

Utilization of Bio-Fertilizers in Field Crops Production 16-Groundnut Yield, its Components and Seeds Content as Affected by Partial Replacement of Chemical Fertilizers by Bio-Organic Fertilizers

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Abstract: Two field trials were implemented during the summer seasons of 2004 and 2005 at private farm, Al Nagah Village, South El Tahrir Province, El Behaira Governorate, Egypt. The present work was aimed to investigate part replacement of NPK chemical fertilizers by bio-organic fertilizers on groundnut yield and its components c.v Giza 5(early punch) grown in poor sandy soil. Nine treatments used which were the combinations of the recommended chemical fertilizer NPK (40:30:48), organic farmyard manure (20 m³/fed.) and 75, 50 or 25 % of these recommended doses with or without biofertilizer (microbein). Data presented clear significant differences between treatments for all studied characters. Treatment of 25% rec. chem.. fert. NPK + 75% org FYM +bioertilizer (microbein) came in the first order for groundnut yield, yield components,oil yield (kg/fed.); P% Fe,Zn (ppm) except for no. of seeds/pod and weight of straw (g/plant) 50% chem.+50%org.+(microbein) was the best treatment. The highest seed index;harvest index;oil %; protein%; protein yield(kg/fed.) ; N% and Mn (ppm) recorded by 75% rec.chem.NPK +25%org.+(microbein). Abbviations: Fed: feddan = 4200 m³ rec: recommended dose

Key words: Groundnut, Bio-organic fertilizers, FYM

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is considered one of the most important oilseed crops in the world. The cultivated area of groundnut in Egypt during 2001-2005 seasons was about 60,000 hectares. Most of the cultivated area in poor sandy soil using high rates of NPK chemical fertilizers aiming to maximize seed yield for human feeding and straw yield to use it in animal feeding. Although oil consumption 1.1 million ton/year in Egypt the production was 0.121 million ton /year with shortage 89%, thus, increasing oilseed crops was important aim in Egyptian agriculture.

Due to intensive farming Egypt is known as a heavy consumer of chemical fertilizers. The use of chemical fertilizers has been doubled during the last two decades⁽⁸⁾. Thus the coincident application of organic manures and bio-fertilizers is frequently recommended firstly for improving biological, physical and chemical properties of soil and secondary to get high and clean agricultural yield products free from undesirable high doses of heavy metals and other pollutants.

NPK came from organic sources, such as FYM can be used as a sole source or as a substitute for part of inorganic fertilizers. These benefits, however, are not always easy to optimize because of N content and its subsequent release being difficult to predict. Increasing groundnut yield and its components by using the

integrated action of both bio-organic and chemical fertilizers were reported by many researchers.⁽¹⁶⁾ stated that increasing organic manure in the form of FYM up to 15 t/ha maximize pods, seeds yields/ ha of groundnut varieties, plant height; shelling %; 100 seed weight; haulm yield / ha.⁽¹¹⁾ stated that 12.5 t/ha FYM + N 34- P 17 – K 54 maximize no. of pods/ plant; pod weight /plant; haulm yield/ ha. Utilization of recommended dose of NPK (25:75:37) + 10 t/ha FYM gave the greatest no. of pods / plant; haulm and seed yields. ⁽¹³⁾ suggested that 7.5 t/ha FYM + NPK (25:32:20) produced the highest pods, seeds yield /ha.Also,⁽¹¹⁾ concluded significant increase in peanut seed yield as affected by bio and organic fertilizers.⁽¹⁹⁾ stated significant increase in pods,seeds yields; plant height; shelling %; seed and haulm yields /ha.by FYM up to 15 t/ha.⁽¹⁷⁾ reported that superiority of 10 t/ha FYM + bio-fertilizer due to plant height; no. of branches /plant; DM. The integrated nutrient management by bio-organic and chemical fertilizers recorded 35 % yield increase⁽¹⁸⁾. Partial replacement of 50% NPK chemical fertilizer by 50% through FYM recorded the maximum pod and haulm yield/ ha^(4,5), also, the same result by added *Azotobacter* as bio-fertilizer ⁽⁶⁾. ^(3,6,10,12) stated that combined application of 5 t/h FYM+ 3/4 recommended dose of NPK (25:50:0) increased no. of pods/ plant; pod yield; 100 seed weight; seed protein and oil content,⁽⁹⁾ recorded the same results with bio and chemical fertilizers nutrient sources.

The aim of this study was to replace part of NPK chemical fertilizers by bio-organic fertilizer firstly for get clean agricultural product free of undesirable high doses of heavy metals and other pollutants plus increasing yield and yield components, secondary for improving biological, physical and chemical properties of these new cultivated sandy.

MATERIALS AND METHODS

Two field trials were carried out in a private farm at Al Nagah Village, South El Tahrir Province, El Behaira governorate, Egypt, during two successive summer seasons of 2004 and 2005.

Soil texture was sandy having the following characteristics, sand 94.7 %, silt 4.3 %, clay 1 %, P^H 8.1, organic matter 0.65 %, $CaCO_3$ 3.15 %, EC 0.7 mmhos/cm², N= 4, P= 1.7 and K= 6.2mg/100g soil.

Seeds of (groundnut) c.v Giza 5 (early punch) were sown in hill 10 cm apart in ridges on second week of May in both seasons. The randomized complete block design with three replicates was used, Each experimental unit (plot) contains 5 rows (3.5 m in length and 60 cm apart), the plot area was 10.5 m² (i.e. 1/400 fed.).

Seeds of groundnut c.v Giza 5 divided into two equal parts one of them were coated just before sowing with (microbein) biofertilizer and specific *Rhizobium* strain using Arab gum as an adhesive agent.

FYM was used at a rate of 20 m³ /fed as recommended dose, 25%, 50% and 75% of recommended dose were added to plots 15 days before sowing. The recommended dose of chemical fertilizer NPK (40:30:48) was used as positive control i.e. nitrogen fertilizer was added at a rate of 200 kg / fed ammonium sulfate (20.6%N) in two equal parts at 15 and 45 days after sowing, while phosphorus and potassium were added at a rate of 200 kg / fed calcium superphosphate 15.5 % P₂O₅ and 100 kg/fed potassium (48 % K₂O), respectively. 75%, 50% or 25% of recommended chemical fertilizer plus 25%, 50% or 75% of recommended organic fertilizer were used either together or with microbein. At pig formation stage 400 kg/fed (agricultural) gypsum were added to all experimental plots.

A. The nine experimental treatments were as follows:

1. Chemical fert. Rec. NPK (40:30:48)
2. Organic fert. Rec. 20 m³ / fed FYM
3. Bio-fert. (microbein)
4. 75 % Chemical fert. + 25 % Organic fert.
5. 75 % Chemical fert. + 25 % Organic fert. + Bio-

fert. (microbein)

6. 50 % Chemical fert. + 50 % Organic fert.
7. 50 % Chemical fert. + 50 % Organic fert. + Bio-fert. (microbein)
8. 25 % Chemical fert. + 75 % Organic fert.
9. 25 % Chemical fert. + 75 % Organic fert.+ Bio-fert. (microbein)

The microbein is biofertilizer innovated and identified by⁽¹⁴⁾, fecund by biofertilizers unit, General Organization of Agriculture Equalization Fund (GOAEF) oversight Ministry of Agriculture, Egypt, contains *Azotobacter spp*; *Azospirillum spp*; *Pseudomonas spp*; *Bacillus megatherium*; *Rhizobium spp*.

FYM contents were organic matter 39.7 %, organic carbon 23 %, C/N ratio 13, P^H 7.8, EC 2.1 mmhos cm², total N 1.87 %, available P 88 and K 84 ppm. Sprinkler irrigation was applied as plants needed. Groundnut was manually harvested at 120 days after sowing in both seasons.

B. Data recorded: At harvest 120 (DAS) ten plants from the two central rows guarded randomly (from all plots) to determine: 1- Number of pods/plant, 2- Number of seeds/pod, 3-Number of seeds/plant, 4-Weight of pods/plant (g/plant), 5- 100-seed weight (in grams) (seed index), 6- Seed yield (g/plant). All plants from each plot were harvested to determine seed, straw, biological yield as kg/feddan. Harvest index calculated by dividing seed yield / bio-yield, while shelling % = seed weight / pod weight %. Oil, N,P,Fe,Zn and Mn in seed was determined according to ⁽⁷⁾ and crude protein % was calculated by multiplying N% by 6.25. Oil and protein seed yield as kg/fedden was calculated by multiplying seed weight (kg fed.) X oil % or protein % in groundnut seeds.

All data were statistically analyzed according to⁽¹⁵⁾. The combined analysis was conducted for data of the two seasons. The least significant differences (LSD 5 %) was used to compare means.

RESULTS AND DISCUSSIONS

Yield and yield components: Data presented in Tables 1 and 2 clear that there were significant differences between treatments for all studied characters. Treatment of 25% recommended NPK chemical dose + 75% organic fertilizer (FYM) + biofertilizer (microbein) produced the greatest number of pods / plant, seeds/plant, heaviest plant pod weight and seed yield /plant, also it gave the highest seed; straw; biological yields (ton/fed.) and shelling % comparing to the other studied fertilization treatments. Treatment of 50% recommended NPK chemical dose + 50% (FYM) + biofertilizer (microbein)

Table 1: Yield and yield attributes of groundnut plants as affected by interactions of chemical , organic and bio-fertilizers (combined of 2004 & 2005 seasons).

Yield attributes Treatments	Number of			Weight of (g/plant)		
	Pods/plant	Seeds/pod	Seeds/plant	Seeds	Pods	Straw
Chemical fert. Rec. NPK (40:30:48)	41.1	1.21	49.7	32.4	51.7	74.4
Organic fert. Rec. 20m3/fed.FYM	39.1	1.31	51.2	34.2	49	70.8
Bio fert. (microbein)	37.5	1.21	44.1	28.7	47.5	57.5
75% Chem. + 25% Org.	42	1.38	58	38.5	58.5	70.5
75% Chem.+ 25 % Org. +Bio (microbein)	43.1	1.32	56.9	38.6	55.9	78.3
50 % Chem. +50% Org.	46.6	1.33	61.4	39.1	60.9	96.4
50 % Chem. +50% Org.+Bio (microbein)	49	1.42	69.6	45.2	64.8	97.5
25 % Chem. +75% Org.	49	1.29	63.2	41.3	59.5	90.6
25 % Chem. +75% Org.+Bio (microbein)	50.1	1.4	70.1	46.2	65.3	95.1
Mean	44	1.32	58.2	38.3	57.5	81.2
LSD 0.05%	2.2	0.24	8.5	3.2	3.9	0.6

Rec.: recommended microbein: bio-fertilizer FYM: farmyard manure

Table 2: Groundnut yield and yield (contents) as affected by combinations of chemical , organic and bio-fertilizers (combined of 2004 & 2005 seasons).

Yield attributes Treatments	Yield of (ton/fed.)					
	Seeds	Straw	Biological	Seed index	Shelling %	Harvest index
Chemical fert.Rec. NPK (40:30:48)	1.551	3.094	4.645	65	62.7	0.334
Organic fert.Rec. 20m3/fed.FYM	1.496	3.217	4.713	66.3	67.6	0.317
Bio fert. (microbein)	1.362	3.05	4.412	63.6	60.4	0.309
75% Chem. + 25% Org.	1.737	3.307	5.044	66.6	65.8	0.344
75% Chem.+ 25 % Org. +Bio (microbein)	1.881	3.55	5.431	67.9	69.1	0.346
50 % Chem. +50% Org.	1.835	3.55	5.385	63.6	64.2	0.341
50 % Chem. +50% Org.+Bio (microbein)	1.902	3.694	5.596	65	69.7	0.34
25 % Chem. +75% Org.	1.973	3.802	5.775	65.3	69.4	0.342
25 % Chem. +75% Org.+Bio (microbein)	2.005	3.911	5.916	65.9	70.7	0.339
Mean	1.749	3.464	5.213	65.5	66.6	0.335
LSD 0.05%	0.136	0.203	0.248	1.4	1.1	0.027

Rec.: recommended microbein: bio-fertilizer FYM: farmyard manure

gave the greatest no. of seeds /pod and straw yield (g/plant). The heaviest 100 – seed weight (seed index) and the highest harvest index were recorded by treatment of 75% chem. + 25% org. + biofertilizer (microbein), There is an increase in seeds, straw and biological yields/fed this superior treatment over that of 100 % chemical treatment reached about 29.3%, 26.4% and 27.4%, respectively (Table, 2). These findings are in

harmony with those obtained by⁽²⁾ working on groundnut bio-organic fertilization using pot experiment. The superiority of combined application of 15 ton/ ha FYM + 1/4 recommended dose of NPK reported by ^(6,10) who stated the same result by adding *Azobacter* as biofertilizer beside organic and chemical fertilizers.⁽¹⁸⁾ found that the integrated nutrient management by bio-organic and chemical fertilizers recorded 35 % increase in summer groundnut yield.

Table 3: Chemical contents of groundnut seeds as affected by combinations of chemical, organic and bio-fertilizers(combined of 2004 & 2005 seasons).

Chem. seeds contents Treatments	Oil		Protein		Macro nutrients (%)		Micro nutrients ppm		
	%	Yield (kg/fed.)	%	Yield (kg/fed.)	N	P	Fe	Zn	Mn
Chemical fert.Rec. NPK (40:30:48)	52.35	811.9	23.25	360.6	3.72	0.8	189	37	16
Organic fert.Rec. 20m3/fed.FYM	52.88	791.1	24.75	370.3	3.96	0.79	195	34	18
Bio fert. (microbein)	51.18	697.1	24.81	337.9	3.97	0.75	190	32	16
75% Chem. + 25% Org.	53	920.6	26.75	464.6	4.28	0.83	208	37	15
75% Chem.+ 25 % Org. +Bio (microbein)	53.88	1013.5	27.37	514.8	4.38	0.8	238	39	18
50 % Chem. +50% Org.	52.69	966.9	24.06	441.5	3.85	0.81	223	35	15
50 % Chem. +50% Org.+Bio (microbein)	53	1008.1	24.93	474.2	3.99	0.81	235	40	18
25 % Chem. +75% Org.	52.35	1032.9	24.31	479.6	3.89	0.79	203	39	17
25 % Chem. +75% Org.+Bio (microbein)	53.18	1066.3	25.06	502.5	4.01	0.83	242	40	18
Mean	52.72	923.2	25.03	438.4	4.01	0.8	214	37	17
LSD 0.05%	0.21	89.3	0.43	56.2	0.12	0.02	13	3	2

Rec.: recommended microbein: bio-fertilizer FYM: farmyard manure

B- Effect of NPK, organic and bio-fertilizers on

groundnut seed chem. contents: Data presented in Table 3 show significant differences between fertilization treatments for all seed content studied characters, The highest seed contents of oil %, protein %, N%, Mn (ppm) recorded by treatment of 75 % recommended NPK chemical fertilizers + 25% FYM + microbein. The highest protein yield (kg/fed), also, the maximum P %, Fe and Zn (ppm) in seeds were obtained by using 25% chem. + 75% org. + Bio.(microbein) treatment, These results were in accordance with those obtained by ^(1,9,10).

Conclusion: Recently the use of bio-organic fertilizers in agriculture has received considerable attention because of the environmental problems associated with alternative disposal methods and the harmful affect on human health. On the other hand, bio-organic fertilizers improves the physical properties of the soil, increasing water holding capacity, preventing nutrient leaching and adding more mineral nutrients to the poor sandy soil. The combined effect of 25% recommended chemical fertilizer NPK + 75% recommended dose of organic fertilizer + biofertilizer (microbein) gave the best results due to the long-term effects of organic fertilizer including reduced leaching losses and enhanced nutrients uptake, inhancing effects of microorganisms (biofertilizer) on growth of groundnut plants as well as quick positive effect of NPK at first period of plant life. Therefore combining NPK at 1/4 recommended dose with bio-organic fertilizers at 3/4 recommended dose could be effective in groundnut production under these (Egyptian) poor sandy soil.

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