Effect of Biofertilization in Increasing the Efficiency of Two Peanut Varieties in Utilizing of Phosphorus Fertilization: 1- Effect on Growth

Abdel-Haliem, S. M.*; M. H. Abdel-Motaleb*; G. M. Yakout*; A. M. Abdel-Wahab* and A. A. Nasef**

*Agronomy Department, Faculty of Agriculture, Suez Canal University

**Oil Crop Section, Agricultural Research Center, Ismailia, Egypt

Received: *24/10/2015*

Abstract: Two field experiments were conducted during 2012 and 2013 seasons in the Experimental Farm of Agriculture Research Station, Agric. Res. Centre at Ismailia, Egypt to study the effect of four levels of phosphatic fertilizer i.e. 0, 15.5, 23.25 and 31.0 kg P_2O_5/fad (faddan = 4200 m^2) combined or separate with applying the biofertilizers phosphorine or microbin on different growth characters and leaf chlorophyll content of two Peanut varieties Giza-6 as erect cv and Gereogry as spread cv. Giza-6 surpassed significantly Gereogry in leaf area/plant, LAI, dry weight of leaves and dry weight of stem and branches, while Gereogry surpassed significantly Giza-6 in plant height, leaf chlorophyll content, number and dry weight of pods/plant and total dry weight of plant. That was held true at different stages of growth i.e. 70, 85 and 100 days from sowing. Increasing phosphorus fertilizer up to the highest level 31.0 kg P_2O_5/fad with and without biofertilizers phosphorine or microbin increased significantly all the aforementioned growth traits at different stages of growth. It is worthy to note that biofertilizers phosphorine or microbin increased the efficiency of peanut plants in utilizing phosphatic fertilizers, which in turn had favorable effect on peanut growth, consequently increased the different growth characteristics at different growth stages and the two biofertilizers almost did not differ significantly in this respect.

Keywords*:* Biofertilization, phosphorein, microbein, growth, peanut.

INTRODUCTION

Peanut is the main summer oil crop in Egypt and acreages 134146 fads. 70% of these areas are new reclaimed soils, mainly sandy soils. So, intensive research work should be carried out on the crop under new reclaimed sandy soil conditions to obtain strong peanut plants in their growth and to increase dry matter accumulation in the vegetative organ. Vegetative organ is the source of photosynthesizes formation which translocation to the sink (seeds), consequently increase peanut crop productivity. In this respect high yielding varieties and fertilization (mineral, especially, phosphorus fertilization and biofertilization) are with great importance. The growth of peanut plants as well as other legumes was found to be affected by phosphorus nutrition (Abdel-Wahab *et al.*, 1999 and Hafiz, 2007).

Phosphorus is constituent of nucleic acids (DNA and RNA) and high energy storage compounds, stimulates cell division and metabolic processes such as photosynthesis and synthesis of protein, carbohydrates and lipids (Marschner, 1986). Also, phosphorus enhances root growth (Russel, 1973), nodulation and N fixation (Albert, 1978). The phosphorus content in the sandy soils is low, in addition Egyptian soils pH is high. Under such conditions most of the phosphorus content is converted to unavailable form, mainly as tricalcium phosphate. In such case, application of phosphate dissolving bacteria could increase the available phosphorus for plant and increased the efficiency of peanut plants in utilizing phosphatic fertilizer. Many investigators reported that the aforementioned cultural practices *i.e.* high yielding varieties as well as phosphorus and biofertilization increased growth and growth characteristics of peanut (Madny, 1998; Migawer and Soliman, 2001; Yasein, 2005; Mohamed, 2010 concerning peanut varieties and Kabesh *et al.*, 1987; Bahr, 1997; Detroja *et al.*, 1997; Abdel-Wahab *et al.*, 1999; El-Dsouky and Attia, 1999; Borse *et al.*, 2002; More *et al.*, 2002; El-Habbasha *et al.*, 2005 and Mirvat *et al.*, 2006, concerning phosphorus and biofertilization).

So, the objective of this study was to investigate the response of growth and different growth characters of two peanut varieties to phosphorus and biofertilization in new reclaimed sandy soils.

MATERIALS AND METHODS

Two field experiments were conducted during 2012 and 2013 seasons in the Experimental Farm of the Agricultural Research Station, Agric. Res. Center at Ismailia, Egypt to study the effect of phosphatic and biofertilization on different growth characteristics and leaf chlorophyll content of two peanut varieties Giza-6 as erect cv and Gereogry as spread cv. Chemical analysis and physical properties of the experimental sites are stated in Table (1). These analyses were carried out using standard methods described by Piper (1950) and Jackson (1967).

Each experiment consisted of 24 treatments which were the combination of two peanut varieties (Giza-6 and Gereogry) and four levels of phosphatic fertilization (0, 100, 150, 200 kg/fad (faddan= 4200 m^2) in form of calcium superphosphate (15.5% P_2O_5), *i.e.* 0, 15.5, 23.25 and 31 kg P_2O_5/fad, combined or not combined with applying biofertilizers phosphorine (contains *Bacillus megatherium*) or microbin (contains *Azotobacter* spp., *Azospirillum* spp., *Pseudomonas* spp., *Bacillus megatherium* and *Rhizobium* spp.). The factorial experiment in split plot design with three replications was made in use, where peanut cvs were allocated in the main plots and P_2O_5 levels with and without phosphorine or microbine in the sub plots. Each experimental sub plot consisted of 6 ridges 4 m in length and 60 cm in width (4*3.6 = 14.4 m^2).

Table (1): Some physical and chemical properties of the experimental soil in the two seasons of investigation (2012 and 2013).

Properties	First season 2012	Second season 2013
Physical analysis:		
Coarse sand (%)	74.60	72.50
Fine sand (%)	18.50	18.65
Silt (%)	2.45	3.50
Clay (%)	4.45	5.35
Texture grade	Sandy	Sandy
Chemical properties:		
pH	7.86	7.90
EC dsm^{-1}	0.125	0.13
OM %	0.42	0.53
$CaCO_3$ %	1.95	2.13
Soluble cations meq/100 g soil		
Ca^{2+}	0.20	0.40
Mg^{2+}	0.10	0.30
Na^{+}	0.22	0.58
K^{+}	0.10	0.13
Soluble anions meq/100 g soil		
CO_3^{2-}	-	-
HCO_3^{-}	0.25	0.63
Cl-	0.22	0.68
SO_4^{2-}	0.15	0.30
Available NPK (ppm)		
N	18.21	21.32
P	4.85	5.78
K	63.45	73.20

Phosphatic fertilizer at the mentioned rates as well as a basal dose of 15kg N/fad and 24 kg K_2O/fad for all experiments were applied to the soil during preparing the land. All seeds of peanutcvsGiza-6 and Gereogry were coated by arab gum and inoculated with the specific Rhizobium strain. Then the seeds were sown by hand on one side of the ridge in hills 10 cm apart for Giza-6 and 20 cm apart for Gereogry on 20th May in the first season 2012 and on 25th May in the second season 2013 and the preceding crop was Egyptian clover in the two growing seasons. The biofertilizers (phosphorine or microbin) was mixed with moisten sand and drilled beside seedlings after 5 days from sowing. After 20 days from sowing peanut plants were thinned to one plant per hill, then the other cultural practices of growing peanut at Ismailia Governorate were followed as normal.

At 70, 85 and 100 days from sowing five guarded plants were taken randomly from the inner ridges in each sub plot for measuring different vegetative growth characters, namely plant height, leaf area/plant, leaf area index (LAI), leaf chlorophyll content, number of pods/plant, dry weight of leaves, stem and branches, pods/plant and total dry weight/plant.

Statistical analysis of the data obtained from each trail was subjected to the analysis of variance of split plot design as described by Snedecor and Cochran (1967). Combined analysis of variance for the two seasons was taken, using the appropriate analysis of variance according to Leclery *et al.* (1966). Treatments means were compared using the least significant difference (LSD) test developed by Waller and Duncan (1969) at 0.5 % level. Generally, the interaction between the two studied factors (cvs and P with and without biofertilizations) on the growth characters in different growth stages did not reach the 0.5% level of significance; consequently the data for these interactions were excluded.

RESULTS AND DISCUSSION

Tables (2, 3, 4 and 5) show the effect of phosphorus fertilization with and without bio fertilizers phosphorine or microbine on vegetative growth characteristics of two peanut varieties.

It is clearly evident from the data presented in Table (2) that over phosphorus and bio fertilization, Gereogry cv surpassed significantly Giza 6 in plant height, leaf chlorophyll content, number and dry weight of pods/plant and total dry weight of plant. While, Giza-6 surpassed significantly Gereogry in leaf area/plant, LAI, dry weight of leaves and dry weight of stem and branches. That held true at different stages of growth i.e. 70, 85, and 100 days from sowing. Some investigators found varietal differences between the two studied cvs Giza-6 and Gereogry in different vegetative growth characters (Yasein, 2005 and Mohamed, 2010).

Also, over varieties, the data illustrated in Tables (3, 4, and 5) show that increasing phosphorus levels from 0 to the highest level 31 kg P_2O_5/fad increased significantly almost the forementioned vegetative growth characteristics of peanut. The favourable effect of increasing phosphorus levels on the above mentioned traits was more pronounced when the bio fertilization phosphorine or microbin was applied and the two bio fertilizers did not differ significantly in this respect. This might be attributed to that fertilization with any of the two bio fertilizers converted the unavailable phosphorus as tricalcium phosphate to the available phosphorus. That led to enhance the efficiency of peanut plants in utilizing phosphorus fertilizer, which in turn had favourable effects on peanut growth. These results concerning the mentioned beneficial effect of P fertilizer with or without bio fertilization on peanut growth are in harmony with those obtained by several investigators (Kabesh *et al*., 1987; Bahr, 1997; Detroja *et al*., 1997; Abdel-Wahab *et al*., 1999; El-Dsouky and Attia, 1999; Borse *et al*., 2002; More *et al*., 2002; El-Habbasha *et al*., 2005 and Mirvat *et al*., 2006).

The interaction between peanut varieties and phosphorus fertilizers with or without any of the two studied bio fertilizers phosphorine and microbin did not exert significant effect on different vegetative characteristics of peanut as well as leaf chlorophyll content, which means that each factor act independently. Therefore the data of the interaction were excluded.

Table (2): Effect of varieties on some growth characters of peanut plants at 70, 85 and 100 days after sowing combined averages of the two growing seasons 2012 and 2013.

Growth stage	70 day	85 day	100 day	70 day	85 day	100 day	70 day	85 day	100 day
Characters varieties	Plant height (cm)			Leaf area/plant (cm^2)			Leaf area index (LAI)		
Giza-6	40.2 b	48.3b	53.8b	2531.6 a	2983.7 a	3458.8 a	4.22 a	4.97 a	5.76 a
Gereogry	44.1 a	53.3a	58.3a	2338.2 b	2635.9 b	3189.8 b	1.95 b	2.19 b	2.66 b
LSD at 5%	1.2	1.2	0.9	24.8	24.7	22.2	0.04	0.03	0.03
Characters varieties	Leaf chlorophyll content			Number of pods/plant			Dry leaves/plant (gm)		
Giza-6	45.29 b	45.30 a	47.26 b	22.8 b	33.9 a	41.4 b	34.6 a	47.3 a	57.5 a
Gereogry	46.88 a	46.07 a	49.28 a	34.4 a	47.3 a	63.9 a	30.9 b	44.9 b	53.7 b
LSD at 5%	1.38	ns	0.59	0.6	1.2	1.1	0.7	1.3	1.4
Characters varieties	Dry weight of stem and branches per plant (gm)			Dry weight of pods/plant (gm)			Total dry weight /plant (gm)		
Giza-6	28.9a	41.3a	50.2a	19.2 b	41.2	41.2 b	82.6 a	121.1 b	148.9 b
Gereogry	26.3b	39.9b	47.3b	26.9 a	43.6	55.5 a	84.3 a	126.9 a	156.5 a
LSD at 5%	0.8	0.9	0.8	1.1	1.2	1.2	ns	1.7	1.6

Table (3): Effect of phosphorus fertilization levels and biofertilization with phosphorein or microbein on some growth characters of peanut plants at 70, 85 and 100 days after sowing, combined averages of the two growing seasons 2012 and 2013.

Characters Fertilization		Plant height (cm)			Leaf area/plant (cm^2)			Leaf area index/plant		
		70 day	85 day	100 day	70 day	85 day	100 day	70 day	85 day	100 day
P_2O_5 kg/fad without biofertilizer	0	34.2	39.1	46.5	2082.6	2506.9	2903.3	2.62	3.18	3.67
	15.5	37.9	46.7	50.3	2170.4	2583.2	3074.3	2.75	3.29	3.90
	23.25	41.3	50.2	53.7	2395.4	2774.0	3273.1	3.04	3.54	4.15
	31.0	43.7	51.6	56.9	2533.2	2861.5	3360.7	3.22	3.67	4.25
P_2O_5 kg/fad with phosphoreine	0	38.4	44.9	50.5	2336.8	2745.7	3269.8	2.92	3.46	4.13
	15.5	41.3	50.7	56.9	2384.4	2787.3	3369.4	3.01	3.54	4.28
	23.25	45.4	56.1	59.9	2592.3	2936.4	3495.2	3.27	3.74	4.43
	31.0	47.5	56.4	62.3	2835.6	3165.6	3591.4	3.62	4.08	4.54
P_2O_5 kg/fad with microbien	0	39.2	46.6	52.4	2256.1	2650.0	3258.9	2.85	3.36	4.14
	15.5	43.9	53.1	58.3	2323.2	2720.9	3317.9	2.94	3.47	4.20
	23.25	44.5	56.2	62.3	2549.8	2893.9	3465.1	3.23	3.70	4.39
	31.0	48.7	58.2	62.3	2758.9	3091.7	3512.3	3.53	3.99	4.46
LSD at 5 %		1.9	2.4	2.9	79.5	71.2	55.3	0.10	0.09	0.08

Table (4): Effect of phosphorus fertilization levels and biofertilization with phosphorein or microbein on some growth characters of peanut plants at 70, 85 and 100 days after sowing, combined averages of the two growing seasons 2012 and 2013.

Characters Fertilization		Leaf chlorophyll content (LCC)			Number of pods/plant			Dry leaves/plant (g)		
		70 day	85 day	100 day	70 day	85 day	100 day	70 day	85 day	100 day
P_2O_5 kg/fad without biofertilizer	0	42.64	43.27	46.18	18.6	30.9	38.3	21.6	33.1	38.6
	15.5	44.43	46.03	47.16	25.5	35.1	48.1	26.8	37.7	49.2
	23.25	46.95	47.73	47.61	28.3	38.2	51.7	33.6	46.6	55.3
	31.0	47.28	47.28	47.57	32.0	42.3	54.6	38.1	50.4	59.3
P_2O_5 kg/fad with phosphoreine	0	44.37	46.58	47.49	23.7	38.4	48.4	26.9	42.2	49.7
	15.5	46.54	47.58	48.86	28.7	40.0	53.5	31.6	43.1	55.7
	23.25	48.28	47.68	49.46	35.4	48.1	63.9	36.9	51.4	63.4
	31.0	48.67	47.25	49.85	36.8	49.7	63.6	41.9	60.7	68.7
P_2O_5 kg/fad with microbien	0	43.38	46.41	47.82	22.6	36.5	44.9	26.8	36.9	47.9
	15.5	44.80	47.29	48.44	28.0	40.3	52.1	31.1	42.0	53.3
	23.25	47.37	47.19	49.04	29.7	42.2	54.5	37.4	51.3	61.5
	31.0	48.37	48.22	49.75	33.8	46.3	58.9	40.8	57.9	64.7
LSD at 5 %		1.60	1.95	2.13	2.3	2.6	3.7	2.6	3.0	3.2

Table (5): Effect of phosphorus fertilization levels and biofertilization with phosphorein or microbein on some growth characters of peanut plants at 70, 85 and 100 days after sowing, combined averages of the two growing seasons 2012 and 2013.

Characters Fertilization		Dry stem and branches/plant (gm)			Dry weight of pods/plant (gm)			Dry weight of /plant (gm)		
		70 day	85 day	100 day	70 day	85 day	100 day	70 day	85 day	100 day
P_2O_5 kg/fad without biofertilizer	0	18.1	28.0	34.2	17.9	32.4	41.8	57.7	92.6	114.6
	15.5	21.0	33.3	42.7	19.3	34.7	44.1	67.1	104.6	135.9
	23.25	26.7	39.8	48.2	21.3	36.4	46.4	81.1	121.8	149.8
	31.0	32.3	46.4	54.7	23.3	38.9	47.9	94.2	134.8	160.9
P_2O_5 kg/fad with phosphoreine	0	21.8	35.2	42.5	22.0	38.4	48.8	70.6	115.3	140.9
	15.5	26.5	38.5	49.5	22.8	38.9	49.0	81.0	120.5	154.1
	23.25	31.4	44.7	56.3	26.6	41.8	52.7	94.9	137.9	172.4
	31.0	37.1	53.8	59.0	28.8	42.7	52.7	107.8	155.4	180.4
P_2O_5 kg/fad with microbien	0	22.6	31.7	41.8	21.0	36.8	46.8	70.4	105.5	136.5
	15.5	27.7	36.2	45.2	22.0	37.3	47.9	80.8	115.5	146.4
	23.25	29.5	45.7	54.6	25.3	41.8	51.2	92.1	138.8	167.3
	31.0	36.5	48.8	57.2	26.3	41.3	50.7	103.6	145.5	172.5
LSD at 5 %		2.0	1.9	2.2	2.7	2.9	3.8	4.4	4.4	5.8

REFERENCES

Abdel-Wahab, A. M., G. M. Yakout, E. A. Ali and M. H. Greish (1999). Response of soybean crop to phosphatic fertilization, organic manuring and bio-fertilization under new reclaimed sandy soil conditions. Egypt. J. Appl. Sci., 14(8): 125-138.

Albert, E. (1978). Pot experiments for determining favourable NPK and PK ratio to be applied to spring wheat and red clover. Acker und Pflanzenbau, 22(4): 241- 251.

Bahr, A. B. (1997). Response of chickpea crop to some fertilization treatments. Ph. D. Thesis, Fac. Agric., Suez Canal Univ, Egypt, 173 p.

Borse, N. S., L. K. Patel, Y. G. Patil, P. K. Rathod and B. M. Kamble (2002). Integrated nutrient management in summer groundnut. Advances in Plant Sci., 21(1):329-331.

Detroja, K. S., D. D. Malavia, B. B. Kaneria, V. D. Khanapraand and R. K. Patel (1997). Effect of phosphatic fertilizer, phosphobacteria and seed size on plant stand, growth and yield of summer groundnut (*Arachis hypogaea*). Indian J. Agron., 42(3): 495-497.

El-Dsouky, M. M. and K. K. Attia (1999). Effect of inoculation with phosphate solubilizing bacteria, organic manuring and phosphate fertilization on peanut grown on sandy calcareous soil. Assiut J. Agri. Sci., 30(5): 177-187.

El-Habbasha, S. F., A. A. Kandil, N. S. Abu-Hagaza, A. K. A. El-Haleem, M. A. Khalafallah and T. G. Behairy (2005). Effect of phosphorus levels and some bio-fertilizers on dry matter, yield and yield attributes of groundnut. Bull. Fac. Agric., Cairo Univ., 56(2): 237-252.

Hafiz, S. I. (2007). Influence of bio and mineral phosphatic fertilization and spraying with micronutrients on peanut crop in newly reclaimed sandy soils. Egypt. J. Appl. Sci., 22(2A): 169-187.

Jackson, M. L. (1976). Soil chemical analysis. Prentic Hall Private ltd., New York, USA., pp. 498.

Kabesh, M.O., M. S. M. Saber and T. G. Behairy. (1987). Utilization of biofertilizers in field crop production. 1- Effect of the increasing rates of phosphatic fertilizer with and without biofertilization on growth and yield of soybean plants in pot experiments. Egypt. J. Agron., 12(1-2): 123-130.

Leclery, E. L., W. H. Leonard and A. G. Clark (1966). Field plot technique. Brugross Publishing Co-Minneopolis, Minnesota, USA.

Madny, A. M. (1998). Growth analysis and yield response of certain peanut cultivars to phosphorus fertilization and micronutrients. M. Sc. Thesis, Fac. Agric., Ain Shams Univ.,129 p.

Marschner, H. (1986). Mineral nutrition of higher plants. Academic Press INC, USA, 674 pp.

Migawer Ekram A. and Mona A. M. Soliman (2001). Performance of two peanut cultivars and their response to NPK fertilization in newly reclaimed loamy sand soil. J. Agric Sci. Mansoura Univ., 26(11): 6653-6667.

Mirvat E. Gobarah, Magda H. Mohamed and M. M. Tawfik (2006). Effect of phosphorus fertilize and foliar spraying with zinc on growth, yield and quality of groundnut under reclaimed sandy soils. J. Appl. Sci. Res., 2(8): 491-496.

Mohamed, M. A. H. (2010). Response of some peanut varieties to potassium and foliar application with boron at the New Valley. Ph. D. Thesis, Fac. Agric., Assiut Univ., Egypt, 131p.

More, K. A., C. B. Gaikwad and D. V. Dahat (2002). Effect of N, P, Rhizobium and phosphate solubilizing bacteria on groundnut. J. Maharashtra Agric. Univ., 27(2): 202-204.

Piper, C. S. (1950). Soil and Plant Analysis. Inter. Science Publishers Inc., New York, USA., pp 368.

Russel, E. W. (1973). Soil conditions and plant growth. Language Book Society and Longman, London pp 30-37.

Snedecoer, G.W. and W.G. Cochran (1967). Statistical methods. 8th ED., Iowa State Univ., Press, Ames, Iowa, U.S.A., pp. 593.

Waller, R. A. and D. B. Duncan (1969). Abays rule for the symmetric multiple comparisons problem. Am. Stat. Assoc. J. Dec., 1485 p.

Yasein, M. A. T. (2005). Some factors affecting yield and seed quality of peanut (*Arachis hypogaea* L.). M. Sc. Thesis, Fac. Agric., Zagazig Univ, 167 p.

تأثير التسميد الحيوي في زيادة كفاءة صنفين من الفول السوداني في الاستفادة من التسميد الفوسفاتي: ١- التأثير على النمو

منال شكرى عبد الحليم مصطفي*، حسن محمد عبد المطلب*، جمال محمد ياقوت*، عبد الفتاح محمد عبد الوهاب*، على ناصف على عبد العال**
* قسم المحاصيل - كليه الزراعة - جامعه قناة السويس
**مركز البحوث الزراعية- محطة البحوث الزراعية بالإسماعيلية

أجريت تجربتان حقليتان خلال موسمي ٢٠١٢، ٢٠١٣ بمزرعة محطة البحوث الزراعية، مركز البحوث الزراعية بالإسماعيلية، وذلك لدراسة تأثير أربعة مستويات مختلفة من التسميد الفوسفاتي (٠، ١٥.٥، ٢٣.٢٥، ٣١ كجم فو٢أ٥/ فدان) في وجود التسميد الحيوي بالفوسفورين أو الميكروبين أو بدونهما علي بعض صفات النمو الخضري ومحتوي الأوراق من الكلوروفيل، وذلك لصنفين من الفول السوداني (جيزة ٦، جريجوري).

أجريت التجربة بنظام القطع المنشقة مرة واحدة في ثلاثة مكررات حيث وضع صنفي الفول السوداني في القطع الرئيسية، بينما وزعت عشوائيا معاملات التسميد الفوسفاتي مع الحيوي في القطع تحت الرئيسية.

عند الأعمار الثلاثة تحت الدراسة (٧٠، ٨٥، ١٠٠ يوم من الزراعة) أظهر جيزة ٦ تفوقا علي جريجوري في المساحة الورقية للنبات، دليل المساحة الورقية، الوزن الجاف للأوراق/ نبات، الوزن الجاف للساق والأفرع/نبات. بينما تفوق صنف جريجوري علي جيزة ٦ في ارتفاع النبات، محتوي الأوراق من الكلوروفيل، عدد القرون ووزنها الجاف /نبات، الوزن الجاف الكلي للنبات.

زيادة معدل التسميد الفوسفاتي حتى٣١ كجم/ فدان في وجود التسميد الحيوي بالفوسفورين أو الميكروبين أدى إلي زيادة معنوية في كل قراءات النمو الخضري تحت الدراسة بالمقارنة بالمعاملات السمادية بدون تسميد حيوي. حيث أن استخدام الأسمدة الحيوية (الفوسفورين أو الميكروبين) زاد من كفاءة نباتات الفول السوداني في الاستفادة من الأسمدة الفوسفاتية المضافة، وبالتالي تحسن في صفات النمو الخضري لنباتات الفول السوداني عند جميع الأعمار تحت الدراسة.