZ (42.3%) and RZ+AS (42.4%) applications in average of both years.

Macro and Micronutrient Concentrations of Dry Bean Leaf

Data dealing with the effect of the test materials on some nutrition (N, P, K, Fe, Zn, Cu and Mn) concentrations of the dry bean leaf are given in Table 3. Table 3 shows that the effects of the bio organic fertilizers, applications × year interactions N, P, K contents were not significant ($p<0.05$) except from K contents. Treating the sandy clay loam soil with tested bio organic fertilizer increased the N concentration with the control. The highest N concentration (4.2%) in the flag leaf was obtained

Table 3: The effect of bio-organic fertilizers application on macro and micronutrient contents of dry bean leaf (average of 2003 and 2004 mean±SE n = 3)

		(%)		
Treatments		N	P	K
Control		3.2±0.51e	0.35±0.04	3.2±0.43ef
Mycorrhiza (AM)		3.6±0.57cd	0.32±0.07	3.0±0.32f
Rhizobium (RZ)		3.6±0.24b-d	0.39±0.12	3.6±0.80b-d
FarmYard Manure (FYM)		3.7±0.63b-d	0.38±0.07	3.4±0.42de
Ammonium Sulphate (AS)		3.9±0.29a-c	0.37±0.15	3.9±0.56a-d
AM+RZ		3.5±0.57de	0.37±0.05	3.6±0.90b-d
AM+FYM		3.9±0.46a-c	0.42±0.04	4.0±0.66a-c
AM+AS		3.9±0.47a-c	0.35±0.04	4.0±0.72ab
RZ+FYM		3.8±0.45b-d	0.43±0.08	3.9±0.66a-d
RZ+AS		3.8±0.53b-d	0.37±0.05	3.6±0.58b-e
FYM+AS		3.9±0.51a-c	0.42±0.07	4.2±0.83a
AM+RZ+FYM		4.2±0.31a	0.36±0.09	3.8±0.60a-d
AM+RZ+AS		3.7±0.32b-d	0.32±0.09	3.5±0.60c-e
AM+FYM+AS		3.6±0.41b-d	0.49±0.14	3.9±0.71a-c
RZ+FYM+AS		3.9±0.57a-c	0.41±0.10	3.8±0.67a-d
AM+RZ+FYM+AS		4.0±0.35ab	0.38±0.13	3.8±0.29a-d
Average		3.8±0.23	0.38±0.04	3.7±0.30
Source	DF		ANOVA	
Treatment (T)	15	*	NS	*
Year (Y)	1	*	*	*
T×Y	15	NS	NS	*
Error	64			
Total	95			

		mg kg^{-1}			
Treatments		Fe	Cu	Mn	Zn
Control		187±50.8	4.8±1.06	57.1±24.48	7.1±2.96
Mycorrhiza (AM)		220±75.4	4.9±0.89	57.5±25.10	7.4±2.98
Rhizobium (RZ)		195±67.6	5.6±0.77	48.6±20.07	8.9±3.67
FarmYard Manure (FYM)		206±79.8	6.1±0.87	60.1±14.14	9.6±3.73
Ammonium Sulphate (AS)		234±113.3	5.4±1.72	56.5±30.50	8.1±7.01
AM+RZ		375±117.9	5.0±0.43	60.3±29.20	10.2±6.16
AM+FYM		254±118.8	5.7±0.72	57.4±21.75	9.8±3.84
AM+AS		231±64.10	4.8±0.44	55.6±18.22	6.9±3.94
RZ+FYM		315±165.4	5.5±0.76	54.0±17.99	8.8±5.51
RZ+AS		249±59.50	5.5±1.47	49.7±21.28	7.8±2.29
FYM+AS		284±88.10	4.9±0.99	58.1±24.42	8.9±6.43
AM+RZ+FYM		201±86.60	5.4±0.97	62.1±22.51	7.4±.3.37
AM+RZ+AS		182±75.60	5.6±0.77	55.5±29.30	6.8±2.57
AM+FYM+AS		337±242.90	5.8±1.59	63.6±33.70	10.9±5.53
RZ+FYM+AS		248±99.50	5.9±0.63	53.0±15.72	13.4±9.22
AM+RZ+FYM+AS		233±101.80	4.9±0.65	55.5±28.20	5.9±4.40
Average		247±55.5	5.3±0.42	56.5±4.03	8.65±1.88
Source	DF		ANOVA		
Treatment (T)	15	NS	NS	NS	NS
Year (Y)	1	*	*	*	*
T×Y	15	NS	NS	NS	NS
Error	64				
Total	95				

Means followed with the same letter within each column are not significant different (Duncan's Multiple Range Test = 0.05); *significant at 0.05 probability level, NS: Not Significant

with the AM+RZ+FMY application during both years. Meanwhile, the highest P, K concentrations (0.49 and 4.2%) were derived from an AM+FYM+AS and AM +RZ+FYM application respectively on average of both years. Also, the lowest N, P, K contents were obtained for the control treatment in both years. On the average both years, application with bio-organic fertilizer increased N, P and K concentrations of dry bean leaf compared with control. Generally N, P, K contents of dry bean leaf was increased with mix applications (Table 3). Also, in the growth of 2003 and 2004 similar results were obtained from mix applications (data not shown).

Table 4: The effect of bio-organic fertilizers application on macro and micronutrient contents of dry bean grain (average of 2003 and 2004 mean±SE n = 3)

		(%)		
Treatments		Protein content	P	K
Control		20±2.81a	0.47±0.05b	2.0±0.18bc
Mycorrhiza (AM)		21±2.75a	0.46±0.05b	2.0±0.13bc
Rhizobium (RZ)		20±2.20ab	0.55±0.11a	2.0±0.04bc
Farm Yard Manure (FYM)		21±2.13a	0.50±0.06b	2.0±0.09bc
AMMONIUM SULPHATE (AS)		20±1.50a-c	0.48±0.03b	2.0±0.16bc
AM+RZ		17±2.63ef	0.56±0.15a	2.0±0.10bc
AM+FYM		17±3.06c-f	0.49±0.06b	2.0±0.10bc
AM+AS		16±3.75ef	0.48±0.04b	2.0±0.17bc
RZ+FYM		19±2.75a-d	0.50±0.08ab	2.0±0.13bc
RZ+AS		16±3.06f	0.48±0.06b	1.9±0.08bc
FYM+AS		18±2.44c-f	0.45±0.06b	2.0±0.16c
AM+RZ+FYM		17±3.44d-f	0.48±0.05b	2.1±0.18c
AM+RZ+AS		17±1.38ef	0.47±0.05b	2.0±0.06ab
AM+FYM+AS		18±4.20b-f	0.49±0.06b	2.0±0.25bc
RZ+FYM+AS		17±3.06c-f	0.51±0.09ab	2.2±0.23bc
AM+RZ+FYM+AS		19±2.56a-e	0.46±0.02b	2.0±0.12a
Average		18±1.63	0.49±0.03	2.0±0.06
Source	DF		ANOVA	
Treatment (T)	15	*	*	*
Year (Y)	1	*	*	*
T×Y	15	*	*	*
Error	64			
Total	95			

		mg kg^{-1}			
Treatments		Fe	Cu	Mn	Zn
Control		116±39.60	5.5±1.29bc	9.6±1.37	27.1±16.00ab
Mycorrhiza (AM)		102±49.4	5.6±1.62bc	10.1±2.96	29.4±19.58ab
Rhizobium (RZ)		149±29.80	5.7±1.31bc	10.4±1.33	19.5±2.85ab
Farm Yard Manure (FYM)		118±49.60	9.1±6.90a	9.6±1.99	21.3±4.51ab
AMMONIUM SULPHATE (AS)		148±85.00	6.3±1.67bc	9.9±2.27	21.6±6.83ab
AM+RZ		119±58.50	4.6±1.60c	8.9±1.65	17.8±2.64b
AM+FYM		157±129.9	5.1±1.45bc	9.8±2.14	32.8±25. 70a
AM+AS		73±36.70	5.1±1.48bc	9.0±1.90	26.9±16.09ab
RZ+FYM		81±8.95	5.8±2.28bc	9.0±1.85	19.5±4.03ab
RZ+AS		103±46.30	4.5±1.38c	8.9±2.16	22.1±4.54ab
FYM+AS		92±38.30	5.1±1.94bc	9.8±2.95	15.3±3.49b
AM+RZ+FYM		128±77.90	6.8±3.53b	9.8±2.29	33.0±21.57a
AM+RZ+AS		103±85.90	5.2±1.30bc	10.1±2.37	16.2±4.27b
AM+FYM+AS		121±58.90	5.5±1.66bc	10.1±1.94	28.1±18.10ab
RZ+FYM+AS		116±72.70	5.6±1.88bc	9.6±2.65	28.2±17.38ab
AM+RZ+FYM+AS		120±43.50	5.1±1.23bc	9.3±2.17	29.5±18.53ab
Average		115±23.30	5.6±1.07	9.6±0.48	24.3±5.79
Source	DF		ANOVA		
Treatment (T)	15	NS	*	NS	*
Year (Y)	1	*	*	*	*
T×Y	15	NS	*	NS	NS
Error	64				
Total	95				

Means followed with the same letter within each column are not significant different (Duncan's Multiple Range Test = 0.05); *significant at 0.05 probability level, NS: Not Significant

Bio organic and inorganic treatments also affected the micro elements investigated (Table 3). However, the Fe, Mn, Cu and Zn contents of the leaf fluctuated in both years comparison to control. The bio-organic fertilizer applications in the different variety to the soil greatly effected micronutrient concentrations and the differences among the treatments were insignificantly ($p<0.05$). Although the effect in both years on Mn and Zn concentrations was found significant ($p<0.05$). Fe and Cu concentrations were found insignificant. Addition of bio-organic fertilizers to soils in general enhanced concentration of Fe, Zn, Cu and Mn in tested plant leaf. On the other hand, the highest Fe

concentration was found for the double and triple applications that is, mixed applications (337 mg kg^{-1} AM+FMY+AS and 375 mg kg^{-1} AM+ RZ in, respectively). On average, Fe content both years was as bigger than in 2003 and 2004 years (data not shown). The highest Cu content of the dry bean leaf (average 6.10 mg kg^{-1}) was determined from farm yard manure application. But differences among treatments and years were insignificant. On average, both years bio-organics fertilizer applications increased the Cu concentration of bean leaf. Also Mn and Zn contents of common bean leaf were more increased with treatment than control application. Although Mn concentration increased in 2003. The Zn concentration was increased in 2004 (data not shown). On average Mn concentration changed from 48.6 to 63.6 mg kg^{-1} *Rhizobium* and AM+AS+FYM application, respectively. On the other hand, Zn concentration of leaf was higher in 2004 years than 2004 years (data not shown) (Table 3).

Macro and Micronutrient Concentrations of Dry Bean Grain

Some elements such as P, K, Fe, Zn, Mn, Cu and protein contents of the dry bean grain were given in Table 4. Table 4 shows that the types of bio-organic fertilizer considerably enhanced the macro and micronutrients in the grain compared to the control. The effect of the bio-organic fertilizers and application years on protein, P and K contents of grain were significant ($p<0.05$). In the first year experiment, a protein content of dry bean grain was determined higher than the second year experiment (data not shown). While the highest protein content was obtained with the farm yard manure and biological fertilizer treatment. The lowest protein accumulation was derived from control plots. In addition, average protein contents vary between 16% to 21 (Table 4). Also the highest increases among bio-organics fertilizer in terms of K and P concentrations were provided with 2.21% RZ+FYM+ AS and 0.56% AM+ RZ in both years, respectively. The result of the second years was less obtained than from the first years for K and P values (data not shown).

The bio-organic and chemical fertilizers increased some micro nutrient concentrations in the dry bean grain. The effect of the applications during those years on the Cu and Zn content of dry bean grain were significant ($p<0.05$) but were insignificant for Fe and Mn. On average, both years the highest Fe accumulation among treatments were derived from AM+FYM (157 mg kg^{-1}). In the other hand, the first year experiment results was found to be greater than second year application for Cu, Mn and Zn. Although the highest Cu, Mn values were acquired with *Rhizobium* inoculation, Zn value was derived from inorganic fertilizer treatment pods (data not shown).

Discussion

The two year field trials show that all of applications generally increased both yield and yield component in both years. However, the application bio-organic treatments and combined applications consistently gave yields equal to or higher than inorganic applied plots. This was profound for our study and also other scientifics (Singh *et al*., 2000; Çakmakci *et al*., 2001; Singh, 2001; Gomaa *et al*., 2002; Srivastava *et al*., 2002; Patidar and Mali, 2004) got similar results. Although differences among organic manure, bio fertilizer and chemical fertilizer generally affected significantly the yield and yield component of the dry bean, some applications didn't increase insignificantly the tested parameters. In general, the bio-organic treatments performed better than chemical fertilizer in each experimental year. This might mean that addition organic waste to soil improved the yield, yield component and improved nutrient contents of crops. Average the applications in 2 years, the highest seed yield was obtained from Ammonium Sulphate (4970 kg ha^{-1}). Compared to other applications in 2 years, harvest, the index gave the highest mean (56.1%). A similar trend was found in the pod number, seed number per plant, biological yield, plant height and the thousand seed weight. These results imply that the highest yield and yield component in bean occurred when bio-organic fertilizers were applied, this is very important. Also some studies, bio-organic fertilizer application increased seed yield and seed component (Singh, 2001, Patidar and Mali, 2004). Inoculation with N_2-fixing bacteria and AM alone less increased than double and mix with organic and inorganic fertilizers. Compared with a single inoculation of biological fertilizers, yield and yield component increased in the combinations with two

or three organic fertilizers. This shows that organic fertilizers supply nutrients to plants and microorganisms are mixed with organic material to produce the right amount of nutritional solutions for the soil.

Also macro and micronutrient concentrations in the grain and leaf of the dry bean were affected by single, double and mixed treatments. This emphasizes again that the farmyard manure increases the availability of nutrients and they are food for bacteria and other organisms. Organic fertilizers as farmyard manure are the biological decomposition or breakdown of organic material by bacteria and other organism. These organisms bring about decomposition by feeding on organic material. On the other hand, some organisms such as *Rhizobium* and AM are important for soil productivity and plant nutrition. Of the treatments tested, dual and mixed application consistently gave macro and micro nutrition's equal to or higher than single of all application plots. Although, the differences between bacteria and AM were insignificant, all the applications significantly improved yield-yield components and macro and micro nutrition. Other studies with bio-organic fertilizer reported remarkable yield increase in potato, wheat, sugar beat, sorghum (Patidar and Mali, 2004), in citrus (Srivastava *et al*., 2002) and in barley (Çakmakci *et al*., 2001).

Conclusions

From the results of this experiment, it can be concluded that:

- Organic and biological fertilizer applications increased significantly plant heigh, number of pods, number of seed, 100 kernel weight, biological yield, harvest index and grain yield.
- Added farm yard manure and inoculated biological fertilizers were more effective on micro and macronutrients accumulations than combinated applications.
- Beneficial effects of bioorganic fertilizers were more than chemical fertilizer.
- Micro and macronutrients concentrations both of grain and leaf were increased with bioorganic fertilizer.
- In general, bio-organic treatments performed better than chemical fertilizer in each experimental year.

As a result, it can be said that the use of bio-organic fertilizers for plants has become a very important subject. In addition to this, the determination of the chemical fertilizer content of farm soil (according to result of analysis, to determine a fertilizing program without damaging plant and environmental health) is another important matter. Therefore, experiment should be repeated with different microorganisms and organic fertilizers.

References

Abdelhamit, M.T., T. Horiuchi and S. Oba, 2004. Composting of rice straw with oilseed rape cake and poultry manure and its effects on faba bean (*Vicia faba* L.) growth and soil properties. Bioresource Tech., 93: 183-189.

Abdul Wahid, O.A. and T.A. Mehana, 2000. Impact of phosphatesolubilizing fungi on the yield and phosphorus uptake by wheat and faba bean plants. Microbiol. Res., 155: 221-227.

Akçin, A., 1974. A research on the effects of fertilization,sowing date and row spacing on seed yield of various dry bean cultivars grown under Erzurum ecological conditions and theirphonologic, morphologic and technological characteristics. Publ. Fac. Agric., 157: 1-112.

Alonso, R., E. Orue and F. Marzo, 1998. Effects of extrusion and conventional processing methods on protein and antinutritional factor contents in pea seeds. Food Chem., 63: 505-512.

Bouyoucos, G.D., 1951. A recalibration of the hydrometer method for making mechanical analysis of soil. Argon. J., 43: 434-438.

Bremner, J.M., 1965. Methods of Soil Analysis Part 2, Chemical and Microbiological Properties. In Eds. Black, C.A. Am. Soc. Agron. Inc. Pub. Argon. Series No: 9 Madison, WIS.

Çakmakçi, R., F. Kantar and F. Şahin, 2001. Effect of N_2-fixing bacterial inoculations on yield of sugar beet and barley. J. Plant Nutr. Soil Sci., 164: 527-531.

Düzgüneş, O., T. Kesici and F. Gürbüz, 1987. Statistic Methods II. University of Ankara. Publ. No: 1021, Ankara.

Elizondo Baron, J., R.J. Pasini, D.W. Davis, D.D. Stuthman and P.H. Graham, 1999. Response to selection for seed yield and nitrogen (N_2) fixation in common bean (*Phaseolus vulgaris* L.). Field Crops Res., 62: 119-128.

Elsheikh, E.A. and A.A. Elzidany, 1997. Effects of Rhizobium inoculation, organic and chemical fertilizers on yield and physical properties of faba bean seeds. Plant Foods Hum. Nutr., 51: 137-144.

FAO, 2003. http:// www.fao.org.

Gomaa, A.M., A.A. Bahr, M.F. El-Karamany and M.A. El-Kholy, 2002. The bio-organic farming and its effect on nodulation, growth and yield parameters of Vetch (*Vicia sativa L.*). 17th WCSS, Thailand. Symp. No. 14, Paper No: 2297-7, presantitation: poster.

Hizalan, E. and H. Ünal, 1965. Soil chemical analysis. Univ. of Ankara, Publ, 273, Ankara.

Igbasan, F.A., W. Guenter, T.D. Warkentin and D.W. Mcandrew, 1996. Protein quality of peas as influenced by location, nitrogen application and seed inoculation. Plant Foods Hum. Nutr., 49: 93-105.

Jackson, M.L., 1973. Soil Chemical Analysis. Prentice-Hall of India Private Limited, New Delhi, India.

Knudsen, D., G.A. Peterson and P.F. Pratt, 1982. Lithium, Sodium and Potassium, Method of Analysis, 2: ASA-SSSA, Madison, WIS, pp: 225-246.

Olsen, S.R., C.W. Cole, S.S. Watanabe and L.A. Dean, 1954. Estimation of available phosphorus in soil by extraction by sodium bicarbonate. USDA Agric. Circ, pp: 939- 919.

Patidar, M. and A.L. Mali, 2004. Effect of farmyard manure, fertility levels and bio-fertilizers on growth, yield and quality of sorghum (*Sorghum bicolor*). Indian J. Argon., 49: 117-120.

Richards, L.A., 1954. Diagnosis and Improvement of Saline and Alkali Soils. Department. of Agriculture, No: 60, Washington, DC.

Sari, N., I. Ortaş and H. Yetişir, 2002. Effect of Mycorrhizae inoculation on plant growth, yield and phosphorus uptake in garlic under field conditions. Commun. Soil Sci. Plant Anal., 33: 2189-2201.

Singh, R., N. Kumar and N.S. Rana, 2000. Response of rainfed guinea grass (*Panicum maximum*) to bio-fertilizers inoculation and nitrogen. Ind. J. Argon., 45: 205-209.

Singh, K., 2001. Response of potato (*Solanum tuberosum*) to bio-fertilizer and nitrogen under North-Eastern Hill conditions. Indian J. Argon., 46: 375-379.

Soltanpour, P.N. and S.M. Workman, 1981. Use of Inductively-Coupled Plasma Spectroscopy for the Simultaneous Determination of Macro and Micro Nutrients in NH_4HCO_3-DTPA Extracts of Soils. In: Developments in Atomic Plasma Analysis, Ed., Barnes, R.M., USA., pp: 673-680.

Srivastava, A.K., S. Singh and R.A. Marathe, 2002. Organic citrus: Soil fertility and plant nutrition. J. Sustainable Agric., 19: 5-29.

Yağmur, M. and D. Kaydan, 2004. Effects of sowing densities and phosphorus doses on some phenologic, morphologic characters and seed yield of dry bean under irrigation condition in Van, Turkey, Pak. J. Biol. Sci., 7: 1782-1787.