

## **INFLUENCE OF GYPSUM AND NPK RATES APPLICATION ON YIELD AND SOME NUTRIENTS UPTAKE OF PEANUT PLANTS GROWN IN NEWLY RECLAIMED SANDY SOIL**

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### **ABSTRACT**

Two experimental were conducted at Ismailia Agricultural Experimental Station through two seasons 2001/2002 and 2002/2003 to study the influence of gypsum and NPK rates' application on yield and some nutrients uptake by peanut crop in newly reclaimed soil under using sprinkler irrigation system. Each experiments were designed in randomized complete block design. Each experiment included 7 treatments where each treatment replicated three times.

The obtained results could be summarized as follows:

- 1- The application of gypsum and NPK at the recommended rates (30 kg N, 30 kg  $P_2O_5$ , 24 kg  $K_2O$   $fed^{-1}$ ) or application of gypsum individually or NPK at the recommended rates individually gave significant increases to the studied parameters involved 100-seed weight, pod yield, straw yield and shilling percentage. The superiority was found with the application gypsum at 500 kg  $fed^{-1}$  plus NPK at the recommended rates.
- 2- The application of gypsum and NPK at the recommended rates showed highly significant increases the control or the individual addition of gypsum or NPK at the recommended rates in the parameters dry weight of 100-pods, dry weight 100-seeds, seed and straw yield. Also, the superiority was gypsum application 500 kg  $fed^{-1}$  plus NPK recommended rates.
- 3- The previous treatment, the gypsum application individually or NPK at the recommended rates individually gave a significant increase over the control in N, P and K uptake of seed and straw.
- 4- Oil and protein yields were a highly significant increase higher than the control due to applying gypsum plus NPK recommended rates or application of gypsum individually or NPK at the recommended rates individually. The application of gypsum at the rate 250 kg  $fed^{-1}$  + half NPK recommended rates gave the lowest values with respect to oil and protein yield.
- 5- Generally, the results revealed that the sprinkler irrigation system in newly reclaimed sandy soils with gypsum application (500 kg  $fed^{-1}$  + NPK recommended rates) on peanut crop to achieve the highest pods yield  $fed^{-1}$ , shilling percentage, N, P and K-uptake.

### **INTRODUCTION**

Groundnut (*Arachis hypogae*, L.) is considered one of the important edible oil crops in Egypt. About 40 % of the total seed production in Egypt, is exported. Among oil seed crops, groundnut has an important target to overcome oil efficiency gap in Egypt.

Peanut production needs light soils, which are located mainly in Eastern Delta region (Ismailia and Sharqia Governorates), Western Delta (South Tahrir) and middle Egypt, where about 80-85 % of peanut area is cultivated. This policy could not be realized during the past few decades without more developed irrigation system as drip or sprinkler irrigation system in addition to recent technique of adding fertilizers to be injected it through the irrigation water.

The problems of production of peanut in newly cultivated sandy soil like unfilling pods, fertility poverty of sandy soil, high loss of elements by leaching and its low field capacity were faced. Many investigators confirmed that gypsum applied with or without NPK increased filling percentage of pods and improved yield quality (Satyanaryana *et al.*, 1975). Also, Ali *et al.* (1994 and 1995) stated that leaf area index, number of pods/plant, pod and seed yields/fed were significantly increased by gypsum application as compared with no adding of gypsum. Moreover, El-Ahmer *et al.* (1994), Dahroug *et al.* (1992), Abou Baker *et al.* (1994), El-Naggar *et al.* (1996) and Gendy *et al.* (1996) demonstrated the beneficial effect of gypsum application on peanut yield and its quality.

On the other hand, some authors reported that, application of gypsum did not increase the yield of unshelled nuts (Gajendra, 1998). Furthermore, some investigators showed that, time and increasing gypsum rates significantly increased pod and unshelled yields (Geethalakshmi and Lourduraj, 1998).

The present study aimed to investigate the influence of gypsum and NPK rates' application on yield components, NPK uptake and oil and protein yield under sprinkler irrigation.

## MATERIALS AND METHODS

A field experiment was established to fulfill the objectives of the present work as follows:

Location: At Ismailia Agricultural Experimental Station.

Soil: Representative surface soil samples (0:30 cm) were taken before performance of the experiment where some characteristics of the studied soil were determined according to Black (1965) and Page (1982) as indicated in Table 1.

**Table 1: Chemical and physical properties of the investigated soil.**

pH <sup>(1)</sup>	E.C <sup>(2)</sup> (dS.m <sup>-1</sup> )	Cations (meq <sup>-1</sup> )				Anions (meq <sup>-1</sup> )			
		Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	K <sup>+</sup>	CO <sub>3</sub> <sup>--</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>
8.1	1.62	3.80	1.10	11.50	0.20	-	2.50	9.70	4.40
Av. N (ppm) <sup>(3)</sup>		Av. P (ppm) <sup>(4)</sup>			Av. K (ppm) <sup>(5)</sup>				
18.0		4.0			41.0				
Coarse sand %	Fine sand %	Silt %	Clay %	O : M %	CaCO <sub>3</sub> %	Soil texture			
76.18	15.17	2.35	6.30	0.23	0.33	Sandy soil			

1- 1:2.5 suspension

2- 1: 5 Extract

3- extracted by 1 % K<sub>2</sub>SO<sub>4</sub>

4- extracted by 1M sodium bicarbonate.

5- extracted by 1M ammonium acetate.

Studied crop: Groundnut seeds (*Arachis hypogae*, L.) cv. "Giza 5" were obtained from Agric. Res. Center. The planting date was 20<sup>th</sup> and 25<sup>th</sup> of April in the two growing seasons of 2001/2002 and 2002/2003, respectively.

Experimental plot: 4 x 3.5 m

Experimental treatments: The experiment was carried out in a randomized complete block design involving 7 treatments. Each treatment was replicated three times. The detailed experimental treatments were as follows:

Seed inoculation was conducted using *Bradyrhizobium japonicum* just before sowing at a rate of 2 packages fed<sup>-1</sup> (packages weight is 200 g).

- 1- Control treatment without any additions.
- 2- Gypsum application at a rate of 500 kg fed<sup>-1</sup>.
- 3- Addition of the recommended N, P and K rates i.e. 30 kg N, 30 kg P<sub>2</sub>O<sub>5</sub> and 24 kg K<sub>2</sub>O fed<sup>-1</sup>, respectively).
- 4- Addition of half of the recommended rates of gypsum and NPK i.e. 250 kg gypsum fed<sup>-1</sup> + 15 kg N, 15 kg P<sub>2</sub>O<sub>5</sub> and 12 kg K<sub>2</sub>O fed<sup>-1</sup>).
- 5- Addition of half recommended doses of gypsum and full recommended doses of NPK.
- 6- Addition of the full recommended doses of gypsum and half the recommended NPK rates.
- 7- Addition of the recommended gypsum and NPK rates.

The calcium superphosphate was added before ploughing in one dose while the rate of gypsum was splitted into two doses, one before ploughing and the other before flowering. The N and K rates were also added in two doses, one after planting and the other before flowering stage.

At harvesting time, ten guarded plants were labeled from each plot to estimate the following characters:

- 1- Total weight (kg).
  - 2- Weight of pods per 10 plants (g).
  - 3- Weight of husks per 10 plants (g).
  - 4- Dry weight of 100 pods (g).
  - 5- Weight of 100-grain (g).
  - 6- Weight of 100-husk (g).
  - 7- 100-seed weight (g).
- Seed weight
- 8- Shilling percentage =  $\frac{\text{Seed weight}}{\text{Pod weight}} \times 100$
  - 9- Pod yield (kg fed<sup>-1</sup>): Pod yield of plants in the central ten ridges of each plot was estimated in kg/m<sup>2</sup>, then it was converted to estimate seed yield kg/fed.
  - 10- Oil yield in the seeds was determined according to A.O.A.C (1980) by using soxhlet apparatus and petroleum ether as an organic solvent.
  - 11- Protein yield: Samples of straw and seeds were oven dried, weighed and ground. Nitrogen, phosphorus and potassium contents in plant materials were determined according to Jackson (1973).

Statistical analysis: the randomized complete block design was adopted and analyzed according to Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### **Dry matter and yield:**

Data in Table 2 show that, there are significant increases in all the studied parameters (dry weight of 100-pod, dry weight of 100-seed, seeds and husk). The dry matter was significantly increased with combination of gypsum and recommended NPK rates. The increase as a percentage over control for all the studied parameters except for husk were 40.71, 71.96, 87.48 and 38.91%. Also the corresponding increases at gypsum rate alone were 21.80, 7.35, 4.91 and 15.68% and at NPK recommended rates were 31.80, 19.98, 33.01 and 40.38%. In case of husk, the control increased over the combination between gypsum rate with NPK recommended rates, gypsum rate application alone and NPK recommended rate alone and these increases could be estimated as 38.90, 20.09 and 1.90%, respectively, as an average in two growing seasons. These results were confirmed with those of El-Saadany and Abdel-Rasoul (1999).

### **Yield components:**

Data presented in Table 3 reveal that gypsum and NPK rates showed a highly significant effects on all the studied characters (100-seed weight, pod yield, straw yield and shilling percentage) as compared with the control. Table 3 reveals also that, the superiority of the gypsum rate (500 kg fed<sup>-1</sup> combined with NPK recommended rate). In this respect, the percent increases of these studied four yield components over the control were 76.99, 43.59, 92.77 and 25.77%, over the recommended gypsum rate alone these increase were 15.01, 3.81, 8.96 and 2.14% and over the recommended NPK rate solely 54.74, 19.97, 33.17 and 2.05 % for the mentioned parameters respectively, as an average in two growing seasons. There were significant differences among solely application of gypsum and solely application of NPK at the recommended rates and the combination between them. Ali *et al.* (1995), Saadany and Abdel-Rasoul (1999) concluded that, the rate of gypsum application (500 kg fed<sup>-1</sup>) was the most effective treatment in increasing peanut yield components. Moreover, Samira *et al.* (2000) confirmed that, the NPK recommended rate had significantly affected on 100-seed weight, pod weight, straw yield and shilling percentage, parameters NPK recommended rate application, increased the studied growth while half NPK recommended rate caused these parameters to decrease.

### **NPK uptake by seeds and straw:**

Application of gypsum combined with NPK recommended rates gave significant increases in nitrogen, phosphorus and potassium uptake in both seeds and straw of peanut, in two seasons.

Table 4 reveal that, the most beneficial treatment was gypsum application combined with NPK at the recommended rates, where it caused increase percentages over the control 83.11, 78.03 and 74.63%, over the applied gypsum rate alone by 32.07, 9.05 and 3.93% and over NPK recommended rates by 34.05, 33.13 and 36.13% for N, P, K uptake in seeds, as an average of the two growing seasons.

The data in Table 5 show the same trend of the previous treatments as they gave significant increases for N, P and K uptake by peanut straw as compared with the control treatment. The mean values of the increase over

Table 2: Effect of gypsum application and various rates of NPK fertilizer on dry matter and yield of peanut plants.

Treatments	Dry weight of 100-pods (g)		Dry 10 <sup>-1</sup> -seed weight (g)		Seeds (kg fed <sup>-1</sup> )		Husk (kg fed <sup>-1</sup> )	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control	132.7	150.3	43.7	44.7	434.7	436.0	304.7	306.3
Gypsum 500 kg fed <sup>-1</sup>	162.0	163.7	70.3	71.3	741.0	740.3	367.7	366.0
NPK recommended rates	150.3	150.7	62.7	64.0	583.7	584.7	311.3	311.3
Gypsum 250 kg fed <sup>-1</sup> + ½ NPK recommended rates	140.7	141.0	59.7	59.7	479.0	471.0	286.3	288.7
Gypsum 250 kg fed <sup>-1</sup> + NPK recommended rates	165.0	166.7	63.7	64.0	546.3	545.3	236.7	231.7
Gypsum 500 kg fed <sup>-1</sup> + ½ NPK recommended rates	186.3	187.7	69.0	70.0	487.3	488.3	304.0	301.7
Gypsum 500 kg fed <sup>-1</sup> + NPK recommended rates	198.0	198.7	75.7	76.3	777.3	776.7	422.7	426.0
LSD at 5%	9.54	23.04	5.80	6.41	42.84	43.03	6.78	6.38

Table 3: Effect of gypsum application and various rates of NPK fertilizer on the yield components of peanut plants.

Treatments	Weight of 100-seeds (g)		Pod yield (kg fed <sup>-1</sup> )		Straw yield (kg fed <sup>-1</sup> )		Shilling %	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control	80.3	81.7	739.3	740.7	1524.0	1508.3	58.8	58.8
Gypsum 500 kg fed <sup>-1</sup>	124.3	125.0	1023.7	1023.7	2683.0	2682.0	72.3	72.5
NPK recommended rates	92.0	93.3	885.3	886.3	2194.7	2194.7	65.9	66.1
Gypsum 250 kg fed <sup>-1</sup> + ½ NPK recommended rates	84.7	83.0	772.3	772.0	1747.7	1747.7	61.9	62.2
Gypsum 250 kg fed <sup>-1</sup> + NPK recommended rates	117.3	121.3	820.3	822.0	2376.3	2377.7	66.6	66.8
Gypsum 500 kg fed <sup>-1</sup> + ½ NPK recommended rates	150.7	153.0	787.7	789.7	2108.7	2108.3	61.8	62.0
Gypsum 500 kg fed <sup>-1</sup> + NPK recommended rates	144.0	142.7	1051.3	1074.0	2922.0	2923.3	73.9	74.0
LSD at 5%	8.51	8.50	51.91	53.41	517.42	517.7	3.76	3.84

Table 4: Effect of gypsum application and various rates of NPK fertilizer on N, P and K uptake by seeds of peanut plants.

Treatments	Nitrogen (kg fed <sup>-1</sup> )		Phosphorous (kg fed <sup>-1</sup> )		Potassium (kg fed <sup>-1</sup> )	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control	16.8	17.17	1.77	1.82	2.73	2.70
Gypsum 500 kg fed <sup>-1</sup>	29.6	29.6	2.93	2.93	4.57	4.64
NPK recommended rates	23.2	23.2	2.40	2.40	3.53	3.50
Gypsum 250 kg fed <sup>-1</sup> + ½ NPK recommended rates	19.1	18.8	1.96	2.01	3.03	2.93
Gypsum 250 kg fed <sup>-1</sup> + NPK recommended rates	21.9	22.0	2.25	2.14	3.37	3.30
Gypsum 500 kg fed <sup>-1</sup> + ½ NPK recommended rates	19.9	19.9	2.18	2.20	2.96	2.93
Gypsum 500 kg fed <sup>-1</sup> + NPK recommended rates	30.8	31.4	3.19	3.20	4.87	4.70
LSD at 5%	1.20	1.31	0.11	0.15	0.22	0.24

Table 5: Effect of gypsum application and various rates of NPK fertilizer on N, P and K uptake by peanut straw plants.

Treatments	Nitrogen (kg fed <sup>-1</sup> )		Phosphorous (kg fed <sup>-1</sup> )		Potassium (kg fed <sup>-1</sup> )	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control	14.4	14.1	1.77	1.80	21.6	22.0
Gypsum 500 kg fed <sup>-1</sup>	23.9	24.5	3.50	3.57	34.7	34.9
NPK recommended rates	26.7	26.5	3.13	3.27	37.8	37.6
Gypsum 250 kg fed <sup>-1</sup> + ½ NPK recommended rates	16.4	16.3	2.40	2.30	28.3	28.3
Gypsum 250 kg fed <sup>-1</sup> + NPK recommended rates	24.5	23.8	2.80	2.73	34.9	34.5
Gypsum 500 kg fed <sup>-1</sup> + ½ NPK recommended rates	18.4	18.5	2.60	2.40	31.6	33.2
Gypsum 500 kg fed <sup>-1</sup> + NPK recommended rates	29.1	29.4	3.80	3.63	44.6	45.8
LSD at 5%	0.75	1.03	0.26	0.22	1.01	0.91

control by 105.29, 108.18 and 107.33%, respectively. Moreover, the corresponding increases over the gypsum application (at its recommended rate) were 20.88, 5.13 and 29.88% and more than NPK recommended rate by 9.97, 16.21 and 19.90% for N, P and K uptake by peanut straw, as an averages of the two growing seasons. Dahroug *et al.* (1992) suggested that addition of gypsum increased N and P content in chickpea plant, moreover, Khalil (1990) found that NPK fertilizer promoted minerals uptake.

**Oil and protein yields:**

Oil and protein yields were significantly increased as a result of applying gypsum at its recommended rate combined with NPK at their recommended rates in the two seasons. The mean values were increased over the control by 181.64 and 83.11% over gypsum application rate alone were 60.99 and 5.07% and increased over NPK recommended rates by 103.76 and 34.05% for oil and protein yield, respectively, as an averages in the two growing seasons. These results stand in well agreement with those of El-Ahmer *et al.* (1987), Sudhir *et al.* (1987), Nour El-Din *et al.* (1990), Hassan (1994) and Das and Gamayak (1995).

Mengle and Kirkby (1975) stated that the intensification of protein synthesis in seeds decreased its fat content. It is noticed that increasing of oil yield in this study was associated with that of protein one.

**Table 6: Oil and protein yield of peanut as affected by gypsum application and various rates of N, P, K fertilizers.**

Treatments	Oil yield		Protein yield	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control	200.2	200.1	105.0	107.31
Gypsum 500 kg fed <sup>-1</sup>	334.3	367.6	185.0	185.0
NPK recommended rates	276.6	276.7	145.0	145.0
Gypsum 250 kg fed <sup>-1</sup> + ½ NPK recommended rates	410.9	411.0	119.38	117.5
Gypsum 250 kg fed <sup>-1</sup> + NPK recommended rates	385.6	385.5	136.88	137.5
Gypsum 500 kg fed <sup>-1</sup> + ½ NPK recommended rates	458.6	458.6	124.38	124.38
Gypsum 500 kg fed <sup>-1</sup> + NPK recommended rates	563.7	563.7	192.50	196.25
LSD at 5%	9.03	7.46	28.81	29.08

It was concluded that nitrogen has a primary importance among the fertilizers, though simultaneous application of phosphorus and potassium is necessary for reaching the highest possible yields. The most beneficial treatment among all the studied ones was gypsum application rate (500 kg fed<sup>-1</sup>) with NPK recommended rates whereas, the application of gypsum (500 kg fed<sup>-1</sup>) before plowing under sandy soil condition was the recommended treatment for raising peanut productivity with highest filling percentage.

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تأثير إضافة معدلات من الجبس الزراعى والتسميد الأرضى بالنيتروجين والفوسفور والبيوتاسيوم على الإنتاج وامتصاص بعض العناصر الغذائية لنباتات الفول السودانى المنماه فى الأراضى الرملية المستصلحة حديثا  
مصطفى عبد العاطى ناصف

قسم تغذية النبات - معهد بحوث الأراضى والمياه والبيئة - مركز البحوث الزراعية - الجيزة - مصر

قيمت تجربتان حقليتان بمحطة التجارب الزراعية بالإسماعيلية خلال موسمى (2001/2002 و 2002/2003) وذلك بهدف دراسة تأثير إضافة معدلات من الجبس الزراعى والتسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى به على الإنبات وامتصاص بعض العناصر الغذائية على نباتات الفول السودانى المنماه فى الأراضى الرملية المستصلحة حديثا تحت نظام الري المحورى. صممت التجربة فى قطاعات كاملة العشوائية وشملت 7 معاملات وكررت كل معاملة 3 مرات. ويمكن تلخيص النتائج المتحصل عليها كالتالى:

- 1- إضافة المعدل الموصى به من الجبس الزراعى (500 كجم/فدان) والتسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم (30 كجم ن، 30 كجم فوسفور، 24 كجم بوريا/فدان) أعطت زيادة معنوية عن الكنترول أو إضافة الجبس الزراعى منفردا أو التسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم منفردا للصفات تحت الدراسة (وزن -100 بذرة، محصول القرون، محصول القش ونسبة امتلاء القرون) وكانت الأفضلية للمعاملة إضافة الجبس بمعدل 500 كجم/فدان + التسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم.
- 2- إضافة المعدل الموصى به من الجبس الزراعى (500 كجم/فدان) والتسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم (30 كجم ن، 30 كجم فوسفور، 24 كجم بوريا/فدان) أعطت زيادة معنوية عن الكنترول أو إضافة الجبس منفردا أو التسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم منفردا للصفات المدروسة (الوزن الجاف لـ 100 قرن، الوزن الجاف لـ 100 بذرة، محصول البذور والقش) وكانت الأفضلية للمعاملة إضافة الجبس بمعدل 500 كجم/فدان + التسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم.
- 3- إضافة المعدل الموصى به من الجبس الزراعى (500 كجم/فدان) والتسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم (30 كجم ن، 30 كجم فوسفور، 24 كجم بوريا/فدان) أعطت زيادة معنوية عن الكنترول أو إضافة الجبس منفردا أو التسميد منفردا بالنسبة لكل من النيتروجين - الفوسفور - البيوتاسيوم الممتص للبذور والقش.
- 4- إنتاج الزيت والبروتين أعطى زيادة معنوية مع معاملة إضافة الجبس بمعدل 500 كجم/فدان + التسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم (30 كجم ن، 30 كجم فوسفور، 24 كجم بوريا/فدان) عن الكنترول أو إضافة الجبس الزراعى منفردا أو التسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم منفردا (30 كجم ن، 30 كجم فوسفور، 24 كجم بوريا/فدان) بينما أعطت معاملة إضافة الجبس بمعدل 250 كجم/فدان + 1/2 التسميد بالنيتروجين والفوسفور والبيوتاسيوم الموصى بهم أقل قيمة بالنسبة لإنتاج الزيت والبروتين.
- 5- بصفة عامة قد أظهرت النتائج أن عند استخدام نظام الري المحورى فى الأراضى الرملية المستصلحة حديثا مع إضافة 500 كجم/فدان من الجبس الزراعى والتسميد الموصى به لمحصول الفول السودانى هى المعاملة التى يوصى باتباعها للحصول على أعلى إنتاج من القرون للفدان وأعلى نسبة امتلاء لهذه القرون وأعلى قيم للنيتروجين والفوسفور والبيوتاسيوم الممتص وكذلك إنتاج الزيت والبروتين.