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Growth, Yield Components and Proximate Composition of Peanut (*Arachis hypogaea* L.) As Influenced by Organic and Bio-Fertilizers

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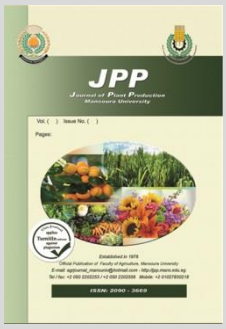

ABSTRACT

In this study, field trials were conducted to evaluate the effect of organic fertilizer (farmyard manure) and bio-fertilizers (mixture of two *bacteria Rhizobium meliloti* with *Rhizobium* spp.),on growth, yield and yield components, and some proximate composition of peanut (*Arachis hypogaea* L.). Seeds from two different varieties (Shamy-1 and Giza-6) were under investigation. After 40 days of germination, different plant growth parameters were tested based on normal seedlings, including plant height, no. of branch, root fresh weight, shoot fresh weight, no. of root nodules, and weight of root nodules. The results obtained indicated that all growth parameters of both varieties increased significantly compared with control treatment, and there were significant differences between fertilizers treatments, as treating seedlings with bio-fertilizer surpassed significantly in compare with treating them with organic fertilizer for all growth parameters.The results obtained in this study also indicated that yield and its components were affected significantly by adding organic fertilizer which surpassed significantly over the adding of bio-fertilizer.Regarded to the effect of organic fertilizer on peanut chemical composition, the data showed that all chemical characters except ash content were increased compared with control treatment without treating with any fertilizer. Many oilseed plants are cultivated with poor input resources, this will have greater impact on productivity. With using the biological and organic fertilizers, a low input system can be carried out and it also helps achieving sustainability of agricultural farms.

***Keywords**:* peanut, organic, fertilizer, biofertilizer; growth, yield and yield components.

INTRODUCTION

The groundnut or peanut (*Arachis hypogaea* L.) is an annual oil seed and one of the natural most nutritious seeds that belong to the Fabaceae family. It's also one of the world's most popular and universal legume crops, cultivated in nearly 100 countries in the world (Kiran *et al*., 2006; Nwokolo and Smartt., 1996).

Commercially it is used mainly for oil production but apart from oil, the by-products of peanuts contain many other functional compounds like proteins, fibers, polyphenols, antioxidants, vitamins and minerals which can be added as a functional ingredient into many processed foods (Arya *et al*., 2016).

Application of fertilizers could improve groundnut output per unit area. In usual agriculture, most of the farmers apply inadequate and imbalanced mineral nutrients which may cause for low groundnut productivity, especially on sandy soil. Therefore, proper nutrient management is a crucial way to obtain optimal yield with good quality in vegetable oil seed crops (Toungos *et al.*, 2018). Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long-term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals (Mishra *et al*., 2013).

Bio-fertilizers that are being an essential component of organic farming, are the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizers or cellulolytic micro-organisms used for application to seed. Soil or composting areas with the objective of increasing numbers of such micro-organisms and accelerate those microbial processes which augment the availability of nutrients that can be easily assimilated by plants (Subhash *et al*., 2016). Biofertilizers play an important role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilizing insoluble soil phosphates and producing plant growth substances in the soil (Sneha *et al*.,2018).

For sustained groundnut production, the modern farming demand integrates use of organic and inorganic fertilizers along with bio-fertilizers. Hence, an investigation was carried out to find out the suitable low-cost input organic and bio-fertilizer to enhance the groundnut productivity. The objective of the research is to study the effect of organic and bio- fertilizer on yield,

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yield components, protein and proximate composition of two peanut cultivars.

MATERIALS AND METHODS

Plant materials and field experiments:

The plant material composed of two varieties of Peanut, including Shamy-1 (V1) and Giza-6 (V2), obtained from Sulaymaniyah agricultural research center. The field experiment was laid out in a 2×2 factorial randomized complete block design (RCBD) with three treatments and each treatment was replicated three times. A net plot size was 0.4×5.5 m^2 and 1 m apart between plots and replicates. The crops were planted during first week of May 2018 by hand, plant to plant distance was 45 cm. All agronomic practices were kept uniform among treatments applied. The amount of water was applied by irrigation as needed to keep plants from showing water deficit stress. Weeding was done by hand hoeing and/ or hand pulling when weeds were tender.

Treatments used in this study:

T1= no fertilization (C), T2= Organic Fertilizer, it is a Farm yard manure (A), three kg per plot for each times, as farmyard manure added two times during growing stages, the first time was after seed germination, and the second time was before flowering. T3= bio-fertilizers (mixture of two bacteria *Rhizobium meliloti* with *Rhizobium* spp.) (B), inoculation with bacteria was done for seeds before sowing.

Soil analysis:

Before cultivation, four samples of soil were randomly taken from the location of experimental from soil land surface (0-40 cm depth) to determinate the physical and chemical properties according to the method of Page *et al.* (1982). The field soil type was loam (472 $g.kg^{-1}$sand, 304.2 $g.kg^{-1}$ silt, 222.9 $g.kg^{-1}$ clay) and it has 7.6 pH, 1.13 $g.kg^{-1}$ total nitrogen, 5.01 $mg.kg^{-1}$ available phosphate, 0.41 mmol L^{-1} potassium, 1.64 mmol L^{-1} calcium.

Quantitative morphological traits:

After 40 days of seed germination the following seedling growth parameters was measured: plant height (cm), number of branches, root biomass and shoot biomass (g), number of root nodules, weight of root nodules (g). After seven months of planting date and maturation stage, six plants from each plot experimental were selected randomly to determine the following traits: total fresh weight (g), pods weight per plant (g), number of seeds per plant, seeds weight per plant (g), total dry weight (Biological Yield) (g), Harvest index (HI).

Phytochemical and Proximate composition analysis:

Two gram of the harvested seeds of each treatment were powdered by electric blender and used for determining the total oil content (TOC) Hedge and Hofreiter (1962). Seed ash content (TAC) was estimated by 1g samples, were dry-ashed in amuffle furnace on the 550 °C for 6 hours until a white residue of constant weight was obtained. While total protein content was measured by Bradford method.

The amount of phenolic (TPC) and flavonoid (TFC) compounds in samples was determined by adding 0.10g of powdered seeds to one mL of distilled water and the mixture was shaken for 2 h at 20±1ºC and incubated overnight for 16h at 4º C. The amount of phenolic and flavonoid in samples were displayed in the equivalent of mg gallic acid/g dry matter (DM), the equivalent of mg quercetin/g dry matter (DM) respectively (Tahir *et al*.2019).

Statistical analysis:

The data collected and analyzed statistically by analyzing variance technique. Treatment means were compared using Duncan test at 5 % level of probability (Steel *et al*., 1997). To assess the relationship of seed yield with other parameters, regression analyses were performed on XLSTAT software.

RESULTS AND DISCUSSIONS

Impact of Organic and Bio-Fertilizers on growth parameters:

The results in Table (1) demonstrated that, there were similarities between the two varieties under study in most of the seedling growth parameters, except Giza-6 variety (V2) that surpassed Shamy-1(V1) in height of plant (64 cm), weight of root nodules (0.380 g), and the Shamy-1 variety showed the higher shoot fresh weight (665.4 g) under control treatment (C). This is may be due to the genotypic behavior of the two varieties and their combination with the environmental conditions.

Table 1. Effect of organic and bio-fertilizer on seedling growth parameters after 40 days of germination:

Treatment	Height of plant (cm)	No. of branch	Root fresh weight (g)	Shoot fresh weight (g)	No. of root nodules	weight of root nodules (g)
V1 * C	51.000 c	14.000 b	172.000 e	665.400 d	14.000 b	0.147 c
V2 * C	60.000 b	16.000 b	167.166 e	551.633 e	17.333 b	0.380 bc
V1 * A	73.000 a	21.000 a	272.267 c	971.133 c	25.667 b	0.500 bc
V2 * A	65.000 b	17.000 b	211.667 d	1079.000 b	18.667 b	0.340 bc
V1 * B	74.167 a	17.000 b	307.333 b	1261.667 a	30.000 ab	0.567 b
V2 * B	70.200 a	16.333 b	371.333 a	1233.333 a	66.667 a	1.543 a

"Each value represents the average of three replicates. Different letters within a column indicate significant variation in treatments according to the Duncan test."

Regarding the effect of treating the seedlings after 40 days of germination with both organic fertilizer (A), which is farm yard manure (3 kg/plot), and bio-fertilizer (B), consists of a mixture of two different bacteria species (*Rhizobium meliloti* with *Rhizobium* spp.), the data showed that all growth parameters of both varieties increased significantly compared with control treatment. Also, it is clear from data that there were significant differences between fertilizers treatments which showed that treating the seedlings with bio-fertilizer surpassed significantly in comparing with treating with organic fertilizer for all growth

parameters. The same results were obtained by Abdel-Hafez and Abo El-Soud (2007; Rizk *et al.* 2012; and Zaki *et al.* 2017).

Impact of Organic and Bio-Fertilizers on Yield and yield components:

Table (2) showed both varieties were different in yield and yield components under control conditions, the Shamy-1 variety surpassed Giza-6 in no. seed/plant, seed weight/ plant (g) and harvest index, while Giza-6 surpassed Shamy-1 in total fresh weight (g), pod weight/ plant (g), and biological yield (g). Treating both variety with organic and bio-fertilizers caused to increase in yield and yield components. Data showed that yield and its components were affected significantly by adding organic fertilizer which also surpassed significantly over the adding of bio-fertilizer. Adding organic fertilizer which causes increasing of yield and yield components may be due to the effects of nutrients rich in organic carbon for the microbial biomass which converts unavailable nutrients in plant residues to one's available and organic fertilizer cause increasing and enhancing of biodiversity of soil microbial populations. These results are in agreements with results obtained by Siam *et al.* (2013; El-Quesni *et al*., 2010; Hanan *et al*., 2015; and Zaki *et al*., 2017).

Table 2. Effect of organic and bio-fertilizer on yield and yield components

	Total fresh weight (g)	Pod weight / plant (g)	No. Seed /Plant	Seed weight /plant (g)	Total Dry weight (Biological Yield) (g)	Harvest index (HI)
V1 * C	983.500 b	180.697 b	129.167 c	91.180 b	312.818 c	0.306 a
V2 * C	1190.833 a	186.512 b	95.333 c	86.988 b	362.583 bc	0.237 a
V1 * A	1706.667 a	385.292 ab	313.667 a	183.968 a	571.303 a	0.338 a
V2 * A	1750.500 a	425.558 a	213.500 b	184.240 a	525.732 ab	0.352 a
V1 * B	1554.333 a	347.442 ab	235.000 b	150.388 ab	492.167 abc	0.309 a
V2 * B	1173.833 a	212.543 b	115.833 c	102.188 b	361.312 bc	0.287 a

"Each value represents the average of three replicates. Different letters within a column indicate significant variation in treatments according to the Duncan test."

Adding bio-fertilizer significantly increased yield and all its components of the Shamy-1 variety in comparison with control (without adding fertilizers) conditions. Data also showed that pod weight/plant (g), no. seed/plant, seed weight/ plant (g), and harvest index were affected significantly by adding bio-fertilizer compared with control for Giza-6 variety, and there were no significant differences in biological yields, and decreasing in total fresh weight (g). In addition, data showed the Shamy-1 variety responded more significantly to bio-fertilizer than Giza-6 variety in all yield and yield components.

Phytochemical and Proximate composition analysis as influenced by Organic and Bio-Fertilizers:

Data in Table (3) indicated that Giza-6 surpassed significantly Shamy-1 in total oil content (TOC %), total ash content (TAC g), amount of phenolic and protein content, while Shamy-1 gave the highest value significantly in amount of flavonoids. With regarded to the effect of organic fertilizer on peanut chemical composition, the data showed that all chemical characters except ash content were significantly increased compared with control. In contrast, treating the seedlings with bio-fertilizer leaded to an increase in TOC (%). In addition, flavonoid contents significantly surpassed in treating with organic fertilizer for both varieties, and significant increases of flavonoid in Giza-6 variety by treating with bio-fertilize (Zaki *et al*. 2012).

Table 3. Effects of organic and bio-fertilizer on total oil content, ash, protein and some of phytochemical in the two peanut verities

	TOC %	TAC (µg g-1 DM)	TFC (µg g-1 DM)	TPC (µg g-1 DM)	Protein (µg g-1 DM)
V1 * C	29.783 b	0.029 a	0.036 c	0.196 e	0.028 c
V2 * C	30.283 ab	0.030 a	0.018 c	0.292 c	0.023 d
V1 * A	30.750 ab	0.027 ab	0.206 a	0.218 d	0.105 a
V2 * A	32.683 a	0.028 ab	0.095 b	0.495 a	0.071 b
V1 * B	30.780 ab	0.029 a	0.081 b	0.198 e	0.020 d
V2 * B	32.817 a	0.026 b	0.090 b	0.375 b	0.021 d

"Each value represents the average of three replicates. Different letters within a column indicate significant variation in treatments according to the Duncan test."

CONCLUSION

The organic and bio-fertilizer have a positive effect on the plant growth traits, yield and yield components of the two varieties, and the bio-fertilizers have the maximum impact on all studied growth characters followed by organic fertilizer. However, the yield and yield components recorded the maximum impact by organic fertilizers followed by bio-fertilizer.

REFERENCES

Abd El-Hafez, G.A., and A.A. Abo El-Soud, 2007. Response of two soybean cultivars to different levels of organic fertilizer (compost). J. Agric. Sci. Mansoura Univ. 32, 8575-8588.

Arya, S. S., Salve, A. R. and Chauhan, S., 2016. Peanuts as functional food: a review. Journal of food science and technology, *53*(1), 31-41.

El-Quesni, F.E.M., Sahar M., Zaghloul and Siam S. Hanan, 2010. Effect of microbien and compost on growth and chemical composition of Schefflera arboricola L. under salt stress. J. of American Sci., 6:(10),1073-1080.

Hanan S. Siam, Safaa A. Mahmoud, A. S.Taalab and Khaled A. Shaban, 2015. Evaluation of Nitrogen Levels and Application Methods with or without compost on Yield and Quality of Peanut under the Newly Reclaimed Soils. Inter. J. of ChemTech Res., 8 (2),1-12.

Hedge, I. E. and Hofreiter, B.T., 1962. Carboydrate Chemistry i7 (Eds Whistler R. L. and Be Miller, J. N.) Academic Press New York.

Hedge, J. E and Hofreiter, B. T. 1962. Carbohydrate chemistry (Editors: Whistler, R.L. and Be Miller, J.N.). Academic Press, New York.

Kiran K Sharma and Pooja Bhatngar-Mathur, 2006. Peanut (*Arachis hypogaea* L.). Methods in Molecular Biology 343, 44-44.

Mishra, D., Rajvir, S., Mishra, U. and Kumar, S.S., 2013. Role of bio-fertilizer in organic agriculture: a review. Research Journal of Recent Sciences Vol. 2(ISC-2012), 39-41.

Nwokolo, E. and J. Smartt 1996. Legumes and Oil seeds, Springer. pp 49-63.

Page, A. L., Miller, R. H. and Keeney, D. R. (eds.) 1982. Methods of Soil analysis, Part 2: chemical and microbiological properties, American Society of Agronomy, Madison, WI.

Rizk, T.Y., E.M.Soliman, F.E.EL-Araby and Hala A.M. EL-Sayed, 2012. Growth response of peanut (*Arachis hypogaea* L.) to inoculation with Bradyrhizobium conjugated with Rhizobacteria under different levels of organic fertilization on sandy soil. Egypt. J. Agron., 34(2), 179-200.

Siam S., Hanan, S.M.El-Ashry and M.R.Abdel-Moez, 2013. Productivity and Nutrients Uptake of Lettuce and Sorghum Grown on Sandy Soil as affected by Some Organic Wastes with Mineral Fertilizers. J. of Applied Sci. Res., 9(7), 4151-4159.

Sneha S., Anitha B., Anjum Sahair R, Raghu Nataraj, Gopenath T.S,Chandrashekrappa GK, Kanthesh M Basalingappa 2018. Biofertilizer for crop production and soil fertility. Academia Journal of Agricultural Research 6(8), 299-306.

Steel, R.G., J.H. Torrie and D.A. Dickey. 1997. Principles and Procedures of Statistics. A Biometrical Approach 3rd Edition. McGraw Hill book Co. Inc. New York, U.S.A.

Subhash R., S. Triveni, K. Damodara chari, 2016. Biofertilizers for Sustainable Production in Oil Seed CropsScholars. Journal of Agriculture and Veterinary Sciences. 3(6),435-44.

Tahir, N.A., Ahmed, J.O., Azeez, H.A., Palani, W.R.M. and Omer, D.A., 2019. Phytochemical, antibacterial, antioxidant and phytotoxicity screening of the extracts collected from the fruit and root of wild mt. Atlas mastic tree (*Pistacia atlantica* subsp. *Kurdica*). Applied ecology and environmental research, *17*(2), 4417-4429.

Toungos Mohammed Dahiru, Hassans Tanko 2018. The Prospects of Organic Agriculture and Yield Improvement in the 21st Century. International Journal of Innovative Agriculture & Biology Research. 6(3),40-48.

Zaki, N.M., Hassanein, A.G.A.M. and Mohamed, M.H., 2017. Effect of organic and bio-fertilizer on yield and some chemical composition of two peanut cultivars under newly reclaimed sandy soil condition. Sciences, *7*(04), 937-943.

Zaki, N.M., M.A.Gomaa, F.I.Radwan, M.S.Hassanein and A.M.Wali, 2012. Effect of mineral, organic and bio-Fertilizers on yield, yield components and chemical composition of some wheat cultivars. J. of Applied Sci. Res., 8(1), 174-191.

تأثر الأسمدة العضوية والحيوية علي النمو ومكونات المحصول والتركيب التقريبي للفول السوداني(*Arachis hypogaea* L)

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أجريت في هذه الدراسة تجارب ميدانية لتقييم تأثير السماد العضوي (سماد المزارع) والأسمدة الحيوية (خليط من بكتريا *Rhizobium melilot* مع *Rhizobium spp.*) ، على مكونات النمو والمحصول وبعض المكونات التقريبية للفول السوداني (*Arachis hypogaea* L). تم دراسة بذور صنفين مختلفين (شامى-1 وجيزة-6). بعد الأربعين يومًا من الإنبات ، تم اختبار معايير نمو النبات المختلفة بناءً على الشتلات الطبيعية ، بما في ذلك ارتفاع النبات ،وعدد الفروع ، الوزن الطازج الجذر ، والوزن الطازج للمجموع الجضري ، وعدد عقد الجذرية ، ووزن عقيد الجذر. أشارت النتائج المتحصل عليها إلى أن جميع معاملات النمو لكلا الصنفين قد زادت معنويا مقارنة بمعاملة المقارنة ، وكانت هناك فروق معنوية بين معاملات الأسمدة ، حيث تجاوزت معاملة الشتلات بالأسمدة الحيوية معنويا بالمقارنة مع معاملتها بالأسمدة العضوية لجميع معاملات النمو. كما أشارت النتائج المتحصل عليها في هذه الدراسة إلى تأثر المحصول ومكوناته معنويا بإضافة السماد العضوي الذي فاق معنويا إضافة السماد الحيوي. فيما يتعلق بتأثير السماد العضوي على التركيب الكيميائي للفول السوداني ، أوضحت البيانات أن جميع الصفات الكيميائية ماعدا محتوى الرماد قد زادت مقارنة بمعاملة المقارنة دون المعالجة بأي سماد. تتم زراعة العديد من نباتات البذور الزيتية بمدخلات فقيرة ، وسيكون لذلك تأثير أكبر على الإنتاجية. باستخدام الأسمدة البيولوجية والعضوية ، يمكن تنفيذ نظام مدخلات منخفضة كما يساعد في تحقيق استدامة المزارع الزراعية.