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EFFECT OF SULFUR AND ORGANIC MANURE APPLICATION ON WHEAT PLANT CULTIVATED IN SANDY SOIL

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ABSTRACT

The combined effect of sulfur at 0,200,400,600,and 800 kg fed^{-1}, and organic manure at 0,10,20,30,40 m^3 fed^{-1} was elucidated in a sandy soil cultivated with wheat plant in a field experiment. Most of wheat growth characters were positively affected by sulfur and organic manure application. The maximum grain yield, plant height, spike grains weight, 1000 grain weight, plant dry weight, spike length, and NPK uptake were attained at the highest rate of sulfur and organic manure application. Pronounced effects on soil hydro-physical properties were detected, the maximum of saturation point, field capacity, wilting point, quickly drainable pores, water holding pores, and available water was attained at the maximum rate of sulfur and organic manure application. Whereas a slight depression in soil pH was obtained at the maximum rate of sulfur and organic manure application.

Keywords: Sulfur, organic manure, wheat crop, sandy soil.

INTRODUCTION

Correcting the physical and chemical properties of sandy soil is considered the main target for sandy soil reclamation. It depends on two elements, the first is increasing the water holding capacity, and the second is increasing macro and micro elements supplying power to plants. These two elements are the main goal of sandy soil cultivation. Applying organic matter can affect crop growth and yield, either directly by supplying nutrients, or indirectly by modifying soil physical properties that can improve the root environment and stimulate plant growth (Taha, 2000; Bassyouny, 2002; Shalabey, 2007 and Helmy and Ramadan, 2009). On the other hand, sulfur

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plays several important roles in soils, physically, biologically and chemically (Hilal, 1990 and Hussein *et al.*, 2007) and others reported that the application of, sulfur fine particles significantly increase the plant growth and yield and water holding capacity of the soil, decrease soil bulk density, pH and EC which results in increasing availability of most nutrients. The main objective of the current study is intended to use the two factors computer model to define the most suitable combination of farmyard manure and sulfur to a sandy soil which cultivated by wheat.

MATERIALS AND METHODS

A field experiment was carried out at the experimental farm of the Faculty of Agriculture, Zagazig University at El-Khattara, Sharkeya Governorate which represent the newly reclaimed sandy soil using wheat (*Triticum aestivum*) c.v. Sakha 93. Table 1 shows some physical and chemical characteristics of the investigated soil. Table 2 shows some organic manure characters. The two factors under investigation are sulfur (X1) at the rates of 0,200,400,600 and 800 kg fed^{-1} and organic manure (X2) at the rates of 0,10,20,30 and 40 m^3 fed^{-1}. Sulfur and organic manure were applied before sowing to the 0-15 cm soil depth, certified wheat seeds were planted in rows 25 cm apart in 2 x 2 m plots. The experiment included 25 treatments with four replicates. All the treatments were received the normal of other fertilizer program of El-khattara farm. The following growth characters were recoded : grain yield(ton/fed), weight of 1000 grain (g), grains weight/spike(g), spike length(cm), plant weight(g), plant length(cm) and grains N,P and K content(%) (Cottenie et al; 1982). At the end of the season soil samples were taken from the surface layer (0-30cm) for the determination of pH, EC (dSm-1), saturation point (%), field capacity (%),wilting point (%),quickly drainable pores (%),water holding pores (%),available water (%), fine capillary pores (%),useful pores (%),available P,N and K (ppm), according to Black *et al.*, (1965) and Baruah and Bbarthakur (1997). Each of the recorded or determined parameters was passed through the two-factor computer model program, (Moussa, 1992). The program out put gave the correlation coefficient, the multi correlation coefficient, Fisher criterion, and minimum values, it also gave the respective graphic curves of the two investigated factors i.e. sulfur and organic manure which show a maximum line (A) followed by smooth line

Table 1. Some physical and chemical properties of El-Khattara soil

Characteristics	Value
Particle size distribution	
▪ Sand [%]	82.16
▪ Silt [%]	11.84
▪ Clay [%]	6.00
▪ Textural class	Loamy sand
density [gcm^{-3}] and Porosity	
▪ Bulk density	1.69
▪ Realy density	2.63
▪ Porosity [%]	35.7
$CaCO_3$ [%]	0.46
Organic matter [%]	0.49
pH [soil water suspension 1:2.5]	7.99
EC dSm^{-1} [soil water extract 1:5]	0.32
Ions [meq/l]	
▪ Ca^{++}	1.32
▪ Mg^{++}	0.59
▪ Na^{+}	1.23
▪ K^{+}	0.32
▪ $CO_3^{=}$	---
▪ HCO_3^{-}	1.12
▪ Cl^{-}	1.12
▪ $SO_4^{=}$	1.22
Available N [mg/kg]	20
Available P [mg/kg]	4
Available K [mg/kg]	200

Table 2. Some physical and chemical composition of farmyard manure (FYM)

Characteristics	FYM
Density gcm^{-3}	1.32
pH*	7.14
Organic matter[%]	2.69
Total N[%]	1.20
Total P[%]	0.22
Total K[%]	0.18
C/N ratio	12.89

* Soil water suspension (1:2.5)

with gradual reduction of the maximum by 5% (e.g. B=95, C=90,...etc%)of the maximum. These curve lines have a practical importance which enables the farmers to balance the costs of any two factors on the investigated parameters to detect the best economical choice.

RESULTS AND DISCUSSION

Wheat Growth Characters

Most of wheat growth characters of wheat were significantly affected by sulfur and organic manure application as shown in Table 3 and Fig 1. However, the response was always the similar trend according to their response to sulfur and organic manure as noticed from the output graphic curves of the growth characters. Hence, the different plant growth parameters can be illustrated by one of them. Wheat 1000 grains weight was chosen to represent this group of plant growth parameters.

This group of growth characters includes 1000 grain weight, plant dry weight, grain yield, plant height, spike grains weight, spike length, and grains NPK content. They have the similar figure, shape i.e. the similar graphical trend, and have correlation coefficients with 1000 grain weight r = 0.34, 0.72, 0.42, 0.23, 0.19, 0.56, 0.39, 0.36, respectively.

All these parameters gave its maximum values designated by letter (A) at the highest rates of sulfur and organic manure application ($40m^3$ OM/fed + 800 kgS/fed), these values were decreased with decreasing the rate of the used amendments.

Multiple regression equations of the different parameters included by this group are as follows: for 1000 grain weight (g) $Y= 23.87+1.11X_1-0.10X_2-1.07X_1\text{^}2+ 2.32X_2\text{^}2+1.36X_1X_2$, for plant dry weight (g) $Y=2.08+1.16X_1- 1.58X_2+1.13X_1\text{^}2+3.81X_2\text{^}2- 1.65X_1X_2$, for grains yield (ton fed^{-1}) $Y= 10.03 - 9.21X_1 - 1.49X_2 + 1.20X_1\text{^}2 + 1.97X_2\text{^}2 + 1.76X_1X_2$, for plant height (cm) $Y=87.49- 2.25X_1+3.07X_2+ 8.13X_1\text{^}2 + 2.18X_2\text{^}2 - 5.06X_1X_2$, for spike grains weight (g) $Y=2.47-1.17X_1- 0.96X_2- 0.04X_2\text{^}2 +1.05X_1X_2$, for spike length (cm) $Y=10.03- 9.21X_1-1.49X_2+ 1.20X_1\text{^}2+1.97X_2\text{^}2+1.76X_1X_2$, for total nitrogen in grains (%) $Y =0.38-1.25X_1-9.62X_2+1.88X_1\text{^}2 +2.77X_2\text{^}2 +2.92\ X_1X_2$, for total phosphorus in grains (%) $Y=0.24- 4.60X_1- 1.06X_2+7.08X_1\text{^}2+2.87X_2\text{^}2- 1.95X_1X_2$, for total potassium in

Table 3. Some wheat growth characters and nutrients content as affected by sulfur and organic manure interaction

treatment		Weight of 1000 grain (g)	plant weight (g)	Grain yield (ton/fed)	plant height (cm)	Grains weight/ spike (g)	Spike length (cm)	N content (%)	P content (%)	K content (%)
X_1 [S] (kg/fed)	X_2 [OM] (m^3/fed)									
0	0	18.95	1.84	1.73	85.53	0.82	9.35	1.75	0.15	0.2
0	10	21.07	2.66	1.68	88.15	0.69	10.74	2.45	0.19	0.2
0	20	21.08	2.89	1.30	90.35	0.78	9.79	2.8	0.19	0.27
0	30	33.34	2.47	2.05	91.13	1.27	9.64	2.87	0.2	0.29
0	40	36.68	2.25	2.40	91.20	1.46	9.76	3.01	0.23	0.33
200	0	26.34	2.21	1.98	87.30	1.24	9.87	2.17	0.17	0.23
200	10	22.99	2.17	1.72	89.13	0.92	9.67	2.87	0.19	0.28
200	20	25.12	2.19	2.00	88.70	1.28	10.09	3.08	0.18	0.34
200	30	24.86	2.42	1.77	90.55	1.34	9.86	3.15	0.18	0.39
200	40	17.18	2.20	1.68	90.00	0.90	9.63	3.22	0.15	0.46
400	0	24.58	2.48	1.68	90.25	1.12	9.94	2.8	0.23	0.31
400	10	23.66	2.68	1.99	89.43	1.16	10.06	3.26	0.26	0.38
400	20	15.77	2.30	0.69	86.95	0.63	9.78	3.22	0.24	0.43
400	30	27.68	2.45	2.25	88.55	1.59	9.97	3.36	0.26	0.51
400	40	25.54	3.10	1.96	90.68	1.25	10.00	3.36	0.29	0.53
600	0	23.53	2.41	1.63	90.68	1.04	10.25	2.84	0.21	0.46
600	10	21.49	2.22	1.76	87.75	0.98	9.56	3.08	0.23	0.6
600	20	13.91	2.19	1.04	88.98	0.78	10.06	3.05	0.25	0.69
600	30	23.68	2.29	2.00	89.05	1.36	9.79	3.22	0.23	0.74
600	40	26.93	2.58	2.34	91.83	1.51	10.41	3.29	0.24	0.74
800	0	24.63	3.04	2.52	90.28	1.52	9.98	2.94	0.3	0.58
800	10	22.86	2.63	2.04	89.93	1.15	9.87	3.08	0.19	0.69
800	20	23.34	2.70	2.17	88.90	1.22	10.33	3.22	0.27	0.87
800	30	25.74	3.44	2.00	93.00	1.20	10.30	3.33	0.28	0.88
800	40	23.26	3.88	2.30	94.23	1.23	10.24	3.36	0.29	0.89
Correlation coefficient (r)		1	0.34	0.72	0.42	0.23	0.19	0.56	0.39	0.36

TOW FACTORS REGRESSION ANALYSIS

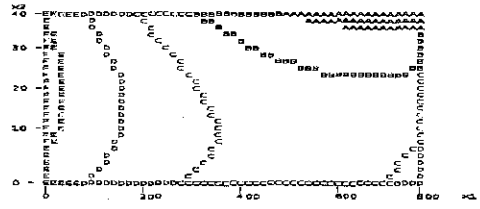
RV^2= .618552 FY= 5.067466 M1= 24 M2= 75
RR^2= .2943536 FR= 7.842239 M1= 5 M2= 94
FA= 3.354927 M1= 19 M2= 75
RV-CORRELATION COEFFICIENT RR-MULTY CORRELATION COEFFICIENT
FY,FR,FA-CRITERION FISHER M1,M2-DEGREE OF FREEDOM
REGRESSION EQUATION

Y=B0 + B1*X1 + B2*X2 + B3*X1^2 + B4*X2^2 +B5*X1*X2
REGRESSION COEFFICIENT

23.87305 1.111265E-02 -.1020325 -1.075259E-05
2.327771E-03 1.364734E-04
MATHEMATICS RESULTS

X1	X2	YS	YR	SYR
0	0	21.905	23.87305	0.5360013
0	10	23.71	23.08551	.2824255
0	20	22.795	22.76351	.2664813
0	30	22.19	22.90707	.2891772
0	40	23.895	23.51619	.5417041
200	0	28.7725	25.66548	.2854576
200	10	22.5575	25.15088	.1327072
200	20	27.2075	25.10183	.1494633
200	30	28.4175	25.51834	.1367339
200	40	23.705	26.4004	.2857103
400	0	25.985	26.5977	.2670571
400	10	27.9925	26.35605	.1478704
400	20	24.595	26.57995	.1755119
400	30	27.395	27.2694	.15099
400	40	31.6625	28.42441	.2654956
600	0	26.9725	26.66971	.2857916
600	10	27.7175	26.701	.1329067
600	20	22.88	27.19785	.1496191
600	30	28.7675	28.16025	.1369371
600	40	27.1025	29.5882	.2860517
800	0	24.445	25.88152	.5362797
800	10	28.58	26.18575	.2824348
800	20	25.945	26.95555	.2664034
800	30	30.12	28.19089	.2891938
800	40	30.0675	29.8918	.541997

YS-TREATMENT MEAN,YR-EQUIVALENT CALCULATED VALUE,SYR-SQUARE MEAN ERROR
YMAX= 29.90103 X1= 768 X2= 40
YMIN= 22.75551 X1= 0 X2= 22.4
EQUATION SMOOTH LINE Y (WITH 5% DEPRESSION INTERVAL)



THE VALUE OF Y LEVEL

A	B	C	D	E
28.40598	26.91092	25.41587	23.92082	22.42577
F	G	H	I	J
20.93072	19.43567	17.94062	16.44556	14.95051
K	L	M	N	P
13.45546	11.96041	10.46536	8.970308	7.475256
Q	R	S	T	U
5.980206	4.485155	2.990103	1.495052	0

Fig. 1. wheat 1000 grain weight(g) as affected by sulfur and organic manure interaction

grains (%) $Y=0.23-3.37X_1-13.41X_2+1.12X_1\text{^}2+1.77X_2\text{^}2+5.80X_1X_2$.

However the values of wheat 1000 grain weight which represent these group of growth characters Fig. 1 reveal that the maximum wheat 1000 grain weight occupied the upper left corner of the graphic denoted by the letter (A) emphasizing the combination role of sulfur and organic matter on wheat growth characters. Whereas the lower left corner denoted by letter (D) which is 90% of the maximum as a result of maximum application dose of sulfur only. On the other hand, application of maximum dose of organic manure only resulted 80% of the maximum denoted by letter (E) in the upper right corner. These results suggest that for sandy soil cultivated with wheat it is better to apply not only organic manure or sulfur , but both sulfur and organic manures together in order to obtain the best results. As it was mentioned before all the other growth character showed the similar trend as that of 1000 grain weight.

However these results are confirmed by Ali (2002) and Shalabey (2007) who stated that the soil treated with sulfur gave higher yield than that of untreated one. The similar conclusion obtained by Hilal (1990) who found that the wheat crop production increased from 564 kg fed^{-1}. up to 693 kg fed^{-1} with an increasing rate of 123% as a result of sulfur application. Hussein, *et al.*, (2007) reported that the application of sulfur to lacustrin soil as soil amendment increased the yield of Jerusalem artichoke and increased dry weight, tuber yield and plant height. Beheiry *et al.*, (2007) pointed out that the increment of wheat grain and straw yield reached to 54% and 28.7% respectively over the control treatment due to FYM treatment.

Regarding to NPK contents by grains which have the similar trend as of the 1000 grain weight are in the harmony with that of Mehta and Singh (1979), Mikhaeel (1997), Moussa *et al.*, (1995) and Mahmoud (2000) pointed out that NPK content for grain and straw of wheat plants increased due to application of organic manures application compared to the control.

Physical and Chemical Properties of Soil

Data in Table 4 and Figs. 2, and 3 showed some physical and chemical properties of soil as affected by sulfur and organic manure application. However, the

response was not always the similar. Hence, the different soil physical parameters can be divided into two distinct groups according to their response to sulfur and organic manure as noticed from the output graphic curves of the physical characters.

The first group includes, field capacity (%), saturation (%),wilting point(%), available water (%), fine capillary pores (%), useful pores (%),available NPK (ppm) and EC (dSm^{-1}), they have the similar figure, shape i.e. the similar graphical trend, and have correlation coefficients with soil field capacity r= 0.78, 0.86, 0.95, 0.95, -0.08, 0.42, 0.58, 0.64, respectively.

All these parameters gave its maximum values designated by letter (A) at the highest rates of sulfur and organic manure application ($40m^3$ OM/fed + 800kgS/fed), these values were decreased with decreasing the rate of these amendments.

Multiple regression equations of the different parameters included by this group are as follows: for field capacity (%) $Y= 5.96+7.96X_1-5.55X_2+5.67X_1^2+1.82X_2^2$, for saturation (%) $Y=25.13-1.14X_1+5.75X_2+2.84X_1^2+3.08X_1X_2$, for wilting point (%) $Y=1.21-1.18X_1+2.54X_2+9.87X_1^2+3.29X_2^2-9.63X_1X_2$, for available water (%) $Y=1.92-4.25X_1-2.24X_2+3.67X_1^2+1.01X_2^2+1.39X_1X_2$, for soil available potassium (ppm) $Y= 157.32-2.11X_1+0.26X_2+2.52X_1^2-1.108X_2^2+1.2X_1X_2$, for soil available nitrogen (ppm) $Y= 0.425-1.26X_1-0.013X_2+1.83X_1^2+3.22X_2^2+4.46X_1X_2$, for soil available phosphorus (ppm) $Y= 4.19+8.61X_1+0.117X_2-6.15X_1^2-1.237X_2^2$, for EC ($dSm^{-1}$):$Y= 0.425-1.26X_1-0.013X_2+1.83X_1^2+3.22X_2^2+4.46X_1X_2$

Field capacity was chosen to represent this group of soil hydro-physical characters. However the values of soil field capacity, Table 4 and Fig 2 showed that the maximum field capacity occupied the upper left corner of the graphic denoted by the letter (A) and defined by X_1=800 kg sulfur fed^{-1} and X2=40 m^3 organic manure fed^{-1}. These result suggested that soil field capacity increased not only by the application of one reclaimed element to the sandy soil but it recommended to apply both of the reclaimed elements together to obtain the best results throughout the interaction between sulfur and organic manures. FAO (1977)

Table 4. Some soil physical and chemical properties as affected by sulfur and organic manure interaction

treatment		FC. (%)	S.P (%)	WP (%)	Av. water (%)	Fine capillary pores (%)	Useful pores (%)	Av. N (ppm)	Av. P (ppm)	Av. K (ppm)	EC dSm^{-1}	pH
X_1 [S] kg/fed	X_2 [OM] m^3/fed											
0	0	6.14	25.51	2.6	3.54	2.6	3.54	17.51	3.97	112.49	0.24	7.97
0	10	6.62	25.79	2.78	3.84	2.78	3.84	21.89	4.2	115.85	0.25	7.93
0	20	6.64	26.22	2.86	3.78	2.86	3.78	24.51	5.04	109.88	0.23	7.9
0	30	6.68	26.48	2.9	3.78	2.9	3.78	24.51	6.05	115.58	0.28	7.89
0	40	8.74	27.05	3.48	5.26	3.48	5.26	16.63	7.67	117.5	0.29	7.88
200	0	6.04	24.29	2.14	3.9	2.14	3.9	19.26	4.6	114.27	0.24	7.93
200	10	6.08	25.72	2.42	3.66	2.42	3.66	21.89	6.42	116.88	0.28	7.89
200	20	6.54	25.77	2.76	3.78	2.76	3.78	24.51	4.96	118.66	0.31	7.87
200	30	7.02	27.79	3.4	3.62	3.4	3.62	22.76	7.61	120.38	0.23	7.86
200	40	9.84	27.98	3.96	5.88	3.96	5.88	19.26	9.52	121.89	0.37	7.80
400	0	6.06	25.84	2.72	3.34	2.72	3.34	21.01	4.98	119.49	0.23	7.86
400	10	6.88	26.29	2.82	4.06	2.82	4.06	24.51	10.71	121.68	0.25	7.79
400	20	7.46	26.36	3.46	4	3.46	4	22.76	7.35	124.84	0.34	7.76
400	30	8.1	26.75	3.48	4.62	3.48	4.62	26.27	4.13	127.31	0.33	7.75
400	40	9.12	27.19	3.7	5.42	3.7	5.42	21.01	4.65	130.6	0.37	7.74
600	0	6.6	24.30	3.12	3.48	3.12	3.48	23.64	3.92	126.55	0.25	7.81
600	10	7.62	26.06	3.4	4.22	3.4	4.22	25.39	2.32	129.71	0.25	7.78
600	20	7.61	26.93	3.42	4.2	3.42	4.2	25.39	6.17	132.18	0.39	7.77
600	30	7.66	27.40	3.48	4.18	3.48	4.18	27.14	6.39	134.92	0.40	7.75
600	40	8.98	27.95	3.68	5.3	3.68	5.3	25.39	6.95	136.78	0.41	7.74
800	0	6.6	26.60	3.28	3.32	3.28	3.32	28.02	2.96	132.66	0.45	7.78
800	10	6.88	26.78	3.56	3.32	3.56	3.32	30.64	6.89	135.88	0.47	7.75
800	20	7.94	26.99	3.6	4.34	3.6	4.34	30.64	7.36	138.77	0.49	7.74
800	30	8.42	27.85	3.88	4.54	3.88	4.54	31.52	7.49	141.78	0.52	7.73
800	40	9.76	28.24	3.9	5.86	3.9	5.86	17.51	7.76	144.12	0.52	7.72
Correlation coefficient (r) with field capacity			0.78	0.86	0.95	0.86	0.95	-0.08	0.42	0.58	0.64	

Notes: FC: Field capacity, WP: Wilting point and Av.: Available.

showed that application of compost to soil improves its physical properties such as water holding capacity, total porosity, permeability and bulk density. Parr *et al.*, (1982) stated that addition of sludge compost to a sandy soil improved its physical properties by increasing water content, water retention. The similar results were obtained by Hilal (1990), Hussein *et al.*, (1998), and El-Tapy *et al.*, (2005). However it is obvious that the minimum soil field capacity occupied the opposite sides of the graphic denoted by the letter (I) which is 60% of the maximum. On the other hand, applying the maximum dose of organic manure only resulted 90% of the maximum whereas applying the maximum dose of sulfur only resulted 70% of the maximum.

Unanimous in all the previous found researchs that the application of sulfur and organic manure improved soil fertility status and chemical properties, in addition to increase the total nitrogen and available contents of phosphorus and potassium in the treated soils (Parr *et al.*, 1982; Taha,2000; Hassanien *et al.*, 2007 and Helmy and Ramadan, 2009).

However Elgala *et al.*, (1998) reported that the application of sulfur improved soil fertility status and chemical in addition to increase the total nitrogen and available contents of phosphorus and potassium in the treated soils.

The second group includes soil pH, Table 4 and Fig 3. Multiple regression equations of the different parameters included by this group are as follows: for pH

$Y= 8.05-9.79X_1-1.54X_2+9.06X_1\text{^}2+3.20X_2\text{^}2+1.41 X_1X_2$

This parameter gave its maximum value designated by letter (A) at the lower left corner, whereas the minimum values lays at the upper right corner designated by letter (B).

However the values of soil pH, Table 4 and Fig 3 showed that the minimum soil pH occupied the upper right corner of the graphic denoted by the letter (B) and defined by X_1=528 kg sulfur fed-1 and X_2=22.4 m^3 organic manure fed^{-1}, however Table 4 and Fig 3 showed that soil pH slightly decreased with increasing sulfur and organic manure application. This result agrees with Hilal *et al.*, (1990) who reported that soil pH values decrease in both rhizospher or bulk soil as affected by sulfur application. This effect may be attributed to the action of biological activity resulting from sulfur oxidation and this reduction

TOW FACTORS REGRESSION ANALYSIS

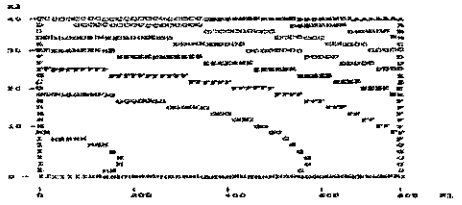
RV^2= .9993805 FY= 5041.501 M1= 24 M2= 75
RR^2= .9043741 FR= 777 M1= 0 M2= 99
FA= 479.2721 M1= 24 M2= 75
RV-CORRELATION COEFFICIENT RR-MULTY CORRELATION COEFFICIENT
FY,FR,FA-CRITERION FISHER M1,M2-DEGREE OF FREEDOM
REGRESSION EQUATION

Y= B0 + B1*X1 + B2*X2 + B3*X1^2 + B4*X2^2 + B5*X1*X2
REGRESSION COEFFICIENT

3.026598 1.134741E-04 -8.502289E-03
6.40621TE-07 1.053124E-03 0
MATHEMATICS RESULTS

X1	X2	YS	YR	SYR
0	0	3.07	3.026598	1.838567E-03
0	10	3.31	3.046887	9.687628E-04
0	20	3.32	3.277802	9.140719E-04
0	30	3.34	3.719341	9.919221E-04
0	40	4.37	4.371506	1.858128E-03
200	0	3.02	3.074917	9.791633E-04
200	10	3.04	3.095207	4.552062E-04
200	20	3.27	3.326121	5.12682E-04
200	30	3.51	3.767661	4.690184E-04
200	40	4.92	4.419825	9.800305E-04
400	0	3.03	3.174487	9.160468E-04
400	10	3.44	3.194776	5.072183E-04
400	20	3.73	3.425691	6.02033E-04
400	30	4.05	3.86723	5.179188E-04
400	40	4.56	4.519394	9.106908E-04
600	0	3.3	3.325306	9.808892E-04
600	10	3.81	3.345595	4.558906E-04
600	20	3.81	3.57651	5.132167E-04
600	30	3.83	4.018049	4.697152E-04
600	40	4.49	4.670214	9.812012E-04
800	0	3.3	3.527375	1.839522E-03
800	10	3.44	3.547665	9.687947E-04
800	20	3.97	3.778579	9.138047E-04
800	30	4.21	4.220118	9.919792E-04
800	40	4.88	4.872283	1.859133E-03

YS-TREATMENT MEAN,YR-EQUIVALENT CALCULATED VALUE,SYR-SQUARE MEAN ERROR
YMAX= 4.872283 X1= 800 X2= 40
YMIN= 3.010051 X1= 0 X2= 4.799999
EQUATION SMOOTH LINE Y (WITH 5% DEPRESSION INTERVAL)



THE VALUE OF Y LEVEL

A	B	C	D	E
4.628669	4.385054	4.141441	3.897826	3.654212
F	G	H	I	j
3.410598	3.166984	2.92337	2.679756	2.436141
K	L	M	N	P
2.192527	1.948913	1.705299	1.461685	1.218071
Q	R	S	T	U
.9744566	.7308426	.4872284	.2436142	0

Fig. 2. Soil field capacity as affected by sulfur and organic manure interaction

TOW FACTORS REGRESSION ANALYSIS

RV^2= .9843282 FY= 196.2779 M1= 24 M2= 75
RR^2= 1.594149 FR=-2.970746 M1= 5 M2= 94
FA=-153.6001 M1= 19 M2= 75
RV-CORRELATION COEFFICIENT RR-MULTY CORRELATION COEFFICIENT
FY,FR,FA-CRITERION FISHER M1,M2-DEGREE OF FREEDOM
REGRESSION EQUATION

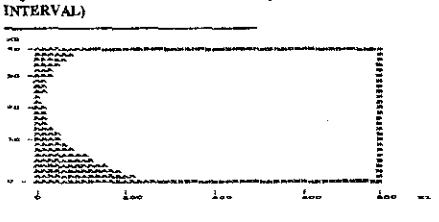
Y= B0 + B1*X1 + B2*X2 + B3*X1^2 + B4*X2^2 + B5*X1*X2
REGRESSION COEFFICIENT

8.053255 -9.790969E-04 -1.547987E-02
9.0616E-07 3.201031E-04 1.418582E-06
MATHEMATICS RESULTS

X1	X2	YS	YR	SYR
0	0	7.965	8.053255	-2.687014E-04
0	10	7.930001	7.930467	-1.41582E-04
0	20	7.8975	7.871699	-1.335891E-04
0	30	7.890001	7.876952	-1.449667E-04
0	40	7.88	7.946225	-2.715603E-04
200	0	7.93	7.893682	-1.43102E-04
200	10	7.8925	7.773731	-6.652711E-05
200	20	7.867501	7.7178	-7.492705E-05
200	30	7.8575	7.72589	-6.854573E-05
200	40	7.8075	7.798001	-1.432287E-04
400	0	7.855	7.806602	-1.338777E-04
400	10	7.792501	7.689488	-7.412853E-05
400	20	7.755	7.636394	-8.798544E-05
400	30	7.7475	7.647321	-7.56924E-05
400	40	7.7375	7.722269	-1.330949E-04
600	0	7.8125	7.792014	-1.432695E-04
600	10	7.775001	7.677737	-6.662714E-05
600	20	7.765001	7.627481	-7.50052E-05
600	30	7.75	7.641246	-6.864757E-05
600	40	7.7375	7.719031	-1.433998E-04
800	0	7.7525	7.84992	-2.68841E-04
800	10	7.7525	7.73848	-1.415867E-04
800	20	7.74	7.691061	-1.3355E-04
800	30	7.73	7.707663	-1.44975E-04
800	40	7.715	7.788285	-2.717072E-04

YS-TREATMENT MEAN,YR-EQUIVALENT CALCULATED VALUE,SYR-SQUARE MEAN ERROR

YMAX= 8.053255 X1= 0 X2= 0
YMIN= 7.619559 X1= 528 X2= 22.4
EQUATION SMOOTH LINE Y (WITH 5% DEPRESSION INTERVAL)



THE VALUE OF Y LEVEL

A	B	C	D	E
7.650593	7.24793	6.845267	6.442604	6.039942
F	G	H	I	j
5.637279	5.234616	4.831953	4.429291	4.026628
K	L	M	N	P
3.623965	3.221302	2.818639	2.415977	2.013314
Q	R	S	T	U
1.610651	1.207988	.8053255	.4026628	0

Fig. 3. Soil pH as affected by sulfur and organic manure interaction

in soil pH may enhance the macro and micro nutrients which, in turn , promote the plant yield production. The similar results were obtained by (El-Fayoumi *et al.*, 2000; Basyouny, 2002, and El-Sodany *et al.*, 2007).

It could be concluded that application of sulfur and organic manures to sandy soil enhanced not only wheat growth character but also soil hydro-physical and chemical characters. Moreover, results declared that the maximum application dose of sulfur and organic manure used in this study not quite enough to create the maximum plant growth character and or soil hydro physical properties.

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تاثير إضافة كل من الكبريت والسماد العضوى على القمح المنزرع فى أرض رملية

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لدراسة التاثير المتبادل للكبريت والمادة العضوية على كل من التربة والنبات استخدم خمسة مستويات من الكبريت هى صفر، ٢٠٠، ٤٠٠، ٦٠٠، ٨٠٠ كجم/ فدان وخمسة مستويات من المادة العضوية هى صفر، ١٠، ٢٠، ٣٠، ٤٠ م^3/فدان وقد استخدم الحاسب العلمى فى تحليل وعرض النتائج حيث يظهر الحاسب منحنى يوضح الاثر الكمى او النوعى للتداخل بين الكبريت والمادة العضويةعلى اى من صفات النبات او التربة، حيث تظهراعلى قيمة الصفة المقاسة من خلال حرف (A) بينما تمثل احـرف B, C, D, ... انخفاض يمثل ٩٥، ٩٠، ٨٥%, ... على التوالى. وقد أوضحت النتـائج تـأثر معظـم صفات النمو لنبات القمح بإضافة الكبريت والمادة العضوية حيث ان زيادة معدلات الإضـافة تؤدى الى زيادة محصول الحبوب، الوزن الجاف للنبات، وزن حبوب السنبلة ،وزن الالـف حبة ،طول السنبلة ، ارتفاع النبـات، محتـوى الحبـوب مـن النيتـروجين والفوسـفور والبوتاسيوم. حيث أعطت جميعها اعلي معدلاتها عند أعلى معدل إضـافة وهـى (٤٠ م٣ مادة عضوية + ٨٠٠ كجم كبريت/فدان).

كما تأثرت بعض الصفات الطبيعية والكيميائية للتربة بإضافة الكبريت والمادة العـضوية حيث ادت زيادة معدلات الإضافة إلى زيادة كل من نقطة التشبع ،السعة الحقليـة، نقطـة الذبول المستديم، مسام الـصرف الـسريعة، المـسام الحافظـة للمـاء ،المـاء الميـسر، النيتروجين والفوسفور والبوتاسيوم الميسر حيث أعطت جميعها اعلي معدلاتها عند أعلـى معدل إضافة وهى (٤٠ م^3 مادة عضوية + ٨٠٠ كجم كبريت/فدان). وفى المقابـل حـدث نقص في الرقم الهيدروجيني عند نفس معدل الإضافة.