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EFFECT OF MAGNESIUM AND EFFECTIVE MICRO-ORGANISMS APPLICATIONS ON PEANUT GROWN ON SANDY SOIL

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ABSTRACT

A field experiment was carried out to study the impact of three rates of magnesium sulphate ($MgSO_4$) and Effective Microorganisms each alone or both together on seed yield and chemical constituents of peanut (c.v. Giza 6) grown on sandy soils at Ismailia Agric. Res. Station. The treatments were zero, 10 and 20 kg/fed $MgSO_4$, and diluted effective microorganisms (1:100) used as foliar application at the rate of 400L/fed to the soil in two times after 30 and 50 days from cultivation.

Results revealed that all the applied rates of $MgSO_4$ led to significant increases in seed yield, pods yield and foliage yield with priority for 20 Kg/fed $MgSO_4$. Moreover, there was a significant increase in seeds uptake of N, P and K.

Generally, application of effective microorganisms either alone or together with $MgSO_4$ 20 kg/fed showed a progressive increase in seed yield, with a maximum value of 1052.8 Kg/fed. In addition, data cleared significant increases for NPK-uptake in case of effective microorganisms application.

Keywords: Magnesium – Effective microorganisms, peanut and sandy soil.

INTRODUCTION

Peanut seeds (groundnut) considered as a source of high quality vegetable oil and also known as the most important world fourth source of edible oil and third important source of vegetable protein. It makes a significant contribution to the diets of many people in developing countries (Smartt 1994).

Plant growth and nutrient uptake are integral parts of the overall processes that influence final peanut yield. Many factors are affected the productivity of peanut, among them, fertilization by macro-and micronutrients as well as organic fertilizers, which are most prominent.

However, the introduction of high-yielding varieties and the increased use of different fertilizers in crop management especially nitrogen, have led to the removal of many secondary elements such as magnesium which can be added through soil application, or possibly by mid-season foliar application.

Foliar sprays would have the advantage of allowing producers to add Mg, when tissue analyses indicate a pending shortage, and thereby prevent yield losses.

Foliar application of 1% magnesium sulphate increased yield and oil content of sunflower (Kene *et al.,* 1990). However, Sagare *et al.* (1990) mentioned that there was no effect on sunflower yields resulted in 15 or 30 kg Mg/ha application, while it increased its oil contents and N, P and K uptake. While Negm *et al.* (1997) found that foliar application of Mg at the high rate (4%) significantly increased the seed and straw yields of lintil. Darwish *et al.* (1997) found that, $MgSO_4$ application as either foliar spray or soil induced significant increases seed oil yields as well as seed contents of protein, oil, K and P of sunflower. On the other hand, Abd El-Mottalb *et al.* (1998) found that seed yield and yield components of faba bean increased with Mg addition as foliar spray (100ppm Mg) but the increments were not significant. Also, insignificant effects on seed yield and oil content were obtained by Muthuvel and Rajukkannu (1983) due to application of 20-60 kg/ha of Mg and/or S to sunflower grown with NPK in a soil containing 600 ppm available Mg and 15 ppm available S.

Abd El-Rasoul and El-Azouni (2002) found that straw and seed yields and their related characters, significantly increased by magnesium application (100-200 ppm) on flax, and they added that the foliar spray significantly increased seed N, P and K content at the rate of 200 ppm Mg.

Organic and nature farming systems are becoming one of the most agricultural practices of both developing and developed countries. The effective technology microorganisms are extensively in many countries. Li and Sun (1999) mentioned that the application of effective microorganisms enhanced soil micro fauna, which in turns improved soil physical and chemical properties and enhanced its nutrients availability. In addition, the use of effective microorganisms enhanced yields of crops, even over that of chemically fertilized systems. Shimoji and Higa (1999) suggested that the foliar spray of effective microorganisms, enhanced antioxidant properties and function within plant, it also increased the quality of harvested products. Kohoplya and Higa (1999) reported that effective microorganisms promoted plant growth through photosynthetic processes and enhancement of enzyme activities. Salib and Abd El-Rasoul (2003) studied that the application of effective microorganisms either alone or together with $FeSO_4$ or Fe3O4 on peanut showed a progressive increase in seed yield, also, data cleared significant increases for uptake of N, P, K, Fe, Mn and Zn as a result of effective micro-organisms foliar application.

The current work aims to study the effect of different magnesium rates (as $MgSO_4$) and effective microorganisms* whether each applied alone or both together (their interaction) on the seed yield and their elements composition of peanut grown in sandy soils.

MATERIALS AND METHODS

A field experiment was set up on peanut plants (Archis hypogaea, Giza 6) grown on sandy soil at Ismailia Agric. Res. Station during summer season of 2003, under sprinkler irrigation system. Some physical and chemical properties of the investigated soil and water irrigation

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*** is a biological solution produced by Forestation and Environment administration, Ministry of Agric, Egypt, in association with EMRO organization, Japan. It is a liquid produced in vats from cultivation of over 80 varieties of microorganisms. The micro-organisms are drown from a 10 genera belonging to five different families (i.e. photosynthetic bacteria, yeast, lactic acid bacteria, fungi) and include both aerobic and anaerobic species, (Higa,1994).**

(Tables 1 & 2), were determined according to the methods described by Piper (1950), Richards (1954) and Jackson (1973).

The plot area was 9 m^2 (3x3 m), and the experiment was designed in complete randomized block with three replicates. Three rates of magnesium as magnesium sulphate ($MgSO_4$) at zero, (10 and 20 kg/fed.) were dressed to the soil in two times (after 30 and 50 days from cultivation). Effective microorganisms were applied a foliar application two times (after 30 and 50 days from cultivation) by at the rate of 400 L/fed (with ratio 10 ml / L for effective microorganisms solution: water).

The recommended doses of phosphorus and potassium fertilizers added at the rates of 31 kg P_2O_5/fed as super phosphate (15.5% P_2O_5) and 50 kg K_2O as potassium sulphat before cultivation. Nitrogen was added in the form of ammonium sulphate (20.5%N) at the rates of 40 kg N/fed. for peanut in two equal doses (after 30 and 60 days from cultivation).

Straw and seed samples were air-dried ground and digested according to Thomas *et al.* (1967), then subjected to the determination of NPK as described by Van Schouwenburg (1968). Available nutrients in the soil extracted as the following, nitrogen by 2N potassium chloride, P by 0.5M sodium bicarbonate and K by 1N ammonium acetate (Jackson, 1973).

All obtained data were subjected to statistical analysis according to Snedecor and Cochran (1989), where means value were compared using L.S.D at 5% level.

RESULTS AND DISCUSSION

The studied soil characterized by sandy texture, with a dominant fine sand fraction (61.61 %) and (clay+silt) less than 10 %, Tables (1&2). The chemical analysis of soil water extract (1:1) as well as soil pH and EC values showed that this soil is non saline and non alkaline. The irrigation water falls in the (C2S1) class; this water can be used with moderate amount of leaching and selection of plants with moderate salt tolerance (Richareds, 1954).

Table (1): Chemical characteristics of the studied soil (0-30 cm) and water irrigation

Sample	EC dS/m	pH	Soluble ions (meq/l)								SAR
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	
Soil	0.33	7.68	1.61	1.28	1.02	0.18	--	1.53	1.92	0.64	0.85
Water	0.41	7.96	1.24	1.76	1.29	0.14	--	0.52	1.92	1.99	1.06

Table (2): Some physical characteristics of the studied soil (0-30 cm)

Particle size distribution %					O.M %	$CaCO_3$
Coarse sand	Fine sand	Silt	Clay	Texture class		
31.82	61.61	1.22	5.35	Sandy	0.44	1.42

1. **Effect of magnesium and effective microorganisms on yield components:**

a) Seed yield kg/fed:

Results in Table (3) indicated that magnesium application significantly increased the peanut seed yields. Application of 20 Kg/fed MgSO4 was the most effective one, where it raised the seed yield by 21.5 % over the control (zero MgSO4/fed). This might due to that beside Mg function in the chlorophyll molecule; it is required in other physiological processes. One major role of Mg is to act as a co-factor in almost all enzymes activating phosphorylation processes (Mengel and Kirkby, 1987), which consequently help in increasing seed yield.

Table (3): Effect of magnesium and effective microorganisms on yield of peanut and its components

Treatments						
MgSO4	effective micro-organisms	Seed yield Kg/fed	Pods yield Kg/fed	Foliage yield Kg/fed	100 seed weight (g)	Shelling %
0 Kg/fed	+	958.00	1551.65	4796.0	96.29	61.80
	-	645.00	1038.34	4291.0	96.57	61.65
10 Kg/fed	+	1022.31	1691.67	5305.5	98.79	60.50
	-	646.00	1050.00	4350.0	93.65	61.14
20 Kg/fed	+	1052.80	1715.00	5333.0	102.33	61.35
	-	895.00	1166.66	4549.5	90.79	60.55
Effect of effective micro-organisms	+	1011.04 a	1652.72 a	5144.67 a	99.13 a	61.22 a
	-	728.96 b	1084.96 b	4396.83 b	93.67 a	61.11 a
Effect of MgSO4	0	801.56 b	1294.85 b	4543.5 b	96.43 a	61.73 a
	10	834.16 b	1370.83 ab	4827.75 a	96.21 a	60.82 a
	20	974.28 a	1440.83 a	4941.0 a	96.56 a	60.95 a
L.S.D at 0.05						
effective micro-organisms		53.92	41.196	43.30	ns.	ns.
MgSO4		109.96	85.56	190.16	n.s	ns.
effective micro-organisms *MgSO4		64.03	ns.	51.42	ns.	ns.

Regarding the effect of effective microorganisms, results in Table (3) showed that the application effective microorganisms alone significantly increased the seed yield by 38.7 % than the control without effective microorganisms. The highest increment was recorded by effective microorganisms + 20 Kg/fed MgSO4 where it recorded 63.2 % over the control treatment (without Mg or effective micro-organisms), as well as, it caused 17.6 % increase in the seed yield than that obtained by 20 Kg/fed MgSO4 alone. Enhancing seed germination, photosynthetic process and enzyme activities due to microorganisms application may explain the high response of seed yield to effective microorganism's application (Sangakkara and Kanapola, 1999).

b) Pods yield Kg/fed:

Data in Table (3) show the effect of magnesium application zero, 10 and 20 Kg/fed $MgSO_4$, individually or in combination with effective microorganisms, on the pods yield Kg/fed in peanut. Applying 20 kg

$MgSO_4$/fed gave the highest peanut pods yield (1440.83 kg/fed) compared to the other applied levels of $MgSO_4$. In addition, the addition of effective microorganisms in combination with Mg led to a pronounced increase in pods yield as compared to the control treatment or applying Mg solely. Twenty Kg/fed $MgSO_4$ + effective microorganisms treatment gave the highest increase of 65.2 % in pods yield over the control treatment (without Mg or effective microorganisms) and the increase represent 47 % over that resulted from using the same rate of MgSO4 alone. It was concluded that effective microorganisms application enhances the efficiency of Mg towards improving and sustaining the pods yield.

c) Foliage yield Kg/fed:

Results in Table (3) show that a significant increase in peanut foliage (Kg/fed) was observed because of $MgSO_4$ application. The highest value of foliage yield (4941.0 kg/ fed) was attained by applying 20 Kg/fed $MgSO_4$. Theses results may be due to the major role of Mg as co-factor in almost enzymes activating phosphorylation processes and biochemical functions; also, it may attribute to the vital role of magnesium in chlorophyll structure especially in sandy soil (Mengel and Kirkby, 1987).

Regarding effective microorganisms, data in Table (3) indicated that the use of effective microorganisms alone significantly increased the foliage yield and the percent of this increase was 17% more than that of control. The highest increment was gave by the use of the effective microorganisms +20 Kg/fed $MgSO_4$ where it recorded 24.3 % over the control treatment, as well as, it caused 17.2 % increase in the foliage yield more than that obtained by the 20 Kg/fed MgSO4 alone.

Concerning other components parameters as dry weights of 100 seeds (g) and shelling percentages, data show slight increases in all treatments as compared with those of the control without reaching the level of significance.

2. Nutrients uptake as affected by magnesium and effective microorganism's application:

a) NPK uptake by seed:

Data in Table (4) show that seed uptake of N, P and K significantly increased by MgSO4 application. Application of 20 Kg/fed MgSO4 produced the highest values of N, P and K (Table 4). These results may attribute to the important role of Mg, which regulates the uptake of other plant nutrients, especially phosphorus, and is involved in the translocation and metabolism of carbohydrates. It acts as a carrier for phosphorus, particularly into the seed (Mengel and Kirkby, 1987).

Regarding effective microorganisms, data in Table 4 revealed that adding effective microorganisms individually or in combination with magnesium led to progressive increases in the contents of all studied macronutrients in comparison to the control treatment. The increments of N, P and K contents in peanut seeds achieved by effective microorganisms individually were 59.5, 61.60 and 29.40 %, respectively. Applying effective microorganisms combined by different magnesium rates led to excellent results, since it increased all the proportion of nutrient contents in seed in comparison with the same rates without effective microorganisms. In general, it could be conclude that addition of effective microorganisms along with the magnesium improved of its efficiency and enhanced nutrient uptake as well as quantity and quality of peanut seeds.

Table (4): Effect of magnesium and effective microorganisms on NPK-uptake (Kg/fed) in peanut seeds and foliage

Treatments		Macronutrients (Kg/fed) by seed			Macronutrients (Kg/fed) by foliage		
MgSO4	effective micro-organisms	N	P	K	N	P	K
0 Kg/fed	+	52.36	7.47	5.84	183.21	11.99	38.61
	-	27.70	4.71	3.55	127.87	12.04	25.95
10 Kg/fed	+	60.64	9.82	6.44	189.41	11.14	53.57
	-	33.46	4.27	4.30	135.72	7.44	43.95
20 Kg/fed	+	68.57	8.53	7.21	178.64	14.99	21.58
	-	52.67	6.99	7.26	140.13	10.83	45.96
Effect of effective micro-organisms	+	60.52 a	8.60 a	6.51 a	183.75 a	12.71 a	37.92a
	-	37.94 b	5.32 b	5.03 b	134.57b	10.10 b	38.62a
Effect of MgSO4	0	40.03 b	6.08 b	4.69 b	155.54b	12.01 b	32.28b
	10	47.05 b	7.04 a	5.39 b	162.56 a	9.29 c	48.76a
	20	60.62 a	7.76 a	7.23 a	159.39ab	12.91 a	33.77b
L.S.D at 0.05							
Effective micro-organisms		7.34	0.45	0.37	1.50	0.12	n.s
MgSO4		12.71	0.91	0.71	6.33	0.39	2.41
Effective micro-organisms *MgSO4		ns.	0.53	0.44	1.79	0.14	5.38

b) NPK uptake by foliage:

Data in Table (4) show that the foliage-N uptake, significantly increased by MgSO4 application. The use of 10 kg MgSO4 / fed plus effective microorganisms recorded the highest increase of 48.1% in N uptake over the control treatment, as well as it caused 39.6% increase N in the foliage more than that obtained by applying 10 kg MgSO4 / fed alone.

Concerning P content, Applying 20 MgSO4 kg / fed plus effective microorganisms achieved 24.5% increase over the control treatment. This increase represents 38.4% over that given by using same rate of MgSO4 individually.

Regarding effective microorganisms, data revealed that adding effective microorganisms individually or in combination with magnesium, lead to progressive N and P contents increases in peanut foliage compared to the control treatment. In addition, these increments of both N and P were 36.5 and 25.8%, respectively. On the other respect, potassium foliage contents had not significantly affected.

3. Available NPK in soil:

In respect to soil available NPK concentration (Table 5), nitrogen concentration significantly increased by addition of magnesium. While the phosphorus and potassium concentrations insignificantly affected. It can also be observe that the maximum values of NPK concentrations were due to 20 Kg/fed MgSO4 combined with effective microorganism's treatment.

Likewise, application of effective microorganisms significantly increased the concentration of nitrogen and phosphorus, while they did not affected potassium concentration.

Table (5): Effect of magnesium and effective microorganisms on NPK (ppm) of the studied soil

Treatments		Macronutrients (ppm)		
MgSO4	effective micro-organisms	N	P	K
0 Kg/fed	+	24.50	10.92	91.65
	-	22.75	10.16	103.35
10 Kg/fed	+	38.50	15.94	99.45
	-	17.50	10.26	85.80
20 Kg/fed	+	41.00	17.46	107.25
	-	14.50	12.25	85.80
Effect of effective micro-organisms	+	34.33 a	14.82 a	99.45 a
	-	18.25 b	11.06 b	91.65 a
Effect of MgSO4	0	23.63 b	10.79 a	97.50 a
	10	27.50 a	13.10 a	92.62 a
	20	27.75 a	14.93 a	96.53 a
L.S.D at 0.05				
Effective micro-organisms		1.09	1.19	ns.
MgSO4		2.67	9.86	ns.
Effective micro-organisms *MgSO4		1.29	1.42	ns.

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تاثيراستخدام الماغنسيوم والكائنات الحية الدقيقة النافعة علـــى محصـــول الفـــول السودانى النامى فى أرض رملية

عـــبــد العـــزيـــز محمـــد محمـــد رجـــب
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أجريت تجربة حقلية بمحطة البحوث الزراعية بالإسماعيلية لدراســـة تـــأثير التســـميد بعنصـــر الماغنسيوم بالاشتراك مع الكائنات الحية الدقيقة النافعـــة effective microorganisms وذلــك علـــى محصول الفول السودانى (صنف جيزة ٦) ومحتواة من العناصر الغذائية.

ولتحقيق هذا الهدف تم إضافة ثلاثة معدلات من سماد كبريتات الماغنسيوم (صفر ، ١٠ ، ٢٠ كجم/ فدان) ، حيث درس تأثير كل معدل منفردا ، وكذلك مشتركاً مع الرش بمحلول الكائنات الحيـــة الدقيقـــة النافعـــة (١ محلول : ١٠٠ ماء) بمعدل رشتين بعد ٣٠ ، ٥٠ يوم من بداية الزراعة بمعدل ٤٠٠ لتر/ فدان .

ويمكن تلخيص النتائج المتحصل عليها فيما يلى :

١- أعطت جميع معاملات كبريتات المغنسيوم تحت الدراسة وكذلك الرش بمحلول الكائنـــات الحيـــة الدقيقة النافعة زيادة معنوية فى محصول البذور والقرون وكذلك العرش ، وكانت أعلى زيادة في حالة معدل إضافة ٢٠ كجم/ فدان كبريتات ماغنسيوم فى وجود الكائنات الحية الدقيقة النافعة .

٢- لم يكن هناك فروق معنوية واضحة لجميع معاملات كبريتات الماغنسيوم في وجود أو عدم وجود الكائنات الحية الدقيقة النافعة على كل من وزن ١٠٠ بذرة وكذلك النسبة المئوية للتصافي .

٣- سجلت معاملة المقارنة (عدم إضافة أي من كبريتات المغنسيوم و الكائنات الحية الدقيقة النافعـــة) أقل قيم في محصول البذور والقرون والعرش.

٤- زاد محتوى البذور من النتروجين والفوسفور والبوتاسيوم زيادة معنوية فـــي جميـــع معـــاملات كبريتات المغنسيوم تحت الدراسة وفى وجود الكائنات الحية الدقيقة النافعة وكـــان أعلـــى معـــدل للزيادة عند اضافة ٢٠ كجم/ فدان كبريتات الماغنسيوم .

٥- زاد محتوى العرش (القش) من النتروجين والفوسفور زيـــادة معنويـــة فـــى وجـــود كبريتـــات الماغنسيوم مع إضافة الكائنات الحية الدقيقة النافعة وسجلت الجرعة ١٠ كجم كبريتات مغنســـيوم /فدان أعلى نتيجة مع النيتروجين بينما سجلت الجرعة ٢٠ كجم/فدان أعلى نتيجة مع الفوسفور ، بينما لم تكن هناك زيادة معنوية لوجود الكائنات الحية الدقيقة النافعة على عنصر البوتاسيوم فـــى القـــش .

يتضـــح مما سبق أن الرش بمحلول الكائنات الحية الدقيقة النافعة فى وجود كبريتـــات المغنســـيوم قـــد أظهر كفاءة معنوية في زيادة المحصول وكذلك معدلات امتصاص NPK للنبات .