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NUTRIENTS UPTAKE AND YIELD QUAILTY OF SOYBEAN AS AFFECTED BY BIO AND ORGANIC NITROGEN FERTILIZERS

Shaban, Kh[1]. A., A. M. Helmy,[2] and A. H. Abd El-Rhman[1]
1. Soil, Water and Environmental Res. Institute, ARC, Giza
2. Soil Science Dept., Faculty of Agriculture, Zagazig Univ.

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ABSTRACT: Two field experiments were carried out during the two growth season of 2006 and 2007 at El-Qntra East region, Ismailia Governorate, Egypt to investigate the response of soybean plant to the application of N- fertilizers from different sources i.e., ammonium sulphate (A.S) as a mineral N- fertilizer at two levels of 119 and 238 kg N ha^{-1}, respectively, compost manure (Co.M), farmyard manure (FYM) and town refuse (T.R) were added at the rate of 15 Mg fed.$^{-1}$ as organic N-sources. Bio N fertilization was achieved through inoculating the seeds with an effective strain of (*Bradyrhizobium japonicium*) for increasing and enhancing nitrogen fertilization efficiency as well as yield, seed quality, nutrient uptake of soybean *(Glycine max L. cv* Giza 35*)*. The obtained results could be summarized as follows: 1) Number of branches and 1000-seed weight as well as macro and micronutrients contents were significantly increased as a result of applied different organic and bio N-sources and their combinations compared to A.S treatment. 2) Seed oil yield and protein yield (kg fed.$^{-1}$) were increased significantly and the individual effect of organic N- sources and bio fertilization showed a descending increase in the order of Bio. > Co.M > FYM > T.R. 3) The highest available N, P and K as well as Fe, Mn, Zn and Cu content in soil after harvest were obtained due to the treatment of Co.M + FYM + T.R + Bio. and 4) The treatment of Co.M + FYM + T.R + Bio.+ A.S (119.0 kg N ha.$^{-1}$) was superior to the other treatments.

Key words: Soybean, organic manure, biofertilization, nutrients content, yield quality

INTRODUCTION

Most countries have traditionally utilized various kinds of organic materials to maintain or improve fertility status and productivity of their agricultural soils. However, several decades ago organic recycling practices in some countries were largely replaced with chemical fertilizers that were applied to high yielding of grains. Compost utilization as manure is becoming wider spread during recent years as a consequence of the rise in price of conventional fertilizers. Beneficial effects of organic fertilizers applications of growth and yield of some field crops were shown by Radwan and Hussien 1996, Mekki *et al.*, 1999 and El-Kholy and Gomaa, 2000. Nowadays emphasis has already been placed on research and development activities that led to the concept of multi strain biofertilizers i.e. the application of gathered groups of soil microorganisms, having a definite beneficial well-known role in supporting plant growth in developing sustainable soil fertility status and in bio-controlling soil born disease (Saber and Gomaa, 1993).

Incorporation of organic material in the form of farmyard manure (FYM) enhances the soil organic C content (Kundu et al., 2002) and has direct and indirect effects on soil properties and processes. Reduced bulk density, increased organic C content, hydraulic conductivity and infiltration rate and improved soil structure were observed through the application of FYM, along with recommended doses of N or NPK (Sharma and Sharma, 1993; Katyal et al., 1997; Swarup and Wanjari, 2000). Nutrient fluxes through microbial biomass are at least one order of magnitude faster than the remaining organic matter (Dalal, 1998), leading to the suggestion that microbial biomass could be used as an important indicator of changes of soil health and soil quality as influenced by agricultural managem-ent practices (Sparling, 1997).

Plant materials, such as crop residues or green manure may be used directly or after composting as nutrient inputs. After decomposition, be taken up by crops to produce biomass and grain. The benefits of the integration of livestock into farming systems and particularly the long term consequences of transferring nutrients from rangelands to croplands are still actively debated (Sumberg, 2003; de Ridder et al., 2004).

Nitrogen is the most limiting nutrient for production in most agricultural systems, due to the large amounts harvested with the crops and because it can be lost easily through gaseous losses, leaching, runoff or erosion. (Smaling et al., 1999). In some African farming systems, manure production is a major reason indicated by smallholder farmers for keeping cattle (Baijukya et al., 2005). Manure stored alone or mixed with urine, feed refusals or other organic materials are called compost after they have undergone a process of combined decomposition known as maturation or composting. Nutrient losses occur during composting, through leaching or volatilization. When compost or fresh excreta or plant materials are applied to soil, a proportion of the N becomes available for plant uptake, through mineralization of organic N or from mineral N already presents (mineralization efficiency).

Considering these facts, the objectives of the present experiment were to examine the impacts of the continuous use of inorganic fertilizers with and without some organic manure on seed yield, seed quality and nutrients uptake of soybean as well as soil nutrient contents after harvest.

MATERIALS AND METHODS

During two summer seasons in Egypt, a field experiment was carried out at 2006 and 2007 at El-Qntra East region, Ismailia Governorate, Egypt and irrigated with El- Salam canal in order to investigate the effect of mineral N- fertilization at two levels of the field recommended rate (i.e., 1/2 & full N-dose equivalent to 119 & 238 kg N ha^{-1}, respectively) as ammonium sulphate (A.S) and bio-N fertilization through inoculating seeds with an effective strain of (*Bradyrhizobium japonicium*) along with organic manures i.e., compost manure (Co.M), farmyard manure (FYM) and town refuse (T.R) at a rate of 15 Mg $fed.^{-1}$; for increasing and enhancing the nitrogen fertilization efficiency as well as yield, seed quality and nutrients uptake of soybean *(Glycine max L.* cv Giza 35*)*. A representative soil sample (0 – 30 cm) was taken before planting to determine some physical, chemical and nutritional properties (Table 1). The chemical compositions of the organic sources are shown in Table 2. Organic sources (Co.M, FYM and T.R) were added and mixed thoroughly with soil two weeks before seeding. Biofeltelizer fertilization was achieved through inoculating Soybean seeds with an effective strain of *Brady rhizobium* just before sowing devoted by (Saber, 1993) and commercially produced by Ministry of Agriculture, Egypt. A randomized complete blocks design with three replicates, having a plot area 12 X 13 m^2, was used. Each plot consisted of 30 rows 40 cm apart, two plant / hill and 20 cm between hills. Soybean seeds *(Glycine max L.)* were sown after soil preparation. Seedling was carried on June 15^{th}, 2006 and June 12^{th}, 2007 for the first and second season, respectively. The plants were thinned to a single plant per hill after 21 days from sowing. Phosphorus fertilizer was added to all plots before sowing at a rate of 31 kg

P ha.$^{-1}$ as superphosphate (6.8 %, P). Potassium sulphate (40 % K) was applied as soil application at a rate of 99 kg K ha.$^{-1}$ in two equal split, 30 and 45 days after sowing.

The treatments used as follows:

1) Control (Ammonium sulfate, A.S at a rate of 238 kg N ha $^{-1}$).
2) Co.M at a rate of 15 ton fed. $^{-1}$ + A.S (119.0 kg N ha.$^{-1}$)

Table 1. Some physical and chemical properties of the experimental soil

Particle size distribution (%)				Textural class	OM (g kg^{-1})	$CaCO_3$ (g kg^{-1})
C. sand	F. sand	Silt	Clay			
17.35	51.74	9.42	21.49	Sandy clay Loam	12.5	23.8

Φ pH	EC (dS m^{-1})	§Cations (cmol kg^{-1})				Anions (cmol kg^{-1})			
		Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	CO_3^{-2}	HCO_3^{-1}	Cl^{-1}	SO_4^{-2}
7.85	3.64	7.66	5.73	22.0	1.15	0.0	5.28	15.0	16.26

Available nutrients (mg kg^{-1})						
Macronutrients			Micronutrients			
N	P	K	Fe	Mn	Zn	Cu
41.0	3.75	165.0	3.18	5.98	1.05	0.74

Φ (1 : 2.5) soil : water suspension

§ Soluble cations and anions in (1 : 2.5) soil : water extract

Table 2. Some chemical characteristics of the organic N- sources used in the current study

Characteristics	FYM	T.R	Co.M
Total carbon (g Kg^{-1})	336.0	276.2	272.6
C/N ratio	20.6:1	24.2:1	21.6:1
pH (1:10)	6.88	7.01	7.24
Total macro nutrients (g Kg^{-1})			
N	16.35	11.42	12.61
P	3.351	2.856	11.01
K	1.152	7.812	9.123
Total micro nutrients (mg kg^{-1})			
Fe	167.0	473.4	984.3
Mn	82.12	181.1	250.4
Zn	65.36	89.45	38.62

3) FYM at a rate of 15 ton fed. $^{-1}$ + A.S (119.0 kg N ha.$^{-1}$)
4) T.R at a rate of 15 ton fed. $^{-1}$ + A.S (119.0 kg N ha.$^{-1}$)
5) Biofeltilization (Bio.)+ A.S (119.0 kg N ha.$^{-1}$)
6) Co.M + FYM + A.S (119.0 kg N ha.$^{-1}$)
7) Co.M + T.R + A.S (119.0 kg N ha.$^{-1}$)
8) Co.M + Biofertilizer (Bio.) + A.S (119.0 kg N ha.$^{-1}$)
9) Co.M + FYM + T.R + Biofeltilizer (Bio.) + A.S (119.0 kg N ha.$^{-1}$)

At maturity, two rows of each plot were harvested and air dried, then seed yield (kg fed.$^{-1}$), seed oil percentage, oil yield (kg fed.$^{-1}$) and seeds protein yield (kg fed.$^{-1}$) were estimated. In addition, representative ten plants were taken randomly from each plot to record the following characters: Number of branches plant^{-1}, 1000 seed weight (g), Seeds yield (kg fed.$^{-1}$), pod yield (kg fed.$^{-1}$), seed protein content (kg fed.$^{-1}$) = protein percentage x seed yield, and seed oil content (kg fed.$^{-1}$) = seed yield x oil percentage.

Methods of Analysis

Seed samples were digested with a mixture of concentrated sulfuric and perchloric acids for nutrients determination. The analysis of plants and soil were determined using the methods described by Black (1965) and Chapman and Pratt (1961). Available Fe, Mn and Zn were extracted by DTPA (Lindsay and Norvell, 1978) and determined using Inductively Coupled Plasma (ICP) Spectrometer model 400 (Soltanpour, 1985). Oil seed content was determined using Soxhlet method (AOAC, 1990). Protein percentage was calculated by multiplying the nitrogen percentage by the converting factor 6.25 (Hymowitz *et al.*, 1972).

The obtained data were subjected to the analysis of variance as described by Snedecor and Cochran (1967). Then Duncan's multiple range test (Duncan, 1955) was used to compare among means.

RESULTS AND DISCUSSION

Some growth characters of soybean plants are shown in Table 3. Application of biofertilization plus organic manures and A.S at a rate of 119.0 kg N ha.$^{-1}$ as one treatment showed more number of branches and 1000 seed weight as compared to the treatments received A.S (238.0 kg N ha.$^{-1}$) only and /or when it combined with organic and Bio. as one treatment. The increase of seeds weight that received Bio. plus organic fertilizers were mainly attributed to the beneficial effect of them, hence, the organic manure improved not only soil physical and biological properties, but also chemical characteristics as well, as resulting in more released available nutrients to plant root. This was true under the same condition, particularly in sand soil that lacks in enough nutrients (Table 2). Application of biofertilizer is suggested as a sustainable way for increasing crop yields. In general, El-Kholy and Gomaa, (2000) stated that the biofertilizer could replace 50% of the chemical fertilizer recommended for millet plants without decreasing the green and dry fodder, this could be attributed to the plant growth promoting substances produced by the biofertilizer, in addition to the reasonable quantity of atmospheric nitrogen fixed by *Azotobacter chrococcum* (Gomaa, 1995). These reaction saved more available nutrients for enzymes required to building up the different organs compounds and consequently for better growing soybean plants. The general physiological status of the plants as indicated by the dry weight always exhibited positive response to use biofertilizer addition. Ghosh et al. (2004) pointed out that organic manures played an important and significant role in increasing yield of soybean. This was attributed to supply of all essential nutrients (Table 2) due to continuous mineralization of organic manures. The treatment of 75 % NPK + FYM 5 t ha^{-1} recorded a significantly higher seed yield. This was attributed to its favorable effect on soil physical, chemical and biological properties as reported by Hati, et al. (2001).

Yield and Yield Components

Data presented in Table 3 show that yield and its components (i.e., 1000 seed weight, seed yield and pod yield were significantly increased due to the addition of organic N sources and biofertilization individually or combined. Bahattacharyya, et al. (2008) stated that application of 10 Mg FYM in conjunction with 20 kg N, 35 kg P and 33 kg K ha^{-1} (NPK + FYM treatment) was able to maintain higher yield of soybean by 99 % over the mean yield of NPK treatment. These results are in agreement with those obtained by Parveen et al. (2006) and Mamta et al. (2006).

Data also show that, when bio fertilization and organic manures were applied individually, the Bio treatment was the superior followed by FYM, Co.M and T.R for both 1000 seed weight and pod yields while the order was Bio followed by Co.M, FYM, and T.R for seeds yield. The superiority of FYM over all the organic manures for yield and its components could be attributed to its higher content of total N and narrow C/N ratio which led to rapid mineralization and decomposition in soil. Comparing the combination of the used treatments, the data presents following descending order: (Co.M + FYM + T.R + Bio) > (Co.M + FYM) > (Co.M + Bio) > (Co.M + T.R) for 1000 seed weight, (Co.M + FYM + T.R + Bio) > (Co.M + T.R) > (Co.M

Table 3. Yield and its components of soybean as influenced by bio and organic N– fertilizers during the two growing seasons of 2006 and 2007

Treatments	A.S (238 kg N ha $^{-1}$)	A.S (119 kg N ha $^{-1}$)							
		Co.M	FYM	T.R	Bio	Co.M + FYM	Co.M +T.R	Co.M +Bio	Co.M +FYM+ T.R +Bio
					Number of branches plant $^{-1}$				
1 st season	10 c*	14 ab	16 a	12 bc	14 ab	15 ab	13 abc	14 ab	16 a
2 nd season	11 c	16 ab	17 ab	14 bc	16 ab	16 ab	14 bc	17 ab	18 a
Mean	11 d	15 abc	17 a	13 cd	15 abc	16 ab	14 bc	16 ab	17 a
					1000 seed weight (g)				
1 st season	14.23 f	16.33 e	18.29 d	15.68 e	20.34 bc	21.53 b	19.63 c	20.36 bc	22.68 a
2 nd season	17.25 d	19.43 c	21.64 b	17.85 d	22.54 b	24.37 a	21.54 b	22.54 b	25.31 a
Mean	15.74 g	17.88 e	19.97 d	16.77 f	21.44 c	22.95 b	20.59 cd	21.45 c	24.00 a
					Seeds yield (kg fed. $^{-1}$)				
1 st season	618.2 d	738.4 c	736.7 c	732.5 c	740.9 c	850.1 b	856.8 ab	854.3 ab	863.5 a
2 nd season	623.3 d	741.7 c	743.4 c	742.6 c	744.2 c	855.1 b	861.2 ab	857.6 ab	866.1 a
Mean	620.8 c	740.1 b	740.1 b	737.5 b	742.6 b	852.6 a	858.9 a	856.0 a	864.8 a
					Pods yield (Kg fed. $^{-1}$)				
1 st season	1139 d	1279 bc	1294 abc	1271 c	1304 abc	1378 ab	1373 ab	1391 a	1395 a
2 nd season	1143 b	1284 ab	1300 ab	1275 ab	1306 ab	1384 a	1381 a	1397 a	1401 a
Mean	1141 d	1281 bc	1297 abc	1273 c	1305 abc	1381 ab	1377 abc	1394 a	1398 a

* The values followed by a different letters are significantly different at $p \leq 0.05$

+ Bio) > (Co.M + FYM) for seed yield and (Co.M + FYM + T.R + Bio) >(Co.M + Bio) >(Co.M + FYM) >(Co.M + T.R) for pods yield. Hence the treatment of (Co.M + FYM + T.R + Bio.) + A.S 119 kg N ha.$^{-1}$) was superior to the other treatments and gives highest 1000 seed weight, seed yield and pods yield. Ismail et al., (2003) reported that both soybean yield and 100 seed weight were increased significantly with compost and bio- composite application. These results are similar to that obtained by Abou Youssef and El-Eweddy (2003); Solaiman and Hassan (2004) and Shaban and Helmy (2006). These results may be due to the increase in the growth characters (Table 3) and the photo-synthetic pigments by the application of N fertilizer, consequently they give more ability to convert light energy to chemical energy which could expressed in more dry matter accumulation in the seeds.

Seed Quality

Seed oil content

Data in Table 4 indicate that seed oil percent as well as seed oil content was increased significantly when soybean plants treated with the different treatments of organic N-sources and biofertilization compared to A.S treatment while, T.R treatment was decreased oil percent. Mekki and Ahmed, (2005) noted that the plants that treated by biofertilization singly and / or received organic manure + yeast surpassed in the soybean seed oil content as compared to the other treatments. The individual effect of organic-N sources and bio fertilization showed pronounced increases the descending order of (bio. > Co.M > FYM > T.R). These results may be due to the favorable effect of biofertilizer in fixing nitrogen, which helps soybean plants to produce higher yield components with best quality of seeds. These findings are in accordance with those obtained by Saleep and Abdel-Ghani, (2000); El-Banna et al., (2000); El- Shimy et al., (2006) and Hussein, (2007).

Regarding the effect of the combinations between the organic N-sources and biofertilization, the treatments followed the order of, (Co.M + FYM + T.R + Bio) > (Co.M + Bio.) > (Co.M + FYM) > (Co.M + T.R).

Seed protein content

The results in Table 4 stated that organic N- sources and biofertilization as well as their combinations significantly increased the protein yield compared to A.S treatment. Mabrouk (2002) found that bio-mineral and organic - mineral fertilization treatments were more effective in increasing protein and oil seed contents of peanut plants as compared with the individual mineral

Table 4. Quality of soybean seeds as influenced by bio and organic N– fertilizers during the two growing seasons of 2006 and 2007

Treatments	A.S (238 kg N ha $^{-1}$)	A.S (119 kg N ha $^{-1}$)							
		Co.M	FYM	T.R	Bio	Co.M + FYM	Co.M + T.R	Co.M + Bio	Co.M + FYM+ T.R +Bio
				Seeds oil content (kg fed. $^{-1}$)					
1 st season	149.0 h*	202.3 e	193.8 f	153.1 g	209.7 d	230.4 b	221.9 c	223.8 c	271.1 a
2nd season	157.7 i	206.9 f	201.5 g	165.6 h	218.8 e	230.0 d	234.2 c	266.7 b	288.4 a
Mean	153.3 i	204.6 f	197.6 g	159.3 h	214.2 e	230.2 c	228.1 d	245.2 b	279.8 a
				Seeds protein content (kg fed. $^{-1}$)					
1 st season	172.7 f	217.8 de	216.4 de	214.7 e	219.0 d	282.1 c	301.5 b	302.8 b	309.8 a
2nd season	181.6 e	219.8 d	219.3 d	219.1 d	219.1 d	285.9 c	305.2 b	306.1 b	311.8 a
Mean	177.2 e	218.8 d	217.9 d	216.9 d	219.1 d	284.0 c	303.4 b	304.5 b	310.8 a

* The values followed by a different letters are significantly different at $p \leq 0.05$

fertilization. These results are in agreement with those obtained by, Ahmed et al., (2002); Fares and Khalil, (2003), Abdel-Haleem, (2005) ;and Hussein, (2007).The individual effect of organic N-sources and bio fertilization showed an ascending increase in the order of (Bio. > Co.M > FYM > T.R).

Regarding the effect of the combinations between the organic N-sources and biofertilization, the treatments followed the order of, (Co.M + FYM+T.R+Bio) > (Co.M + Bio.) > (Co.M + T.R) > (Co.M + FYM).

Macronutrients Content

Data in Table 5 show that N, P and K uptake were increased significantly due to addition of organic and bio N-sources and their combination. Also, the treatment of (Co.M+T.R+FYM + Bio.) was superior for increasing the uptake of N, P and K as compared to the other treatments. This promoting effect could be related to the N supplementary effect of N_2 fixing bacteria (used as bio N -fertilizer) to plants due to their ability to fix free molecular atmospheric nitrogen as well as the role of these bacteria in improving the availability of soil elements (Table 7) through secreting chelator substances (such as organic acids) which are important for solubilizing sparingly soluble inorganic compounds to make easy available forms for plants uptake. On the other hand, the positive effect of organic manures might reflect the different characteristics of the added organic manures (their chemical composition and nutritional status), hence the rate of decomposition and the differences in the subsequent release of included nutrients. However, the organic manures applied resulted in creating favorable soil physical and chemical conditions, which affected the solubility and availability of nutrients and thus uptake nutritional elements.

The individual effect of organic N-sources and biofertilizer showed an ascending increase in the order of (T.R > Bio. > Co.M > FYM) for N uptake and (Bio. > FYM > Co.M > T.R) for P and K uptake.

Regarding the effect of the combinations between the organic N-sources and biofertilization, the treatments followed the order of, (Co.M + FYM + T.R + Bio) > (Co.M +Bio.) > (Co.M+T.R) > (Co.M + FYM) for N, P and K uptake.

Micronutrients Content

Data in Table 6 show that Fe, Mn, Zn and Cu uptake were increased significantly due to addition of organic and bio N-sources and their combination. Also, the treatment of (Co.M + T.R + FYM + Bio.) was superior for increasing the uptake of Fe, Mn, Zn and Cu as compared to the other treatments. This promoting effect could be related to the N supplementary effect of N_2 fixing

Table 5. Macronutrients uptake (kg fed.$^{-1}$) of soybean as influenced by bio and organic N–fertilizers during the two growing seasons of 2006 and 2007

Treatments	A.S (238 kg N ha^{-1})	A.S (119 kg N ha^{-1})							
		Co.M	FYM	T.R	Bio	Co.M + FYM	Co.M + T.R	Co.M + Bio	Co.M + FYM+ T.R +Bio
					N uptake				
1st season	26.85 g*	35.87 ef	34.76 f	39.12 d	36.59 e	42.14 c	46.23 b	47.01 b	48.74 a
2nd season	28.95 e	36.15 d	34.96 d	40.28 c	37.51 d	42.74 c	46.83 b	48.41 ab	50.72 a
Mean	27.90 g	36.01 ef	34.86 f	39.70 d	37.05 e	42.44 c	46.53 b	47.71 b	49.73a
					P uptake				
1st season	2.535 g	3.249 e	3.389 de	3.003 f	3.482 d	4.165 c	4.284 bc	4.442 b	5.354 a
2nd season	2.743 h	3.412 g	3.568 f	3.342 g	3.721 e	4.361 d	4.737 b	4.631 c	5.543 a
Mean	2.638 h	3.330 g	3.478 f	3.171 e	3.602 d	4.263 c	4.509 b	4.537 b	5.448 a
					K uptake				
1st season	11.87 d	15.80 c	15.93 c	15.60 c	15.99 c	19.04 b	19.36 b	20.16 a	20.55 a
2nd season	12.03 e	15.95 d	16.22 d	15.97 d	16.21 d	19.75 c	20.07 ab	20.67 ab	21.13 a
Mean	11.95 d	15.88 c	16.08 c	15.78 c	16.10 c	19.40 b	19.71 b	20.42 a	20.84 a

* The values followed by a different letters are significantly different at $p \leq 0.05$

Table 6. Micronutrients uptake (g fed. $^{-1}$) of soybean as influenced by bio and organic N– fertilizers during the two growing seasons of 2006 and 2007

Treatments	A.S (238 kg N ha $^{-1}$)	A.S (119 kg N ha $^{-1}$)							
		Co.M	FYM	T.R	Bio	Co.M + FYM	Co.M + T.R	Co.M + Bio	Co.M + FYM+ T.R+Bio
					Fe uptake				
1 st season	86.55 g*	120.8 e	121.8 e	114.7 f	122.2 e	156.8 b	153.2 c	150.9 d	167.2 a
2nd season	88.51 i	124.1 g	128.4 f	119.8 h	136.2 e	143.4 d	146.6 c	157.2 a	151.2 b
Mean	87.53 h	122.5 f	125.1 e	117.3 g	129.2 d	150.1 c	149.9 c	154.1 b	159.2 a
					Mn uptake				
1 st season	48.22 i	60.55 f	58.20 g	52.01 h	62.24 e	74.81 c	72.83 d	80.30 b	82.90 a
2nd season	49.86 g	62.30 d	60.22 e	56.44 f	64.00 d	77.81 c	76.65 c	82.33 b	84.88 a
Mean	49.04 i	61.43 f	59.21 g	54.21 h	63.12 e	76.31 c	74.72 d	81.32 b	83.89 a
					Zn uptake				
1 st season	21.02 g	32.49 d	30.20 e	26.37 f	34.08 d	44.21 c	44.55 c	47.84 b	50.95 a
2nd season	23.69 h	33.38 f	35.68 e	31.19 g	37.95 d	47.03 c	48.23 c	50.60 b	54.56 a
Mean	22.35 g	32.93 e	32.93 e	28.76 f	36.02 d	45.61 c	46.38 c	49.22 b	52.75 a
					Cu uptake				
1 st season	6.800 h	11.81 f	11.05 f	8.790 g	13.34 e	17.85 d	18.85 c	22.21 b	24.18 a
2nd season	7.480 g	13.35 e	11.89 f	11.14 f	14.88 d	19.67 c	20.67 c	24.01 b	25.98 a
Mean	7.139 i	12.58 f	11.47 g	9.956 h	14.11 e	18.75 d	19.75 c	23.11 b	25.08 a

* The values followed by a different letters are significantly different at $p \leq 0.05$

bacteria to plants due to the role of these bacteria in improving the availability of soil elements (Table 8). Through secreting hormonal exudation (such as indol acetic acid, gibberillin and cytokinins) these microorganisms can modify root growth resulting in more efficient absorption of available nutrients from the soil. On the other hand, the positive effect of organic manures may be due to the production of organic and inorganic acids during the degradation of such organic materials as well as humates as a result of improving the microbactivities will have a contribution in decreasing soil pH and chelating ions, leading to increase in available forms of elements in rhizosphere zone. Consequently, the uniform supply of nutrients to plants could be expected throughout the growth season.

The individual effect of organic N-sources and bio fertilization showed an ascending increase in the order of (Bio. > FYM > Co.M > T.R) for Fe uptake and (Bio. >Co.M > FYM > T.R) for Mn, Zn and Cu uptake.

Regarding the effect of the combinations between the organic N-sources and biofertilization, the treatments followed the order of, (Co.M + FYM + T.R + Bio) > (Co.M + Bio.) > (Co.M + T.R) > (Co.M + FYM) for Zn and Cu uptake while, it was (Co.M+FYM+T.R+Bio) > (Co.M + Bio.) > (Co.M + FYM) > (Co.M + T.R) for Fe and Mn uptake. Mekki et al. (1999) pointed out that Zn and Mn concentrations were increased due to adding organic manure when associated with biofertilization.

Available Macronutrients in Soil after Harvest

Data presented in Table 7 indicate that the applied of different N treatments led to increase available N, P and K concentration in soil as compared to A.S at a rate of 238 kg N ha^{-1} as a solely treatment. Manna et al. (2007) reported that application of NPK in combination with FYM increased total nitrogen in soil. Bhattacharyya et al. (2008) stated that the application of FYM resulted in an increase in available N, P and K from the soils as FYM increased soil cation exchange capacity. The plots under NPK + FYM treatment showed the maximum accumulation of available N, P and K.

The treatment of (Co.M + T.R + FYM + Bio.) seemed to be generally superior with N and K, while, the increase of P was more associated with the treatment of biofertilizer, which is possibly due to the beneficial role of microorganisms in biofertilization, and their biological activity in particular and help build up the micro flora . On the other hand, the positive effect of organic N-sources on soil available N is likely attributed to the positive balance of

Table 7. Available macronutrient concentration (mg kg $^{-1}$ soil) at harvest as influenced by bio and organic N– fertilizers during the two growing seasons of 2006 and 2007

	Treatments	N			P			K		
		1 st season	2 nd season	Mean	1 st season	2 nd season	Mean	1 st season	2 nd season	Mean
	A.S (238 kg N ha $^{-1}$)	57.3	61.2	59.3	5.68	5.74	5.71	175	180	178
A.S (119 kg N ha $^{-1}$)	Co.M	64.4	67.4	65.9	5.78	5.82	5.80	188	193	191
A.S (119 kg N ha $^{-1}$)	FYM	66.8	69.3	68.1	5.82	5.86	5.84	192	196	194
A.S (119 kg N ha $^{-1}$)	T.R	62.6	71.5	67.1	5.75	5.82	5.79	185	191	188
A.S (119 kg N ha $^{-1}$)	Bio	65.2	72.2	68.7	5.83	8.87	7.35	193	196	195
A.S (119 kg N ha $^{-1}$)	Co.M + FYM	66.5	74.1	70.3	5.88	5.91	5.90	195	199	197
A.S (119 kg N ha $^{-1}$)	Co.M + T.R	68.7	76.6	72.7	5.89	5.92	5.91	192	197	195
A.S (119 kg N ha $^{-1}$)	Co.M + Bio	65.0	72.8	68.9	5.91	5.96	5.94	197	201	199
A.S (119 kg N ha $^{-1}$)	Co.M+FYM+T.R+ Bio	72.1	78.3	75.2	6.05	6.11	6.08	197	203	200

Table 8. Available micronutrients concentration (mg kg $^{-1}$ soil) at harvest as influenced by bio and organic N– fertilizers during the two growing seasons of 2006 and 2007

	Treatments	Fe			Mn			Zn			Cu		
		1 st season	2 nd season	Mean	1 st season	2 nd season	Mean	1 st season	2 nd season	Mean	1 st season	2 nd season	Mean
	A.S (238 kg N ha $^{-1}$)	4.62	4.66	4.64	7.34	7.37	7.36	1.20	1.25	1.23	0.89	0.94	0.92
A.S (119 kg N ha $^{-1}$)	Co.M	4.68	4.70	4.69	7.66	7.69	7.68	1.28	1.32	1.30	0.91	0.96	0.94
A.S (119 kg N ha $^{-1}$)	FYM	4.88	4.92	4.90	7.75	7.78	7.77	1.30	1.33	1.32	0.94	0.98	0.96
A.S (119 kg N ha $^{-1}$)	T.R	4.89	4.93	4.91	7.82	7.85	7.84	1.36	1.38	1.37	0.92	0.93	0.93
A.S (119 kg N ha $^{-1}$)	Bio	4.86	4.88	4.87	8.80	8.86	8.83	1.35	1.37	1.36	0.95	0.99	0.97
A.S (119 kg N ha $^{-1}$)	Co.M + FYM	5.12	5.17	5.15	8.86	8.89	8.88	1.45	1.46	1.46	1.03	1.08	1.06
A.S (119 kg N ha $^{-1}$)	Co.M + T.R	5.23	5.26	5.25	8.90	8.95	8.93	1.59	1.61	1.60	1.07	1.12	1.10
A.S (119 kg N ha $^{-1}$)	Co.M + Bio	5.18	5.21	5.20	8.89	8.93	8.91	1.52	1.54	1.53	1.05	1.10	1.08
A.S (119 kg N ha $^{-1}$)	Co.M+FYM+T.R+ Bio	5.34	5.38	5.36	8.94	8.97	8.96	1.61	1.64	1.63	1.06	1.14	1.10

total soil organic carbon and might have been partially due to a slow release of N from manure, as suggested by Bhandari et al. (2002); Yadav et al. (2000) and Gami et al. (2001). Also, application of A.S might have improved the activities of microorganisms responsible for N transformation (Sarkar and Rathore, 1992). The application of organic N-sources increased available P content because of its P content, and possibly by increasing retention of P in soil (Roy et al. 2001). Also, it may be due to the fact that the major P fraction added through organic manures in the organic pool, which mineralized slowly with time, (Yadvinder et al. 2004).

Available Micronutrients in Soil after Harvest

As shown in Table 8 application of bio and organic N- fertilizers and their combinations treatments were slightly increased available Fe, Mn, Zn and Cu concentration in soil as compared to A.S at a rate of 238 kg N ha^{-1} as a sole treatment. Highest available Fe, Mn, Zn and Cu contents in soil were 5.36, 8.96, 1.63 and 1.10 mg kg^{-1}soil, respectively and were obtained under applied treatment of Co.M + T.R + FYM + Bio.

CONCLUSION

Increasing the productivity of soybean crop with good seed quality under newly reclaimed soil conditions of Egypt was achieved not only by using high rates of N-mineral fertilizers, but also by better management of its application to the soil through a moderate level of 119 kg N ha^{-1} and inoculation of seeds with suitable mixture of effective free living N_2 fixing bacteria along with manuring the soil with matured organic materials such as Co.M, FYM and T.R. On the other hand, such management will decrease the enormous consumption of chemical N-fertilizers and meanwhile will minimize health and environmental risks which are prospectively fulfilled.

REFERENCES

Abdel-Haleem, R. A. 2005. Response of some flax varities to plant densities and biofertilization in sandy soils. M. Sc. Thesis, Fac. Agric. Moshtohor, Banha Univ., Egypt.

Abou Youssef, M. F. and E. A. El-Eweddy. 2003. Effect of tillage and nitrogen application regime on: I. Yield and nitrogen content of sunflower cultivated under calcareous soil conditions. Zagazig J. Agric. Res., 30 (1): 231 – 244.

Ahmed, Kh. A.; M. M. Badran and S. H. Ashmawy. 2002. Response of soybean to chemical and bio-fertilization. Egypt. J. Appl. Sci., 17 (6): 207 – 218.

AOAC. 1990. Official Methods of Analysis. Association of Official Analytical, Arlington, Virgina, USA.

Baijukya, F.P., N. De Ridder, K. F. Masuki and K. E. Giller. 2005. Dynamics of banana-based farming systems in Bukoba District, Tanzania: changes in land use, cropping and cattle keeping. Agric. Ecosyst. Environ. 106: 395–406.

Bhandari, A.L., J. K. Ladha, H. Pathak, A.T. Padre, D. Dawe, and R. K. Gupta. 2002. Yield and soil nutrient changes in a long-term rice–wheat rotation in India. Soil Sci. Soc. Am. J. 66: 162–170.

Bhattacharyya, R., S. Kundu, V. Parkash and H. S. Gupta. 2008. Sustainability under combined application of mineral and organic fertilizers in a rainfed soybean – wheat system of the Indian Himalayas. Europe J. Agronomy, 28: 33 – 46.

Black, C. A. 1965. Methods of Soil Analysis, I & II. Amer. Soc. Agron., Madison, Wisconsin, USA.

Chapman, H.D. and P.F. Pratt. 1961. Methods of Analysis for Soils, Plants and Waters. Agric. Publ. Univ., of California, Riverside.

Dalal, R.C. 1998. Soil microbial biomass: what do the numbers really mean? Aust. J. Exp. Agric. 38: 649–665.

De Ridder, N., H. Breman, H. Van Keulen, and T.J. Stomph. 2004. Revisiting a 'cure against land hunger': soil fertility management and farming systems dynamics in the West African Sahel. Agric. Syst. 80: 109–131.

Duncan, D. B., 1955. Multiple Ranges and Multiple F. Test. Biometrics. II: 1– 42.

El-Banna, A. A.; A. Kh. Ahmed and A. M.Ali. 2000. The effectiveness of nodulation of soybean and its relation to inoculation, N and P application. Egypt. J. Appl. Sci., 15 (4): 41 – 45.

El-Kholy, M.A. and A.M. Gomaa. 2000. Biofertilizers and their impact on forage yield and N-content of millet under low level of mineral fertilizers. Annals of Agric.Sci., Moshtohor, 38(2): 813-822.

El-Shimy, G. H.; M. M. M. Hussein and A. M. M. El-Refaie. 2006. Effect of Nofatrin (N-biofertilizer) application times on yield and yield components of some flax verities. J. Agric. Sci., Mansoura Univ., 31 (6): 3295 – 3307.

Fares, C. N. and M. F. Khalil. 2003. Effect of biofertilizers and mycorrhizal fungi on nutrients uptake and growth of soybean and maize plants cultivated individual or intercropping system. Egypt. J. Appl. Sci., 18 (5B): 774 – 788.

Gami, S.K., J. K. Ladha, H. Pathak, M.P. Shah, E. Pasuquin, S.P. Pandey, P.R. Hobbs, D. Joshy and R. Mishra. 2001. Long-term changes in yield and soil fertility in a 20-year rice–wheat experiment in Nepal. Biol. Fertil. Soils 34: 73–78.

Ghosh, P. K., P. Ramesh, K. K. Bandyopadhyay, A.K. Tripathi, K. M. Hati, and A. K. Misra. 2004. Comparative effectiveness of cattle manure, poultry manure, phosphocompost and fertilizer – NPK on three cropping systems in vertisols of semi-arid tropics. I. Crop yields and system performance. Bioresource Technology, 95: 77 – 83.

Gomaa, A.M. 1995. Response of certain vegetable crops to biofertilization. Ph. D. Thesis, Fac. Agric. Cairo Univ.

Hati, K. M., K.G. Mandal, A. K. Misra, P.K. Ghosh, and C. L. Acharya. 2001. Effect of irrigation regimes and nutrient management on soil water dynamics, evapotranspiration and yield of wheat in vertisol. Indian J. Agric. Sci., 71 (9): 581 – 587.

Hussein, M. M. M. 2007. Response of some flax genotypes to bio and nitrogen fertilization. Zagazig J. Agric. Res., 34 (5): 815 – 844.

Hymowitz, T. F., P. Collins and W. M. Walker. 1972. Relationship between the content of oil, protein and sugar in soybean seed. Agron. J., 64: 613 – 616.

Ismail A. B., H. A. Ahmed and E. M. Gaafar. 2003. Some soil properties and soybean productivity as affected by organic amendments and irrigation regime in sandy soil. Egypt J. Appl. Sci., 18 (3B): 653 – 663

Katyal, J.C., K.L. Sharma, K. Srinivas, and M.N. Reddy. 1997. Balanced fertilizer use in semiarid soils. Fertil. News, 42: 59–69.

Kundu S., V. Prakash, B.N. Ghosh, R.D. Singh, and A.K. Srivastva. 2002. Quantitative relationship between annual carbon inputs and soil organic carbon build-up in soybean (*Glycine max*)–wheat (*Triticum aestivum*) cropping sequence. In: Proceedings of the 2nd International Agron. Congress, New Delhi, India, November 26–30 pp.108–110.

Lindsay, W. L. and W. A. Norvell. 1978. Development of a DTPA soil test for Zn, Mn, Fe and Cu. Soil Sci. Soc. Am. J., 24 (2): 421 – 428.

Mabrouk, S. S. 2002. Response of some peanut cultivars to bio and organo - mineral fertilization. Zagazig J. Agric. Res., 29 (6): 2071 – 2083.

Mamta, K., S. K. Thakral and S. S. Pahuja. 2006. Yield attributes and yields of wheat as affected by organic and inorganic source of nutrition. Haryana J. of Agronomy, 22 (1): 71-73

Manna, M. C., A. Swarup, R. H. Wanjari, B. Mishra, and D. K. Shahi. 2007. Long term fertilization, manure and liming effects on soil organic matter and crop yields. Soil & Tillage Res., 94: 397 – 409.

Mekki, B. B., M. M. Selim and M.S.M Saber. 1999. Utilization of Biofertilizer in Field Crop Production. 12. Effect of organic manuring, chemical and biofertilizers on yield and nutrient content of millit grown in newly reclaimed soil. Egypt. J. Argon. 21: 113-124

Mekki, B. B. and A. G. Ahmed. 2005. Growth, yield and seed quality of soybean (*Glycine max* L.) as affected by organic, Biofertilizer and yeast application. Res. J. Agr. & Bio. Sci., 1(4) :320 – 324.

Parveen, K., H. Singh, R. S. Hooda and V. P. Singh. 2006. Effect of nitrogen levels and biofertilizers on yield and quality of crops in pearl mielt – wheat cropping system. Haryana J. of Agronomy, 22 (1):71-73

Powell, J. M., S. Ferna´ndez-Rivera, P. Hiernaux, M.D. Turner. 1996. Nutrient cycling in integrated rangeland/cropland systems of the Sahel. Agric. Syst. 52: 143–170.

Radwan, S.M.A and H.F. Hussein. 1996. Effect of bio. and organic fertilization on wheat yield under different weed control treatments. Egypt. J. Appli. Sci., 11(10): 267-281.

Roy, S. K., R.C. Sharma, and S. P. Trehan. 2001. Integrated nutrient management by using farmyard manure and fertilizers in potato–sunflower–paddy rice rotation in the Punjab. J. Agric. Sci. 137: 271–278.

Saber, M.S.M. 1993. Microbein, a multi-strain. 6th International Symposium on Nitrogen Fixation with Non-Legumes, Ismailia, Egypt.

Saber M.S.M. and A.M. Gomaa. 1993. Associative action of a multi-strain biofertilizer on tomato plants grown in a newly reclaimed sandy soil. 6th International Symposium on Nitrogen Fixation with Non-Legumes, Ismailia, Egypt.

Saleep, S.R. and M. M. Abdel-Ghani. 2000. Effect of sulphur application and *Rhizobium* inoculation on growth, nodulation and yield of soybean. Egypt. J. Appl. Sci., 15 (4): 93 – 101.

Sarkar, S., and T.R. Rathore. 1992. Soil properties changes associated with wheat straw management. Indian Agriculturist 43, 177–183.

Sharma, G.D., and H.L. Sharma. 1993. Fertility management for yield maximization of rice–wheat cropping system. Fertil. News, 38: 19–23.

Shaban, Kh. A. and A. M. Helmy. 2006. Response of wheat to mineral and Bio N-fertilization under saline conditions. Zagazig J. Agric. Res., 33 (6): 1189 – 1205.

Smaling, E. M. A., O. Oenema, and L.O. Fresco. 1999. Nutrient disequilibria in agroecosystems: Concepts and case studies. CAB International, Wallingford, UK.

Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods. Iowa State University Press. pp. 593, Ames., Iowa, U.S.A.

Solaiman, B. M. and M.A. Hassan. 2004. Influence of organic-N sources on some chemical and physical properties of soil, growth, root distribution and leaf NPK content of young Valencia orange trees grown in sandy soil under drip irrigation. Zagazig J. Agric Res., 31 (1): 201 – 218.

Soltanpour, N. 1985. Use of ammonium bicarbonate-DTPA soil test to evaluate elemental availability and toxicity. Soil Sci Plant Anal., 16 (3): 323 – 338.

Sparling, G.P. 1997. Soil microbial biomass, activity and nutrient cycling as indicators of soil health. In: Pankhurst, C.E., Doube, B.M., Gupta, V.V.S.R. (Eds.), Biological Indicators of Soil Health. CAB International, Wallingford, UK, :97–119.

Sumberg, J. 2003. Toward a dis-aggregated view of crop–livestock integration in western Africa. Land Use Policy 20: 253–264.

Swarup, A. and R.H. Wanjari. 2000. Three decades of all-India .co-ordinate research project on long-term fertilizer experiments to study changes in soil quality, crop productivity and sustainability. Indian Institute of Soil Science, Bhopal, India.

Yadav, R.L., B.S. Dwivedi, and P.S. Pandey. 2000. Rice–wheat cropping system: assessment of sustainability under green manuring and chemical fertilizer inputs. Field Crops Res. 65: 15–30.

Yadvinder S., B. Singh, J.K. Ladha, C.S. Khind, R.K. Gupta, O.P. Meelu, and E. Pasuquin. 2004. Long-term effects of organic inputs on yield and soil fertility in rice–wheat rotation. Soil Sci. Soc. Am. J., 68: 845 – 853.

امتصاص العناصر الغذائية وجودة محصول فول الصويا تحت تأثير التسميد العضوي و الحيوي

خالد عبده حسن شعبان [1] – أيمن محمود حلمي محمد [2] – أحمد حمادة عبد الرحمن [1]
1. معهد بحوث الأراضي و المياه والبيئة – مركز البحوث الزراعية بالجيزة
2. قسم علوم الأراضي – كلية الزراعة – جامعة الزقازيق

أجريت تجربة حقلية خلال موسمي صيف لعاميين متتاليين هما 2006 و 2007 بمنطقة القنطرة شرق بمحافظة الإسماعيلية لدراسة تأثير التسميد النيتروجيني من مصادر مختلفة مثل سلفات الامونيوم (A.S) كمصدر معدني أضيف بمعدلين (نصف وكل الكمية المقررة للاضافة الحقلية بما يعادل 119 و 238 كجم ن للهكتار علي التوالي) وثلاث مصادر عضوية هي (مكمور عضوي Co.M و السماد البلدي FYM و سماد مخلفات المدن T.R أضيفت بمعدل 15 ميجا جرام للفدان) و التسميد الحيوي من خلال تلقيح البذور بسلالة نشطة وفعالة من(*Bradyrhizobium japonicium*) علي تحسين كفاءة التسميد النيتروجيني و المحصول و جودة البذور وكذلك امتصاص بعض العناصر الغذائية الكبرى و الصغري لنبات فول الصويا صنف (جيزة 35) كما اشتملت الدراسة علي استبيان هذا التأثير على مدى تيسر بعض العناصر الكبرى و الصغري بالتربة بعد الحصاد ويمكن تلخيص أهم النتائج المتحصل عليها كما يأتي:

1) ازداد عدد الفروع للنبات ووزن 1000 بذرة وكذلك محتوي العناصر الغذائية الكبرى و الصغري الممتصة معنويا بإضافة المصادر العضوية و التسميد الحيوي بمفردهم وكذلك نتيجة اضافتهم معا مقارنة بسماد سلفات الامونيوم (238 كجم ن للهكتار).
2) ازداد محتوي الزيت ومحتوي البروتين للبذور معنويا نتيجة لاضافة المعاملات المختلفة و التسميد الحيوي و كان تسلسل الزيادة بالنسبة للمعاملات الفردية كالتالي
Bio>Co.M>FYM>T.R
3) أعلي محتوي من النيتروجين و الفسفور و البوتاسيوم الميسر وكذلك الحديد و المنجنيز و الزنك و النحاس بالتربة قد تم التحصل عليها نتيجة معاملة الإضافة
(Co.M + FYM + T.R + Bio.) + A.S (119.0 kg N $ha.^{-1}$).

كانت المعاملة (Co.M + FYM + T.R + Bio) + A.S (119 kg N $ha.^{-1}$) هي افضل و أحسن معاملة علي الإطلاق مقارنة بباقي المعاملات المستخدمة وذلك لجميع العناصر تحت الدراسة. ويمكن من النتائج السابقة التوصية (باستخدام التسميد العضوي بمعدل 15 ميجا جرام للفدان مع التسميد الحيوي لفول الصويا واستخدام نصف الكمية الموصي بها فقط من السماد النيتروجيني المعدني وهو ما يعد افضل معاملة من حيث تقليل التكاليف و التلوث البيئي الناتج عن استخدام الاسمدة المعدنية.