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RESPONSES OF THREE PEANUT CULTIVARS TO GYPSUM

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ABSTRACT

This study was carried out during the two successive summer seasons of 2008 and 2009 at the Experimental Farm of Environmental Studies and Research Institute, Minufiya University, Sadat City, to evaluate the influence of the yield and yield attributes of groundnut to four gypsum applications (0, 250, 500 and 750 kg/fed) in a split-plot design using (Giza-kaem, Giza-4 and Giza-5) peanut cultivars of four replications. Other nutrients were applied uniformly.

The results from this experiment show that adding gypsum with the rate of 500 kg / fed increased significantly pods weight / plant, 100- seed weight, shelling %, oil seed % total protein and pod yield / plant.

On the other hand Giza 5 cultivar was superior than Giza 4 and Giza kaem in plant height, number of branches / plant, number of pods / plant, 100-pod weight, shelling % oil seed %, total protein and pod yield kg /fed.

The interaction between gypsum frequency and cultivars had significant effect on pod yield / fed. The highest pod yield / fed were produced by using Giza 5 and gypsum with the rate of 500 kg / fed.

Finally, it could be concluded that the superior interaction treatments concerning yield and its components were the cultivated peanut plants Giza 5 variety when received 500 kg gypsum/fed with all other treatments.

Keywords: Peanut cultivars; oil seed percentage, total protein, growth, yield and yield attributes.

INTRODUCTION

Peanut is considered to be one of the most important edible oil crops in Egypt. At present, the crop is usually planted as second or main crop in Egypt. Research activity have been intensified in Egypt as well as all over the world in order to increase the crop production .

Inadequate Ca is a problem for peanut (*Arachis hypogea* L.) production on soils that are acidic and sandy with low cation exchange capacity (Adams *et al.*, 1993).

In low Ca soils, gypsum is applied at flowering to insure adequate availability of Ca in the fruiting zone (0- to 3-inch soil depth) during pod development (Alva *et al.*, 1990). However, Calcium is important for adequate kernel development in peanuts (Gascho *and Davis* 1995). The best yields of peanut for soils with low pH have been obtained following application of dolomic lime, which increases soil pH, Ca, and Mg over a period of years. (Gascho and Parker 2001) Gypsum ($CaSO_4 \cdot 2H_2O$) rapidly supplies Ca to the soil profile (Ritchey and Sunffer 2002) and is effective in increasing Ca in the subsoil and alleviating Al toxicity.

Cox and Sholar (1995) and Jordan *et al.* (2001) noted that when higher rates of preplant fertilizer are needed, incorporation throughout the soil profile is recommended by applying fertilizer to the previous crop or during the autumn preceding the spring of peanut planting. This approach generally allows movement of fertilizer deeper into the soil profile out of the pegging zone.

Peanut fruits absorb Ca directly from the soil solution; therefore, the concentration of soil solution Ca in the fruiting zone is important in determining the availability of adequate Ca during fruit development (Alva *et al.*, 1991).

Results from lime experiments conducted several decades ago may have limited recommendation value due to the adoption of conservation tillage practices use of greater amounts of fertilizer, increased irrigation, improved cultivars, and greater removal of Ca and Mg by increased crop yields.

Jordan *et al.* (2001) suggested that production in reduced tillage systems minimizes the ability to incorporate fertilizers below the pegging zone and that residue on the soil surface could impact movement of calcium sulfate ($CaSO_4$) into the soil reducing Ca availability to pegs.

The peanut cultivars has been studied by several investigators included (Ahmed and Zeidan, 2001) who reported that the tested cultivars differed significantly in pod and seed yield and yield attributes. (Abd El-Motaleb and Yousef 1998) found that the peanut erect cultivar Giza-5 surpassed the semi erect cultivar Giza-4in plant hight-100 seed weight and pods yield/fed. Similar results were reported by Yasien (2004).

The aim of the study was to evaluate the influence of gypsum application on yield, and yield attributes of Giza-kaem, Giza-4 and Giza-5 peanuts.

MATERIALS AND METHODS

Field trials with Giza-Kaem, Giza-4 and Giza-5 peanuts were conducted in 2008 and 2009 seasons on sandy loam soil at the experimental farm of Environmental Studies and Research Institute, Minufiya University, Sadat City. The climate of this region is warm dry and the soil is sandy loam. The physical and chemical properties of the test soil in Table 1.

Table 1. Physical and chemical properties of experimental soil.

Particulars	Values
Sandy loam %	72.85
Silt %	19.35
Clay %	7.80
Bulk density(Mg/cu.m)	1.59
Soil reaction (pH)	7.15
Organic material (%)	0.29
Available N mg/kg	12.0
Available P mg/kg	4.8
Available K mg/kg	34.6
$CaCO_3$%	5.5

Treatments consisted of three peanut cultivars (Giza-Kaem, Giza-4 and Giza-5) and four gypsum applications (0, 250, 500 and 750 Kg/fed). The field was thoroughly prepared and fertilized with 50 kg, N(ammonium nitrate) /fed, 200 Kg P_2O_5 (calcium super phosphate) /fed in four equal doses starting 15 days after sowing and 10 days intervals, while potassium sulphate (48% k_2O) at the rate of 100kg/fed was added directly after sowing.

Gypsum (calcium sulfate) was surface-applied at the beginning of flowering stage (around 30-40 days from sowing).

The experiment was layed out in split plot design with four replications and a plot size of 4.2 x 3 meter, contained 6 ridges (3m length and 4.2 m wide). Ridges to ridges and plant to plant distance was kept as 70 and 25 cm, respectively with a sowing depth of 2-3 cm.

Three seeds were deposited in the hill, and then thinned to 2 seedlings/hill after two weeks from planting. Seeds were treated with fungicide (Vitavax) at rate of 3 gm for each kg of seeds.

Drip irrigation using underground water. Where, irrigation was applied as it was needed by the crop. Harvest was done after 120 days from sowing. The other cultural practices were applied as recommended.

The main effect was gypsum application and cultivars were the sub plot. Sowing took place on April 9th in both seasons, respectively.

At harvest, the following characters were recorded on ten graded plants taken randomly from the two inner ridges of each experimental unit area in both seasons.

1- Plant height (cm).
2- Number of branches / plant.
3- Number of pods / plant.
4- 100- Pod weight (g).
5- 100- Seed weight (g).
6- Pod yield (kg / fad).
7- Shelling %.
8- Protein (%).
9- Oil percentage.

Protein was estimated by determining the nitrogen content and it by 6.25. Oil % was determined by multiplying using Soxthelt apparatus and N hexane as a solvent according to (A.O.C.S. 1964)

Statistical analysis:

The data of these experiments were subjected to proper statistical analysis of variance according to Snedecor and Chochran (1980) and means separation were done according to New LSD at 5 % level of probability.

RESULTS AND DISCUSSIONS

1. Yield components

1.1. Effect of gypsum application.

Plant height, both number of branches and pods had significant affected by addition of gypsum in both seasons. Treated peanut plants with 250 kg/fed gypsum gave the tallest plant. While addition of 500 kg/fed

significantly increased both number of branches and pods in the two seasons. On the other hand, the lowest values in this respect were obtained when plants did ont receive gypsum (Table 2) .

Calcium is a critical element in peanut seed development. It is important in the formation of cell walls, in cell function and in tissue formation and it is essential for the germination processes. Seedlings produced from seeds with a calcium deficiency exhibit several symptoms, including watery hypocotyls (also known as hypocotyl collar rot) and deformed plumules.

The favourable effect of gypsum application on vegetative growth of peanut might be due to its role in lowering the pH of the soil. Such reduction in pH lead to increase the availability of P, Fe, Mn, Cu, Mg, SO_4 and Zn to the pea plant roots. Each of these elements has distinct role in improving plant growth. Also gypsum or sulphur elemental form application resulted in improving the movement of P from bulk soil to rhizosphere and stimulating its uptake. Moreover, sulphur plays a role in improving soil water relation, increasing root growth and regulating urea transformation in the soil (Hilal *et al.*, 1990 and Mostafa *et al.*, 1990).

These results agreed with reported by Ali *et al.* (1994) , Ramadan (1997) and Yasein (2004) application of gypsum at the rate of 500 or 1000 kg/fed to peanut plants caused significant increase in No. of branches/plant.

1.2. Effect of varieties

The results indicated significant differences among the tested varieties in plant height, both number of branches and pods in both seasons, where Giza 5 recorded the highest values of plant height, both number of branches and pods plant of peanut plants. However, Giza kaem variety gave the lowest values in this respect in both seasons (Table 2).

Table 2: Average of plant height, number of branches/plant and number of pods/plant as affected by gypsum application and peanut cultivars during 2008 and 2009 seasons.

Characters / Treatments	Plant height cm		No. of branches/plant		No. of pods/plant	
	2008	2009	2008	2009	2008	2009
Effect of gypsum						
0	53.78	52.73	9.03	8.13	28.58	23.75
250	54.02	54.03	11.79	11.24	34.88	28.41
500	53.99	52.11	14.06	12.86	40.38	35.05
750	53.54	52.76	12.31	11.69	36.88	34.72
N-LSD 5%	**0.25**	**0.33**	**0.16**	**0.07**	**0.44**	**0.27**
Effect of cultivars						
Giza-kaem	50.97	49.50	9.29	9.12	28.75	27.10
Giza- 4	53.32	52.91	12.67	11.23	34.33	30.27
Giza- 5	57.20	56.31	13.43	12.59	42.47	34.08
N-LSD 5%	**0.18**	**0.26**	**0.10**	**0.08**	**0.44**	**0.26**
Interaction						
N-LSD 5%	**0.36**	**0.53**	**0.20**	**O.16**	**0.89**	**0.53**

The differences among peanut varieties in plant height could be mainly due to differences in their genetic make-up. In addition, several investigators

showed significant differences between peanut cultivars regarding morphological characters Abd-Allah (1999) ,Adhikari *et al.*(2003) , Rehap, Abd El-Kareem (2003) , Maha, Abd- Allah (2004) and Yasein (2004) indicated that Gerogorey and Ismailia "1" varieties surpassed the other varieties. Meanwhile, Giza "6" and Ismailia "1" varieties gave higher number of branches, leaves/plant. However, Gerogorey variety produced the highest plants and the highest dry weight of leaves/plant.

1.3. Effect of the interaction between gypsum rates and varieties

The significant interaction effect between gypsum application and varieties (Table 3) cleared that longer plants were obtained by Giza 5 variety with application of gypsum at the rate of 250 kg/fed in the both seasons, while application of 500 kg/fed Gypsum with the same Varity significantly increased and recorded the maximum values of both number of branches and pods of peanut plants in both seasons.

Table 3: Effect of the interaction between gypsum rates and varieties on the plant height, number of branches /plant and number of pods /plant of peanut plants during 2008-2009

Treatments		Plant height (cm)		Number of branches		Number of pods	
Gypsum Rates (kg/fed)	Varieties	2008	2009	2008	2009	2008	2009
0	Giza kaem	50.63	49.71	7.64	6.70	23.66	20.58
	Giza 4	53.30	52.76	9.29	8.16	27.83	22.66
	Giza 5	57.40	55.70	10.16	9.53	34.25	28.00
250	Giza kaem	51.12	50.00	8.94	9.83	27.25	24.50
	Giza 4	53.46	53.97	13.20	11.50	34.66	28.41
	Giza 5	57.47	58.10	13.22	12.40	42.75	32.33
500	Giza kaem	51.24	48.91	11.14	10.54	33.83	31.66
	Giza 4	53.34	52.16	14.78	13.23	39.16	35.16
	Giza 5	57.40	55.27	16.28	14.81	48.16	38.33
750	Giza kaem	50.91	49.35	9.44	9.43	30.25	31.66
	Giza 4	53.19	52.76	13.43	12.04	35.66	34.83
	Giza 5	56.52	56.15	14.07	13.60	44.75	37.66
New LSD at 0.05		0.36	0.53	0.20	0.16	0.89	0.53

2. Yield and its components

2.1 Effect of gypsum application

Addition of gypsum had a significant increased both weight of 100 seeds and 100 pods and total pod yield/fed as well as shilling percentage of peanut plants during two seasons (table 4). Treated peanut plants with 500 kg/fed. Gypsum gave the maximum values of both weight 100 seeds and 100 pods and total pod yield /fed. of peanut plants in both seasons plant. With regard to shilling percentage, addition of gypsum at the rate of 500 and 750 kg/fed recorded the maximum values in the first and second seasons, respectively. On the other hand, the lowest values, in this respect were obtained when no received plants gypsum.

The favourable effect of gypsum on yield and its components may be related to the oxidation of sulphuric acid, hence lowering the soil pH and increasing the availability of certain nutrient elements (Ramadan, 1997).

Similar results were recorded by Bhaskar and Shiva Shankar (1993) , Chaubey *et al.* (2000) ,Venkatesh *et al.* (2002), Mausumi Raychaudhuri *et al.* (2003) and Yasein (2004) application of gypsum at the rates of 500 or 1000 kg/fed caused significant increase in number of seeds/pod, weight of seeds/plant, 100-seed weight, pods yield/fed and fodder yield/fed.

2.2 Effect of varieties

The results indicated significant differences among the tested varieties in both seasons, where Giza 5 recorded the highest values of both weight of 100 seeds and 100 pods, shilling percentage and total pod yield kg/fed of peanut plants in both seasons. However, Giza kaem variety gave the lowest values in this respect in both seasons (Table 4). The differences among peanut varieties in plant height could be mainly due to differences in their genetic make-up. In addition, several investigators showed significant differences between peanut cultivars regarding plant height including Abd-El-Motaleb and Yousef (1998), Abd-Allah (1999), Adhikari *et al.* (2003) and Maha, Abd-Allah (2004).

Table 4: Average of 100-seed weight, 100-pod weight, shelling % and pod yield as affected by gypsum application and peanut cultivars during 2008 and 2009 seasons.

Characters / Treatments	100-seed weight (g)		100-pod weight (g)		Shelling (%)		Pod yield (kg/fad)	
	2008	2009	2008	2009	2008	2009	2008	2009
Effect of gypsum								
0	79.80	75.38	196.41	168.02	54.27	49.05	1090.42	1088.25
250	82.47	78.33	203.77	172.30	59.06	53.32	1162.72	1156.50
500	87.25	81.72	213.66	179.75	61.95	58.39	1242.67	1231.50
750	82.50	79.50	206.17	173.58	59.31	60.30	1222.05	1203.75
N-LSD 5%	**0.51**	**0.30**	**0.76**	**0.35**	**0.52**	**0.63**	**6.67**	**10.50**
Effect of cultivars								
Giza-kaem	72.10	72.27	191.31	168.14	52.06	50.14	1020.90	1005.00
Giza- 4	86.14	79.60	189.54	163.93	59.85	56.56	1182.22	1172.25
Giza- 5	90.77	84.33	234.35	188.16	64.04	59.10	1335.30	1332.75
N-LSD 5%	**0.47**	**0.25**	**0.80**	**0.27**	**0.37**	**0.55**	**5.77**	**9.75**
Interaction								
N-LSD 5%	**0.94**	**0.50**	**1.59**	**0.55**	**0.75**	**1.10**	**11.62**	**12.10**

2.3. Effect of the interaction between gypsum rates and varieties

Weight of 100 seeds, weight of 100 pods, shilling percentage and total pods yield in both seasons had significantly affected by the two factors interaction in both seasons Table (5). Data cleared that the maximum weight of 100 seeds and weight of 100 pods, shelling percentage and total pod yield kg/fed in both seasons were obtained by Giza 5 variety with application of gypsum at the rate of 500 kg/fed in the both seasons, while the minimum were obtained by Giza kaem variety without application of gypsum in the both seasons (Table 5). These results are in harmony with obtained by

Bandopadhyay and Samui (2000) and Adhikari *et al.* (2003) applied 200 and 400 kg gypsum/ha to some groundnut varieties. They found that increasing gypsum levels from 0 to 400 kg/ ha significantly increased each of plant height, number of pods/ plant, shelling percentage, 100- kernel weight and pod yield/ ha. While number of branches/plant did not differ significantly with gypsum application.

Table (5): Effect of the interaction between gypsum rates and varieties on the100-seed weight, 100-pod weight, shelling % and pod yield of peanut plants.

Treatments		100-seed weight (g)		100-pod weight (g)		Shelling (%)		Pod yield (kg/fad.)	
Gypsum Rates (kg/fed.)	Varieties	2008	2009	2008	2009	2008	2009	2008	2009
0	Giza kaem	70.16	69.91	183.58	162.50	45.68	42.92	957.30	943.50
	Giza 4	81.83	75.41	183.25	158.66	56.37	46.67	1083.30	1080.75
	Giza 5	87.41	80.83	222.41	182.91	60.75	57.55	1230.75	1239.75
250	Giza kaem	72.33	72.75	188.33	166.70	51.37	47.60	1002.75	998.25
	Giza 4	85.00	78.25	189.33	162.16	59.39	54.00	1147.27	1136.25
	Giza 5	90.08	84.00	233.66	188.00	66.44	58.36	1311.15	1335.75
500	Giza kaem	74.00	74.66	199.16	174.50	56.35	54.60	1065.90	1044.75
	Giza 4	91.50	83.75	196.16	170.50	63.12	62.31	1259.47	1254.00
	Giza 5	96.25	86.75	245.66	194.25	66.38	58.27	1402.65	1395.00
750	Giza kaem	71.91	71.75	194.16	168.83	54.85	55.45	1057.50	1032.75
	Giza 4	86.25	81.00	189.41	164.41	60.50	63.26	1238.85	1216.50
	Giza 5	89.33	85.75	235.66	187.50	62.58	62.20	1369.72	1360.50
New LSD at 0.05		0.94	0.50	1.59	0.55	0.75	1.10	11.62	12.10

3. Seed quality:

3.1. Effect of gypsum

Data in Table 6 show that gypsum had significant effect on total protein contents and oil percentage in seeds (average two seasons).

Table (6): Effect of gypsum rates on total protein and oil percentage of peanut plants average two seasons

Treatments	Total protein (%)	Oil percentage
Effect of gypsum		
0 (kg/fed)	19.74	40.78
250	24.12	43.65
500	24.97	44.91
750	24.95	46.70
New LSD at 0.05	0.05	0.05
Effect of cultivars		
Giza kaem	21.62	42.81
Giza 4	23.50	45.22
Giza 5	25.23	43.99
New LSD at 0.05	0.05	0.05
Interaction		
New LSD at 0.05	0.10	0.11

Gypsum at 500 kg/fed recorded in, general, higher values of total protein content in peanut seeds more than those obtained with 250 or 750 kg/fed , while gypsum at 750 kg/fed recorded the highest values of oil percentage.

The favourable effect of S on nutrients uptake may be due to decreasing pH value of soil and expected to increase the availability of many elements in rooting zone, consequently their absorption by plants will be increased (Heter, 1985). These findings suggested to enhancing seed quality of peanut.

These results are agreement with those obtained by Mohsen (1968) , Abd El-Motaleb (1983) , Sudhir *et al.* (1987) , Maha, Abd- Alla and Ali (1992) , Baldeo Singh *et al.* (1993) and Yasein (2004) found that application of gypsum at rates of 500 or 1000 kg/fad caused significant increase in seed oil percentage, while, the higher rate of 1000 kg gave the highest oil and protein yields/fad in peanut .

3.2 Effect of varieties

Data in Table (6) show the effect of verities on total protein and oil percentage of peanut plants.

Data revealed the significant differences between varieties, whereas Giza 5 and Giza 4 varieties recorded the maximum total protein and oil percentage in peanut seeds, respectively (average two seasons).

Madkour *et al.* (1992) , Maha, Abd-Alla and Ali (1992) , Basha (1994) , El- Mandoh *et al.* (1996) , Shams El-Din and Ali (1996) , Bandopadhyay and Samui (2000) , Sundaramoorthy *et al.* (2001) , Maha, Abd-Alla (2004) and Yasein (2004) indicated that Gerogorey variety surpassed the other investigated varieties in seed content of oil and protein, oil and protein yields/fad

3.3. Effect of the interaction between gypsum and varieties

Results in Table 7 indicate that the interaction between gypsum and varieties had significant effect on total protein and oil percentage in seeds of peanut (average two seasons).

The interaction between gypsum at 500 kg/*fed* and Giza 5 varity gave the highest values of total protein, while the interaction between gypsum at 750 kg/fed and Giza 4 varity gave the highest value of oil percentage in seeds. On the other hand, Giza kaem variety with no treated by gypsum gave the lowest values of total protein and oil percentage in seeds of peanut. These results are in agreement with those obtained by Yasein (2004) found that Gerogorey variety could maximize seed oil yields/fad. when received 500 kg gypsum/fad also, Giza 5, Giza 6 and Ismailia achieve maximum seed oil yields when received 500 or 1000 kg gypsum/fad.

Table 7: Effect of the interaction between gypsum rates and varieties total protein and oil percentage of peanut plants (average two seasons)

Treatments		Total	Oil
Gypsum Rates (kg/fed)	Varieties	protein (%)	percentage
0	Giza kaem	17.15	40.00
	Giza 4	19.05	41.71
	Giza 5	23.02	40.63
250	Giza kaem	22.50	42.88
	Giza 4	24.43	44.53
	Giza 5	25.44	43.53
500	Giza kaem	23.35	43.50
	Giza 4	25.29	46.00
	Giza 5	26.28	45.21
750	Giza kaem	23.46	44.85
	Giza 4	25.21	48.64
	Giza 5	26.19	46.60
New LSD at 0.05		0.10	0.11

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استجابة ثلاثة أصناف من الفول السودانى للجبس الزراعى

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*** معهد الدراسات و البحوث البيئية – جامعة المنوفية- مدينة السادات**

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تم اجراء هذة الدراسة خلال موسمى ٢٠٠٨و ٢٠٠٩بمزرعة معهد الدراسات و البحوث البيئية بمدينة السادات لدراسة تأثير الاختلاف فى معدلات الجبس الزراعى (صفر، ٢٥٠، ٥٠٠ و ٧٥٠ كجم / فدان) على المحصول و مكوناته و المحتوى البروتينى و الزيتى لثلاثة اصناف من الفول السودانى (جيزة قائم، جيزة ٤، جيزة ٥) .

كما أوضحت النتائج ان اضافة الجبس بمعدل ٥٠٠ كجم/ فدان أعطت زيادة معنوية فى وزن القرون/ نبات- وزن ١٠٠ بذرة (جم)- نسبة التقشير- نسبة الزيت- كمية البروتين- انتاج الفدان من القرون.

حيث أظهرت النتائج ان صنف (جيزة ٥) كان أفضل من الأصناف الأخرى فى ارتفاع النبات- عدد الفروع / نبات- عدد القرون / نبات- وزن ١٠٠ قرن جرام- نسبة التقشير- نسبة الزيت- كمية البروتين- انتاج الفدان من القرون .

كما بينت النتائج أن التفاعل بين معاملات الجبس و الأصناف أعطى زيادة معنوية على ارتفاع النبات و عدد الفروع / نبات- عدد القرون / نبات و وزن ١٠٠ قرن جرام و نسبة التقشير و كمية البروتين و إنتاج الفدان من القرون عند إضافة الجبس بمعدل ٥٠٠ كجم/ فدان و صنف جيزة ٥ و ٧٥٠ كجم/فدان مع نفس الصنف في نسبة الزيت.

و توصى الدراسة بالاتى:

١- يمكن الحصول على اعلى معدل من ارتفاع النبات و عدد الفروع / نبات- عدد القرون / نبات و وزن ١٠٠ قرن جرام و نسبة التقشير و كمية البروتين و إنتاج الفدان من القرون عند إضافة الجبس بمعدل ٥٠٠ كجم/ فدان و صنف جيزة ٥

٢- يمكن الحصول على اعلى معدل من الزيت عند إضافة الجبس بمعدل ٧٥٠ كجم/ فدان و صنف جيزة٤