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Response of Two Peanut Varieties to Foliar Spray of Some Micronutrients and Sulphur Application under East of El-Ewinat Conditions

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Abstract

Two field experiments were conducted at East of El-Ewinate Agricultural Research Station, New Valley, Egypt during 2013 and 2014 seasons to investigate the response of two peanut varieties to the foliar application of some micronutrients (Fe, Zn and Mn) and sulphur addition. A randomized complete block design (RCBD) using a split- split-plot arrangement with three replications was used. Seven combinations of Fe, Zn and Mn were randomly allocated in the main plots. Two elemental sulphur levels (200 and 400 kg fed.$^{-1}$) were randomly assigned in the sub-plots, as well as two peanut varieties (Giza-6 and Sohag-110) were arranged in the sub-sub-plots.

The obtained results showed that, the peanut varieties varied significantly in most studied traits except the shelling percentage in both seasons. Sohag-110 variety surpassed Giza-6 in the most studied traits of peanut crop. The foliar application of micronutrient treatments had a significant influence on all studied traits of peanut crop in both growing seasons. Also, the interaction of varieties and the micronutrients foliar application showed a significant impact on some studied traits compared to the control. The yield and its attributes were significantly affected when sulphur and micronutrient treatments were applied. The highest mean values of most studied traits were obtained by applying 400 kg fed.$^{-1}$ of sulphur with adding Fe +Zn + Mn treatment as a foliar spray. Moreover, the highest mean values of yield and its attributes as well as oil yield were obtained by adding 400 Kg fed.$^{-1}$ of sulphur and spraying Sohag-110 variety of peanut crop with Fe + Zn + Mn treatment.

Key words: Peanut, micronutrient foliar application and sulphur addition

Introduction

The production of vegetative oils is considered one of the major economic problems in Egypt because the produced oil amounts do not satisfy the increased demands by the population. The limited cultivated area to grow oil crops as well as their competition with other strategy crops in the agricultural rotation restricts the insufficient produced amounts of this oil. One solution of this problem is to reclaim new desert lands which are mostly sandy and calcareous sandy soils.

Peanut (*Arachis hypogaea* L.) is one of the most important oil crops and food grain legumes which is successfully cultivated in the newly reclaimed sandy soils which commonly suffers from the deficiency or unavailability of most micronutrients. It ranks the 13th among the food crops and annual oil seed crops in the world. It has a good ability for improving the physical structure of such soils. Most nutrients in these soils are deficient due to the low organic matter content, high $CaCO_3$ content and high soil pH. To overcome the problems of these soils and improve the fertility levels, soil amendments, such as clays and organic materials, as well as chemical fertilizers should be applied to these soils (Attia, 2004). The beneficial effect of micronutrients comes from its role in the improvement of photosynthesis and peanut yield and quality as well as the nutrient uptake. Micronutrients promote the plants to grow well and improve transferring the photosynthetic substances from leaves to grains during the synthesis process due to their effects on enzymatic activities that are positively reflected on the weight of grains (Nassar and Osman, 2008).

Sulphur has become a major limiting plant nutrient due to the continuous use of high analysed NPK fertilizers. Groundnut, due to its underground pod bearing habit, is mainly grown on light-textured soils that are generally deficient in sulphur and micronutrients. The groundnut grown on calcareous soils shows chlorosis mainly due to the lime-induced deficiencies of micronutrients causing considerable yield reductions (Singh and Chaudhari, 1997). These deficiencies are so intermingled that it is very difficult to single them out in field-grown crops, especially in calcareous soils. However, they can easily be detected through their correction by applying sulphur and micronutrients either to the soil or through the foliar application. Sulphur particles significantly increase the water holding capacity of the soil and decrease the soil bulk density, pH and EC which results in increasing the availability of most nutrients and so the plant growth and yield (Fatereh *et al.*, 2012 ; Mgdi *et al.*, 2013).

The application of elemental sulphur that is chemically and biologically oxidized to SO_4^{-2} and sulphoric acid lowers the soil pH consequently increases the availability of most nutrients and improves the physical and chemical properties of the soil (Skwierawska *et al.*, 2008). Changes produced by the application of elemental sulphur to calcareous soils such as the reduction in the soil pH and the increase in the availability of P, Fe, Mn, Zn and Cu were reported by (Karimizachi *et al.*, 2014). The conjunctive use of manure and sulphur was found to increase the production of many crops. So, it is of great importance to improve peanut production, through applying several agricultural practices, such as using new genotypes and micronutrient foliar fertilization. Under these soils, peanut may need sulphur application to improve pods production and its quality.

The agricultural recommendations for peanut planting are scarce under East of El-Ewinate where new reclaimed soils are cultivated and available for peanut planting. Therefore, this study aims to investigate the effects of the foliar application of some micronutrients (Fe, Zn and Mn) as well as sulphur addition on the growth, yield and yield traits of two peanut varieties (Giza-6 and Sohage-110) grown under East of El-Ewinate conditions.

Materials and Methods

Tow field experiments were carried out at East of El-Ewinate Agricultural Research Station, New Valley governorate, Egypt during 2013 and 2014 growth seasons to investigate the response of two peanut varieties (Giza-6 and Sohage-110) to the foliar spray of iron (Fe), zinc (Zn) and manganese (Mn) and sulphur application. Some soil physical and chemical properties of the experimental site that were determined according to the methods described by Jackson (1967) before sowing are present in Table 1.

Table 1: Some physical and chemical properties of representative soil samples (0-30 cm depth) of the experimental site before sowing for 2013 and 2014 seasons.

Soil property		2013*	2014*
Particle - size distribution			
Sand	(%)	74.5	73.7
Silt	(%)	18.5	17.9
Clay	(%)	7.0	8.4
Texture grade		Sandy loam	Sandy loam
EC (1:1 extract)	(dS m^{-1})	1.95	1.84
pH (1:1 suspension)		7.59	7.64
Total $CaCO_3$	(%)	8.75	8.63
Organic matter	(%)	0.04	0.043
Soluble Ions			
Ca^{++}	(mmol kg^{-1})	3.50	3.47
Mg^{++}	(mmol kg^{-1})	1.00	1.00
Na^{+}	(mmol kg^{-1})	7.91	7.83
K^{+}	(mmol kg^{-1})	2.50	2.29
Cl^{-}	(mmol kg^{-1})	5.07	5.04
HCO_3^{-}	(mmol kg^{-1})	6.23	5.74
$SO_4^{=}$	(mmol kg^{-1})	2.25	2.29
DTPA-extractable Fe	(mg Kg^{-1})	3.65	3.84
DTPA-extractable Mn	(mg Kg^{-1})	1.75	1.83
DTPA-extractable Zn	(mg Kg^{-1})	0.35	0.38

* Each value represents the mean of three replications.

A randomized complete block design (RCBD) using a split split-plot arrangement with three replications was used in this experiment. Seven micronutrient combinations (Fe, Zn and Mn) using 100 mg L^{-1} for each from Fe, Zn and Mn in a chelate form (EDTA, 11 %) were allocated in the main plots. These combinations was Fe, Zn, Mn, Fe+Zn, Fe+Mn, Zn+Mn and Fe+Zn+Mn. Foliar application of micronutrient combinations were carried out on the plants at 30 days and 60 days after planting at a level of 200 and 300 L $fed.^{-1}$, respectively. Two levels of elemental sulphur (200 and 400 kg $fed.^{-1}$) were used and assigned to the sub-plots as well as two peanut varieties (Giza-6 and Sohag-110) were represented in the sub-sub-plots. Each experimental unit contained five drills of 3.5 meters in length and 0.6 apart (10.5 m^2). Peanut seeds were inoculated with *Rhizobium spp*. at sowing as it is recommended by Agricultural Research Centre. Seeds were sown on May 20th and 22nd in the first and the second seasons, respectively. Seeds of peanut (3-4 seeds) were deposited in the hill, and then the plants were thinned after complete emergence (two weeks from planting) to two plants. Nitrogen was applied at a level of 15 kg fed.$^{-1}$ as ammonium nitrate (33.5% N), potassium fertilizer was applied at a level of 50 kg fed.$^{-1}$ in the form of potassium sulphate (48% K_2O) after thinning; phosphorus fertilization was added at a level of 31 kg P_2O_5 fed.$^{-1}$ in the form of phosphoric acid (85% P_2O_5). The recommended agricultural practices for peanut crop were followed in both growing seasons. The preceding crop was wheat in both seasons. Sprinkler irrigation system was used. One week before harvest, the irrigation of peanut was stopped in both seasons.

At harvest (120 days after sowing), a sample of 10 guarded plants from each plot was randomly taken and the plant height (cm), number of pods plant^{-1}, pods yield plant^{-1} (g), seed yield plant^{-1} (g) and 100-seed weight (g) were recorded. Shelling (%) was determined as follows:

Shelling percentage (%) = (Seed yield/Pod yield) X 100.

The pods and seeds yields fed.$^{-1}$ were estimated for each plot and then, transferred to kg fed.$^{-1}$. The oil percentage (%) was determined using dried mature seeds that were ground into very fine powder using Soxhelt apparatus and diethyl ether according to A.O.A.C. (1980), and then, the oil yield was estimated as follows:

Oil yield (kg fed.$^{-1}$) = Oil % X Seed yield (kg fed.$^{-1}$).

Five plant shoot samples were randomly taken from each plot at 120 days after planting, oven dried at 70 ^{0}C until a constant weight (48 hours) and ground. A ground plant sample of 0.5 g was digested with a 2:1 acid mixture of HNO_3 : $HClO_4$ and analysed for Fe, Zn and Mn contents in plant shoots by using Inductivity Coupld Optical Emission Spectrometry (ICP-OES, thermo iCAP 6000 Series).

The analysis of variance was carried out according to Gomez and Gomez (1984) using MSTAT computer software. Means of the different treatments were compared using the least significant difference (LSD) test at the 0.05 level of probability.

Results and Discussion

The results concerned the effects of peanut variety, foliar application of micronutrients, sulphur addition and their interactions on yield and its attributes of peanut crop are discussed as follows:

A- Variety Effect

Table 2 shows a significant difference between both peanut varieties (Giza-6 and Sohag-110) in all studied traits except shelling % and Mn concentration in both growth seasons. Sohag-110 variety surpassed Giza-6 in the most studied traits. It had the highest mean values of plant height of 46.73 and 45.96 cm, number of pods plant^{-1} of 28.70 and 28.21, pods yield plant^{-1} of 29.12 and 28.56 g, seed yield plant^{-1} of 19.23 and 18.35 g, 100-seed weight of 63.20 and 62.85 g, pods yield of 1172.9 and 1176.4 kg fed.$^{-1}$, seed yield of 755.5 and 746.0 kg fed.$^{-1}$, oil percentage of 50.64 and 50.54 %, oil yield of 385.0 and 378.7 kg fed.$^{-1}$ and Zn content of 63.73 and 65.00 mg kg^{-1} in the first and second seasons, respectively. Abd-Alla, (2004) reported that the differences among peanut varieties are mainly due to genetically variations and its interaction with environmental conditions. Several investigators showed such peanut genotype differences in pod yield plant^{-1}, seed yield plant^{-1}, 100-seed weight and seed yield fed.$^{-1}$. Furthermore, Shams El-Din and Ali (1996) found that significant differences between peanut varieties in the shelling percentage as well as oil and protein yields fed.$^{-1}$. Similar results were obtained by Sarhan (2001), Caliskan *et al*. (2008) and Osman and Abdel-Motagally (2009).

B- Micronutrient Foliar Application Effect

The foliar application of Fe, Zn, Mn and their combination revealed a significant influence on all studied traits of peanut plants (Table 2). The foliar application of Fe+Zn+Mn treatment resulted in the highest mean values of plant height of 57.93 and 57.28 cm, number of pods plant^{-1} of 36.82 and 36.24, pods yield plant^{-1} of 37.26 and 36.65 g, seed yield plant^{-1} of 26.15 and 25.45 g, shelling percentage of 71.49 and 71.74 %, 100-seed weight of 75.67 and 73.50 g, pods yield of 1461.8 and 1475.3 kg fed.$^{-1}$, seed yield of 1053.3 and 1044.9 kg fed.$^{-1}$, oil percentage of 51.83 and 51.31 %, oil yield of 546.1 and 536.2 kg fed.$^{-1}$, and Fe content of 702.70 and 775.11 mg kg^{-1}, Zn content of 88.37 and 89.64 mg kg^{-1}, and Mn content of 78.19 and 77.40 mg kg^{-1} in the first and second seasons, respectively. The results caused by the micronutrient foliar application may be attributed to their favorable effects on increasing size and number of leaves which lead to an increase in the leaf area that, in turn, result in high photosynthetic activities. These results are similar to those occurred by Gobarah *et al*., (2006) and Gohari and Niyaki (2010).

The results indicated that the interaction between varieties and foliar application of micronutrients had a significant influence on most studied traits compared to the control (Table 2). The highest mean values of plant height of 59.40 and 58.88 cm, number of pods plant^{-1} of 38.27 and 37.60, pods weight of 38.40 and 37.92 g plant^{-1}, seed weight plant^{-1} of 27.23 and 26.29, 100-seed weight of 78.65 and 77.25 g, pods yield of 1479.40 and 1486.40 kg fed.$^{-1}$, seed yield of 1095.30 and 1083.4 kg fed.$^{-1}$, oil percentage of 52.17 and 51.56 % and oil yield of 571.5 and 558.60 kg fed.$^{-1}$ were obtained using the foliar application of Fe+Zn+Mn treatment on Sohag-110 variety (V_2) in the first and second seasons, respectively. These results may be due to the beneficial effect of micronutrients on plant growth which, in turn, is positively reflected on peanut yield and yield components. These results are similar to those obtained by Darwish *et al*. (2002) and Ali and Mowafy (2003).

C- Sulphur Addition Effect

The results reveal that sulphur application had a significant influence on all studied traits except the shelling percentage in both seasons (Table 3). The highest mean values of plant height of 45.25 and 44.39 cm, number of pods plant^{-1} of 28.38 and 27.94, pods yield plant^{-1} of 29.00 and 28.38 g, seed yield plant^{-1} of 19.00 and 18.36 g, 100-seed weight of 62.51 and 61.93 g, pods yield of 1166.7 and 1168.4 kg fed.$^{-1}$, seed yield of 744.0 and 733.6 kg fed.$^{-1}$, oil percentage of 50.45 and 50.34 %, oil yield of 377.6 and 370.8 kg fed.$^{-1}$ and Fe concentration of 455.43 and 448.32 mg kg^{-1}, Zn concentration of 63.71 and 63.74 mg kg^{-1}, and Mn concentration of 60.90 and 60.62 mg kg^{-1} were obtained from the high applied level of sulphur (400 kg fed.$^{-1}$) in the first and second seasons, respectively. Sulphur is a constituent element of some amino acid, namely cystein and methionine and it is involved in synthesis of chlorophyll. It also plays an important role in the synthesis of certain vitamins, carbohydrates and proteins. It has received increasing attention as world soils are becoming deficient in this element. Thus, use of sulphur as free fertilization is important for increasing and improving crop production. Nasr-Alla *et al.* (1998) found that sulphur application caused a significant increase in the 100-seed weight.

The interaction of sulphur and foliar application of micronutrients had a significant influence on some traits compared to the control (Table 3). The highest mean values of pods yield (1476.4 kg fed.$^{-1}$) and oil percentage (51.58 %) in the second season and the highest mean values of seed yield (1057.0 kg fed.$^{-1}$) and oil yield (553.6 kg fed.$^{-1}$) in the first season were occurred by applying 400 kg of sulphur per feddan and spraying the plants with Fe+Zn+Mn treatment. Singh and Chaudhari (1997) showed that the application of sulphur reduced the chlorosis of groundnut leaves and increased the dry matter, nodule biomass, pods, haulms, and oil yields and concentrations of nutrients in leaf tissue and their uptake by groundnut. The application of Fe, Zn and Mn further helped in recovering the chlorosis of groundnut and increased the above parameters. These results were similar to those obtained by Attia, (1997); Ash-Shormillesy and Abd El-Hameed (2006).

D- Interaction Effect of Variety, Sulphur and Micronutrients

The interaction of variety, sulphur and micronutrients had a significant influence on some traits compared to the control (Tables 4 and 5). The highest mean values of plant height (59.32 cm), number of pods (36.7), pods yield plant^{-1} (38.75 g), seed yield plant^{-1} (27.40 g), straw weight (2058 g plant^{-1}), 100-seed weight (79.20 g), pods yield (1486.1 kg fed.$^{-1}$), seed yield (1088.1 kg fed.$^{-1}$), oil percentage (52.09 %), oil yield (566.9 kg fed.$^{-1}$), plant Fe (803.75 mg kg^{-1}), plant Zn (93.29 mg kg^{-1}), and plant Mn (76.34 mg kg^{-1}) were obtained by applying 400 kg sulphur fed.$^{-1}$ and spraying plants of Sohag-110 variety with Fe+Zn+Mn treatment. This study revealed that the favorable effect of the high level of micronutrients was effective in improving the growth and yield of peanut crop and could be one of the reasons for high dry matter production of peanut.

The beneficial effect of foliar application of micronutrients could be attributed to the essential role of these micronutrients in growth and establishment of peanut plants and their functions in enzymes activities for the biological processes in plants, leading to increases in the yield and yield components. These results are in an agreement with those obtained by El-Saadany (1998), Nasr-Alla *et al*. (1998), El-Far and Ramadan (2000), Ali and Mowafy (2003), El-Saadany *et al*., (2003) and Abd-Alla (2004).

Finally, the significant interaction effects between peanut cultivars, foliar application of Fe+Zn+Mn and sulphur application confirmed the superiority of Sohag-110 variety under high applied level of sulphur (400 kg $fed.^{-1}$) with the foliar application of Fe+Zn+Mn treatment.

Table 2: Effect of variety (V), micronutrients foliar application (M) and their interaction on some studied traits of peanut crop grown on a sandy soil in 2013 and 2014 seasons.

Treatment	V	Plant height (cm)		Number of pods		Pods weight (g plant^{-1})		Seeds weight (g plant^{-1})		Shelling (%)		100-seed weight (g)		Pods yield (kg fed.-1)	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
	V_1	42.28	41.57	27.28	26.77	27.96	27.39	17.82	17.50	63.29	63.40	60.78	59.91	1144.7	1149.2
	V_2	46.73	45.96	28.70	28.21	29.12	28.56	19.23	18.69	65.47	64.93	63.20	62.85	1172.9	1176.4
F value variety		**	**	**	**	**	**	**	**	N.S.	N.S.	**	*	**	**
Fe		40.16	39.31	24.91	24.53	26.10	25.58	17.28	17.05	58.51	56.96	56.89	55.90	954.9	970.6
Zn		41.48	40.86	24.89	24.44	24.73	24.12	15.26	14.57	65.68	65.92	54.94	54.84	930.6	933.8
Mn		44.53	43.88	25.83	25.31	26.13	25.50	16.23	15.91	66.17	66.86	58.45	57.36	986.9	978.3
Fe+Zn		48.55	47.28	29.42	29.73	29.28	28.75	18.08	17.90	61.84	62.31	65.05	66.06	1346.5	1349.0
Fe+Mn		49.32	48.66	31.42	30.58	32.18	31.53	21.33	20.64	66.39	65.52	64.28	63.66	1366.1	1369.3
Zn+Mn		45.59	44.69	28.35	27.41	30.35	29.73	21.70	21.32	70.28	69.51	67.33	66.98	1350.7	1353.1
Fe+Zn+Mn		57.93	57.28	36.82	36.24	37.26	36.65	26.15	25.45	71.49	71.74	75.67	73.50	1461.8	1475.3
Control		28.46	28.18	22.30	21.71	22.28	21.93	12.18	11.94	54.69	54.51	53.33	52.73	872.9	872.9
LSD 0.05 M		1.35	1.38	0.92	0.7	0.91	0.72	0.77	0.64	3.70	2.67	1.14	0.87	15.26	12.16
Fe	V_1	33.70	32.87	24.23	23.90	25.72	25.15	16.75	16.57	57.77	56.08	56.12	54.52	940.2	967.2
	V_2	46.62	45.75	25.58	25.15	26.48	26.02	17.82	17.53	59.25	57.84	57.67	57.28	969.7	974.0
Zn	V_1	36.93	36.43	24.30	23.93	24.18	23.55	14.85	14.10	63.98	64.02	54.32	53.83	921.8	925.1
	V_2	46.02	45.28	25.48	24.95	25.27	24.68	15.67	15.03	67.38	67.82	55.57	55.85	939.4	942.4
Mn	V_1	43.37	42.57	25.07	24.64	25.57	24.99	15.45	15.08	65.49	66.32	57.22	55.83	964.4	943.7
	V_2	45.68	45.18	26.58	25.98	26.68	26.02	17.02	16.73	66.85	67.41	59.68	58.88	1009.4	1013.0
Fe+Zn	V_1	47.37	46.12	28.40	28.67	28.43	27.98	17.27	17.13	60.88	61.32	63.98	64.47	1326.3	1331.5
	V_2	49.73	48.45	30.43	30.80	30.13	29.52	18.90	18.67	62.80	63.29	66.12	67.65	1366.6	1366.6
Fe+Mn	V_1	47.10	46.55	30.68	30.00	31.90	31.37	20.60	19.90	64.82	63.58	63.02	62.62	1344.5	1349.5
	V_2	51.53	50.77	32.15	31.15	32.47	31.70	22.07	21.38	67.95	67.46	65.53	64.70	1387.8	1389.2
Zn+Mn	V_1	44.53	43.67	28.18	26.77	29.28	28.67	20.50	20.70	69.98	72.24	65.58	65.18	1319.3	1322.1
	V_2	46.65	45.72	28.52	28.05	31.42	30.80	22.90	21.93	73.01	71.24	69.07	68.77	1382.0	1384.0
Fe+Zn+Mn	V_1	56.45	56.02	35.37	34.87	36.12	35.37	25.07	24.65	69.56	69.75	72.68	69.75	1444.1	1464.1
	V_2	59.40	58.55	38.27	37.60	38.40	37.92	27.23	26.25	71.00	69.26	78.65	77.25	1479.4	1486.4
Control		28.16	28.02	22.60	22.02	22.10	21.82	12.27	12.02	55.54	55.12	53.32	52.38	848.6	855.5
LSD 0.05 (V X M)		1.45	1.32	0.87	0.65	1.05	0.87	0.91	0.65	N.S.	N.S.	1.14	0.71	13.67	11.20

V_1 = Giza-6, V_2 = Sohag-110 Control = water spraying and without sulphur.

Table 2: cont.

Treatment	V	Seeds yield (kg fed.$^{-1}$)		Oil (%)		Oil yield (kg fed.$^{-1}$)		Fe (mg kg^{-1})		Zn (mg kg^{-1})		Mn (mg kg^{-1})	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
	V_1	718.6	709.8	49.25	49.30	355.9	351.3	438.60	429.34	58.87	60.35	59.81	59.74
	V_2	755.5	746.0	50.64	50.54	385.0	378.7	439.72	452.84	63.73	65.00	58.90	59.30
F value variety		**	**	*	*	**	**	N.S	*	*	*	N.S	N.S.
Fe		608.8	599.0	49.08	49.38	299.0	296.0	342.18	348.63	46.12	48.82	49.86	45.92
Zn		562.2	551.0	48.33	48.68	271.8	268.3	330.03	317.72	66.85	65.92	56.38	60.29
Mn		603.5	592.4	50.35	50.73	304.2	300.7	337.76	326.40	53.95	57.87	66.85	72.00
Fe+Zn		832.8	818.6	50.97	51.00	424.7	417.7	639.91	537.06	58.34	60.66	61.72	63.45
Fe+Mn		860.8	853.1	49.92	49.60	429.8	423.3	496.48	560.30	55.14	57.56	69.03	66.32
Zn+Mn		859.4	847.9	51.38	50.78	441.8	430.8	394.14	399.99	76.84	76.50	56.48	54.33
Fe+Zn+Mn		1053.3	1044.9	51.83	51.31	546.1	536.2	702.7	775.11	88.37	89.64	78.19	77.40
Control		515.7	516.1	47.70	47.89	246.0	247.2	270.17	263.52	44.81	44.40	36.32	36.43
LSD 0.05 M		17.85	14.11	0.88	0.72	10.88	9.07	36.24	21.49	2.80	4.24	3.61	4.95
Fe	V_1	598.6	589.0	47.26	47.65	283.0	280.7	355.63	352.42	43.32	45.94	51.56	46.29
	V_2	618.9	609.1	50.90	51.12	315.0	311.4	328.74	344.84	48.91	51.70	48.17	45.56
Zn	V_1	548.3	538.3	48.16	48.69	264.2	262.2	335.50	304.98	64.06	65.04	56.54	56.83
	V_2	576.1	563.6	48.50	48.67	279.5	274.4	324.55	330.45	69.63	66.79	56.21	63.76
Mn	V_1	578.1	569.1	49.55	49.87	286.5	283.8	336.78	323.00	53.62	60.60	63.32	73.00
	V_2	629.0	615.6	51.16	51.59	321.8	317.6	338.51	329.79	54.28	55.13	70.37	71.00
Fe+Zn	V_1	815.2	802.2	50.19	50.29	409.2	403.5	649.11	528.07	59.73	65.19	63.41	66.16
	V_2	850.4	835.1	51.75	51.72	440.2	431.9	630.72	546.05	56.94	56.14	60.04	60.74
Fe+Mn	V_1	844.3	836.0	49.02	48.72	413.9	407.3	518.02	558.57	43.53	40.68	69.04	67.13
	V_2	877.3	870.3	50.81	50.48	445.7	439.3	474.94	562.02	66.74	74.44	69.03	65.51
Zn+Mn	V_1	827.6	811.8	50.62	50.16	419.0	407.2	363.76	379.45	78.21	76.60	58.22	53.68
	V_2	891.2	884.0	52.14	51.40	464.7	454.3	424.53	420.54	75.47	76.39	54.73	54.97
Fe+Zn+Mn	V_1	1011.3	1006.3	51.48	51.07	520.6	513.9	703.20	753.21	85.83	86.46	82.50	81.27
	V_2	1095.3	1083.4	52.17	51.56	571.5	558.6	702.20	797.01	90.91	92.83	73.87	73.53
Control		506.0	506.6	47.71	47.81	241.4	242.2	246.78	235.04	42.66	42.25	33.87	33.55
LSD 0.05 (V X M)		19.00	13.47	0.77	0.61	9.90	7.96	36.24	21.49	2.80	4.24	3.61	4.95

V_1 = Giza-6 V_2 = Sohag-110 Control = Water spraying and without sulphur.

Table 3: Effect of variety (V), sulphur addition (S) and micronutrients foliar application (M) and their interaction on some studied traits of peanut crop grown on a sandy soil in 2013 and 2014 seasons.

Treatment	S	Plant height (cm)		Number of pods		Pods weight (g plant^{-1})		Seeds weight (g plant^{-1})		Shelling (%)		100-seed weight (g)		Pods yield (kg fed.$^{-1}$)	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
	S_1	43.75	43.14	27.60	27.04	28.08	27.57	18.06	17.83	63.83	64.10	61.47	60.83	1150.9	1157.2
	S_2	45.25	44.39	28.38	27.94	29.00	28.38	19.00	18.36	64.93	64.23	62.51	61.93	1166.7	1168.4
F value sulphur		**	**	**	**	**	**	**	**	N.S	N.S	**	**	**	**
Giza-6	S_1	41.43	40.83	26.87	26.33	27.51	27.03	17.36	17.29	62.70	63.37	60.29	59.40	1135.1	1142.3
	S_2	43.13	42.31	27.69	27.22	28.41	27.75	18.29	17.71	63.88	63.43	61.28	60.42	1154.4	1156.1
Sohag-110	S_1	46.08	45.46	28.33	27.76	28.64	28.10	18.75	18.38	64.95	64.83	62.65	62.26	1166.7	1172.0
	S_2	47.37	46.47	29.08	28.67	29.60	29.01	19.71	19.01	65.99	65.04	63.75	63.43	1179.0	1180.7
LSD 0.05 (VXS)		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S.	N.S.	N.S.	N.S.
Fe	S_1	38.63	38.10	24.73	24.27	25.80	25.28	16.90	16.70	57.30	56.16	56.53	55.17	944.3	966.2
	S_2	41.68	40.52	25.08	24.78	26.40	25.88	17.67	17.40	59.72	57.76	57.25	56.63	965.6	975.0
Zn	S_1	40.63	40.08	24.55	24.02	24.25	23.63	14.77	14.20	65.46	65.51	54.75	54.62	927.8	930.8
	S_2	42.32	41.63	25.23	24.87	25.20	24.60	15.75	14.93	65.89	66.33	55.13	55.07	933.4	936.8
Mn	S_1	43.87	43.13	25.60	25.20	25.88	25.20	15.87	15.50	65.33	66.26	57.68	56.82	980.3	966.0
	S_2	45.18	44.62	26.06	25.42	26.37	25.81	16.60	16.32	67.01	67.47	59.22	57.90	993.5	990.7
Fe+Zn	S_1	47.78	46.72	28.73	29.22	28.72	28.20	17.92	17.67	62.53	62.69	64.57	65.38	1332.5	1334.6
	S_2	49.32	47.85	30.10	30.25	29.85	29.30	18.25	18.13	61.15	61.93	65.53	66.73	1360.5	1363.5
Fe+Mn	S_1	48.67	48.22	31.15	30.18	31.72	31.03	20.60	20.28	64.99	65.35	63.42	63.03	1352.6	1357.3
	S_2	49.97	49.10	31.68	30.97	32.65	32.03	22.07	21.00	67.79	65.69	65.13	64.28	1379.7	1381.3
Zn+Mn	S_1	44.63	44.03	27.97	26.58	29.50	29.22	20.87	21.22	70.70	72.65	66.78	66.50	1342.2	1347.2
	S_2	46.55	45.35	28.73	28.23	31.20	30.25	22.53	21.42	72.29	70.83	67.87	67.45	1359.1	1358.9
Fe+Zn+Mn	S_1	57.48	56.63	35.75	35.28	36.45	35.97	25.38	25.23	69.76	70.26	74.55	72.45	1455.7	1474.2
	S_2	58.37	57.93	37.89	37.19	38.07	37.32	26.92	25.67	70.81	68.76	76.78	74.55	1467.8	1476.4
Control		28.33	28.23	22.32	21.60	22.28	22.00	12.15	11.85	54.55	53.90	53.45	52.68	872.1	879.0
LSD 0.05 (VX M)		N.S	N.S	N.S	0.76	N.S	N.S	N.S	N.S	N.S	N.S	N.S.	N.S.	12.34	14.22

S_1 = 200 kg S fed.$^{-1}$ S_2 = 400 kg S fed.$^{-1}$ Control = Water spraying and without sulphur.

Table 3: cont.

Treatment	S	Seeds yield (kg fed.$^{-1}$)		Oil (%)		Oil yield (kg fed.$^{-1}$)		Fe (mg kg^{-1})		Zn (mg kg^{-1})		Mn (mg kg^{-1})	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
	S_1	730.1	722.1	49.44	49.50	363.3	359.3	422.88	433.86	58.90	61.61	57.81	58.42
	S_2	744.0	733.6	50.45	50.34	377.6	370.8	455.43	448.32	63.71	63.74	60.90	60.62
F value sulphur		**	**	**	**	**	**	**	*	**	*	*	*
Giza-6	S_1	711.6	702.9	48.72	48.81	348.6	344.5	425.00	418.93	56.25	59.82	57.71	58.60
	S_2	725.6	716.6	49.77	49.79	363.2	358.1	452.20	439.76	61.50	60.87	61.90	60.87
Sohag-110	S_1	748.6	741.4	50.16	50.19	377.9	374.1	420.77	448.79	61.54	63.39	57.90	58.23
	S_2	762.5	750.6	51.13	50.89	392.0	383.4	458.66	456.89	65.92	66.60	59.90	60.36
LSD 0.05 (VXS)		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	22.15	18.46	2.17	2.25	N.S.	N.S.
Fe	S_1	601.8	592.8	48.57	48.84	292.4	289.7	326.38	353.91	46.12	48.91	47.39	44.72
	S_2	615.8	605.3	49.59	49.93	305.6	302.4	357.99	343.35	46.12	48.73	52.34	47.12
Zn	S_1	556.5	546.5	46.91	47.09	261.1	257.3	314.13	316.77	65.50	66.94	55.36	60.67
	S_2	568.0	555.5	49.76	50.27	282.6	279.3	345.93	318.66	68.19	64.90	57.39	59.92
Mn	S_1	593.1	583.1	50.10	50.57	297.5	295.1	321.31	313.90	49.88	54.15	64.96	71.38
	S_2	614.0	601.6	50.60	50.89	310.8	306.4	353.98	338.89	58.02	61.58	68.73	72.62
Fe+Zn	S_1	820.5	806.8	50.44	50.51	414.1	407.8	632.88	530.15	53.50	58.48	59.22	64.19
	S_2	845.1	830.5	51.49	51.49	435.3	427.7	646.95	543.96	63.17	62.85	64.23	62.71
Fe+Mn	S_1	847.2	840.6	49.58	49.28	420.1	414.3	481.32	559.17	53.95	56.80	69.24	64.27
	S_2	874.3	865.7	50.25	49.92	439.5	432.4	511.64	561.42	56.32	58.32	68.83	68.37
Zn+Mn	S_1	854.4	842.2	50.97	50.62	435.8	426.6	378.91	397.94	72.28	74.92	56.32	51.74
	S_2	864.4	853.6	51.80	50.94	447.9	435.0	409.38	402.05	81.40	78.08	56.63	56.91
Fe+Zn+Mn	S_1	1049.5	1046.9	51.29	51.04	538.5	534.5	668.68	752.26	86.47	89.15	75.65	75.46
	S_2	1057.0	1042.8	52.37	51.58	553.6	538.0	736.72	797.96	90.27	90.14	80.72	79.34
Control		517.7	518.3	47.67	48.07	246.8	249.2	259.47	246.74	43.46	43.51	34.32	34.91
LSD 0.05 (VXM)		13.13	15.08	N.S.	0.91	N.S.	11.36	N.S.	N.S.	N.S.	1.65	N.S.	N.S.

S_1 = 200 kg S fed.$^{-1}$ S_2 = 400 kg S fed.$^{-1}$ Control = Water spraying and without sulphur.

Table 4: Effect of interaction of variety (V), sulphur (S) and micronutrients foliar application (M) on some studied traits of peanut crop grown on a sandy soil in 2013 and 2014 seasons.

Treatment	V	S	Plant height (cm)		No. of pods plant^{-1}		Pods yield (g plant^{-1})		Seeds yield (g plant^{-1})		Shelling (%)		100-seed weight (g)		Pods yield (kg fed.$^{-1}$)	
			2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Fe	V_1	S_1	32.03	31.37	24.10	23.70	25.37	24.93	16.40	16.27	57.16	54.66	55.80	53.47	923	962
		S_2	35.37	34.37	24.37	24.10	26.07	25.37	17.10	16.87	58.38	57.49	56.43	55.57	957	972
Zn		S_1	36.03	35.40	23.67	23.30	23.73	23.10	14.50	13.63	64.25	63.72	54.17	53.63	918	921
		S_2	37.83	37.47	24.93	24.57	24.63	24.00	15.20	14.57	63.70	64.31	54.47	54.03	926	929
Mn		S_1	42.97	42.10	25.40	24.87	25.43	24.87	15.23	14.73	64.50	65.41	56.30	55.27	959	926
		S_2	43.77	43.03	24.74	24.41	25.71	25.11	15.67	15.43	66.48	67.23	58.13	56.40	970	961
Fe+Zn		S_1	46.00	45.27	27.53	28.33	28.13	27.60	17.13	16.83	61.14	61.10	63.83	63.80	1314	1322
		S_2	48.73	46.97	29.27	29.00	28.73	28.37	17.40	17.43	60.61	61.54	64.13	65.13	1338	1341
Fe+Mn		S_1	46.40	45.97	30.03	29.43	31.20	30.57	19.80	19.53	63.56	63.92	62.37	62.03	1322	1326
		S_2	47.80	47.13	31.33	30.57	32.60	32.17	21.40	20.27	66.09	63.24	63.67	63.20	1367	1373
Zn+Mn		S_1	43.40	43.00	28.30	26.07	28.57	28.33	19.33	20.70	67.70	73.09	65.13	64.90	1315	1318
		S_2	45.67	44.33	28.07	27.47	30.00	29.00	21.67	20.70	72.26	71.39	66.03	65.47	1324	1326
Fe+Zn+Mn		S_1	55.77	55.20	34.17	33.57	35.13	34.57	24.37	24.70	69.51	71.52	71.43	69.17	1436	1469
		S_2	57.13	56.83	36.58	36.18	37.11	36.18	25.77	24.60	69.61	67.98	73.93	70.33	1453	1459
Fe	V_2	S_1	45.23	44.83	25.37	24.83	26.23	25.63	17.40	17.13	57.44	57.66	57.27	56.87	966	970
		S_2	48.00	46.67	25.80	25.47	26.73	26.40	18.23	17.93	61.06	58.02	58.07	57.70	974	978
Zn		S_1	45.23	44.77	25.43	24.73	24.77	24.17	15.03	14.77	66.67	67.31	55.33	55.60	9387	940
		S_2	46.80	45.80	25.53	25.17	25.77	25.20	16.30	15.30	68.08	68.34	55.80	56.10	941	944
Mn		S_1	44.77	44.17	25.80	25.53	26.33	25.53	16.50	16.27	66.16	67.10	59.07	58.37	1002	1006
		S_2	46.60	46.20	27.37	26.43	27.03	26.50	17.53	17.20	67.53	67.71	60.30	59.40	1017	1020
Fe+Zn		S_1	49.57	48.17	29.93	30.10	29.30	28.80	18.70	18.50	63.91	64.27	65.30	66.97	1351	1347
		S_2	49.90	48.73	30.93	31.50	30.97	30.23	19.10	18.83	61.68	62.31	66.93	68.33	1383	1386
Fe+Mn		S_1	50.93	50.47	32.27	30.93	32.23	31.50	21.40	21.03	66.42	66.78	64.47	64.03	1383	1389
		S_2	52.13	51.07	32.03	31.37	32.70	31.90	22.73	21.73	69.49	68.15	66.60	65.37	1393	1390
Zn+Mn		S_1	45.87	45.07	27.63	27.10	30.43	30.10	22.40	21.73	73.70	72.20	68.43	68.10	1370	1377
		S_2	47.43	46.37	29.40	29.00	32.40	31.50	23.40	22.13	72.31	70.28	69.70	69.43	1394	1392
Fe+Zn+Mn		S_1	59.20	58.07	37.33	37.00	37.77	37.37	26.40	25.77	70.00	68.99	77.67	75.73	1476	1484
		S_2	59.60	59.03	39.20	38.20	39.03	38.47	28.07	26.73	72.00	69.53	79.63	78.77	1483	1489
Control.			27.86	28.13	22.87	21.83	22.07	21.73	12.20	11.80	55.31	54.29	53.63	52.43	850	864
LSD 0.05 (VX S X M)			N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	12.63	20.11

Table 4: cont.

Treatment	V	S	Seed yield (kg fed.$^{-1}$)		Oil (%)		Oil yield (kg fed.$^{-1}$)		Fe (mg kg^{-1})		Zn (mg kg^{-1})		Mn (mg kg^{-1})	
			2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Fe	V_1	S_1	594.0	582.7	46.70	47.03	277.4	274.1	335.28	348.22	42.86	45.69	47.12	45.32
		S_2	603.2	595.2	47.83	48.26	288.5	287.3	375.98	356.62	43.79	46.19	55.99	47.25
Zn		S_1	542.3	532.3	46.72	47.08	253.4	250.6	329.36	306.07	62.46	67.55	54.69	55.16
		S_2	554.3	544.3	49.61	50.30	275.0	273.8	341.65	303.90	65.65	62.53	58.40	58.50
Mn		S_1	563.6	556.9	49.32	49.72	278.2	276.9	326.98	314.93	50.65	58.40	60.63	72.40
		S_2	592.6	581.3	49.77	50.02	294.9	290.8	346.57	331.07	56.59	62.80	66.01	73.61
Fe+Zn		S_1	805.4	788.7	49.37	49.24	397.7	388.4	641.15	530.97	52.42	64.16	60.26	67.82
		S_2	824.9	815.6	51.00	51.33	420.7	418.6	657.06	525.16	67.05	66.23	66.57	64.51
Fe+Mn		S_1	829.0	822.4	48.92	48.65	405.6	400.1	511.23	549.04	42.96	39.94	69.05	66.25
		S_2	859.5	849.5	49.12	48.79	422.2	414.5	524.81	568.10	44.10	41.42	69.02	68.00
Zn+Mn		S_1	824.6	807.9	50.08	49.92	413.1	403.3	351.58	378.33	73.08	75.68	58.48	50.14
		S_2	830.6	815.6	51.16	50.39	425.0	411.1	375.94	380.56	83.35	77.52	57.96	57.23
Fe+Zn+Mn		S_1	1006.6	1004.9	50.78	50.61	511.1	508.6	670.70	714.26	83.58	85.93	80.36	80.20
		S_2	1015.9	1007.6	52.19	51.52	530.2	519.1	735.71	792.16	88.08	86.98	84.64	82.34
Fe	V_2	S_1	609.6	602.9	50.44	50.64	307.5	305.3	317.48	359.61	49.37	52.13	47.66	44.12
		S_2	628.3	615.3	51.35	51.60	322.6	317.4	340.00	330.08	48.45	51.27	48.68	46.99
Zn		S_1	570.6	560.6	47.10	47.10	268.7	264.0	298.90	327.48	68.54	66.32	56.03	66.18
		S_2	581.6	566.6	49.91	50.24	290.3	284.8	350.21	333.42	70.72	67.26	56.38	61.33
Mn		S_1	622.6	609.3	50.88	51.41	316.8	313.3	315.64	312.87	49.11	49.91	69.29	70.35
		S_2	635.3	622.0	51.43	51.77	326.8	322.0	361.38	346.71	59.45	60.35	71.46	71.64
Fe+Zn		S_1	835.6	824.9	51.51	51.78	430.4	427.1	624.60	529.32	54.58	52.80	58.18	60.57
		S_2	865.3	845.3	51.99	51.66	449.9	436.7	636.83	562.77	59.30	59.47	61.89	60.91
Fe+Mn		S_1	865.4	858.8	50.23	49.90	434.6	428.5	451.41	569.30	64.94	73.65	69.43	62.28
		S_2	889.1	881.8	51.39	51.05	456.8	450.2	498.47	554.75	68.53	75.22	68.63	68.73
Zn+Mn		S_1	884.2	876.5	51.85	51.32	458.5	449.8	406.24	417.55	71.49	74.16	54.16	53.35
		S_2	898.2	891.5	52.43	51.48	470.8	458.9	442.82	423.53	79.45	78.63	55.30	56.59
Fe+Zn+Mn		S_1	1092.5	1088.8	51.80	51.47	566.0	560.4	666.67	790.26	89.37	92.37	70.95	70.72
		S_2	1098.1	1078.1	52.54	51.64	577.0	556.8	737.73	803.75	92.46	93.29	76.80	76.34
Control.			507.9	509.3	47.46	47.93	241.1	244.1	248.50	240.41	47.57	45.71	31.21	38.63
LSD 0.05 (VX S X M)			18.57	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

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أستجابه صنفين من الفول السوداني للرش الورقى ببعض المغذيات الصغرى وأضافة الكبريت تحت ظروف شرق العوينات

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الملخص

أجريت تجربتان حقليتان في مركزالبحوث الزراعية - محطة بحوث شرق العوينات خلال موسمى الزراعة ٢٠١٣ و٢٠١٤ لدراسة أستجابة صنفين من الفول السودانى المزروع فى الاراضى المستصلحة حديثا للرش ببعض المغذيات الصغرى (حديد والزنك و المنجنيز) واضافة الكبريت العنصرى. وتم استخدام القطاعات كاملة العشوائية في تصميم القطع المنشقة مرتين في ثلاث مكررات حيث وزعت معاملات الرش بالمغذيات الصغرى فى القطع الرئيسية بينما وزعت مستويات الكبريت (٢٠٠ و ٤٠٠ كجم كبريت/فدان) فى القطع المنشقه كما وزع صنفى الفول السودانى (جيزة٦ و سوهاج ١١٠) في القطع تحت المنشقة.

وكانت أهم النتائج المتحصل عليها كما يلى :

١ - كانت الاختلافات بين صنفى الفول السودانى معنوية في معظم الصفات المدروسة حيث تفوق الصنف سوهاج ١١٠ معنويا في معظم الصفات المدروسة على الصنف جيزة٦.

٢- أدى استخدام الرش بالمغذيات الصغرى الى زيادة معنوية فى معظم الصفات تحت الدراسه وكانت احسن النتائج بالرش بالمعاملة التى تجمع كل من الحديد والزنك والمنجنيزمعا. كما أدى استخدام المعدل المرتفع من الكبريت (٤٠٠كيلوجرام كبريت للفدان) الى زيادة معنوية فى معظم الصفات تحت الدراسة.

٣- كان للتفاعل بين الاصناف وأضافة الكبريت أو الرش بالمغذيات الصغرى تأثير معنوي علي معظم الصفات المدروسة.

من خلال نتائج هذه الدراسة يمكن التوصية بزراعة صنف الفول السوداني سوهاج ١١٠ في مثل هذة الأراضى المستصلحة حديثا بشرق العوينات مع رش النباتات بالحديد والزنك والمنجنيز وأضافة الكبريت العنصرى الى التربة عند مستوى ٤٠٠كيلوجرام كبريت للفدان.