INDUCED EFFECT OF CATTLE WASTE COMBINED WITH ELEMENTAL SULPHUR, NITROGEN AND PHOSPHORUS ON WHEAT SUCCEEDED BY MAIZE GROWN ON A CALCAREOUS SOIL

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ABSTRACT

The objective of the current investigation was to study both the direct and residual effects of cattle waste manure, elemental sulphur at different rates, nitrogen in different forms and phosphate at different rates on growth parameters and yields of both grains and straw of wheat succeeded by maize grown on a calcareous soil. To fulfill this objective, two field experiments were conducted on El-Noubaria calcareous soil (CaCO₃>34%). In the first experiment, cattle waste was applied at a rate of 12 ton fed⁻¹ with elemental sulphur at a rate of 0, 50 or 100% of its recommended dose 100 kg fed⁻¹. N in the form of urea, ammonium nitrate or ammonium sulphate at a rate of 120 kg fed⁻¹ and P at a rate of 0, 50 or 100% of its recommended P dose, 150 kg fed⁻¹. The experimental plots were distributed in a split-split design. Wheat (Triticum aestivum L., Giza 163) was cultivated within the first half of November 2005 then harvested in May 2006. The second experiment was conducted to study the residual effect of the aforementioned treatments on maize (Zea maize L., single hybrid 10) cultivated at the same experimental plots in the second half of April 2006 and harvested at the end of August. Results revealed that both plant height and weight of 100 grains positively responded to application of the cattle waste (CW), elemental S, N and P especially at the recommended doses of S, the highest applied rate of P and ammonium sulphate fertilizer as a N source. Both the grain and straw yields as well as the biological yield were affected obviously by rate of the applied sulphur, form of the applied nitrogen and rate of the applied phosphorus. The higher the rate of the applied sulphur, the higher the grain, straw and biological yields were obtained. The nitrogen applied in the form of ammonium sulphate was of a superior effect on yield components. Application of phosphorus was more pronounced by increasing rate of the applied phosphate.

Sulphur application could result in increases in nitrogen uptake values by grains and straw of both the investigated plants. Application of N, regardless of its applied form resulted in higher N-uptake values by grains and straw of both the studied plants as compared with the corresponding N-uptake values attained in control treatments which did not receive N-fertilizer. The highest values of N uptake by both grains and straw of both the investigated plants were attained due to application of N as ammonium sulphate.

Application of sulphur enhanced availability of P and hence its uptake. The applied N forms could be arranged according to their effect on increasing P uptake values in the following descending sequence ammonium sulphate> ammonium nitrate> urea. Moreover, application of phosphate was noticed to be associated with corresponding increases in its uptake values by grains and straw. Values of K uptake were in direct proportion to rate of the applied sulphur. K-uptake values by both wheat and maize plants showed almost similar trends to those of N and P. This observation hold true for both grains and straw of the cultivated plants. The ammonium sulphate

form resulted in the highest K-uptake values whereas urea fertilizer was associated generally with the lowest K-uptake values. It is of importance also to indicate that the beneficial effects of the used fertilization treatments extended to the maize plants which were cultivated succeeding wheat in the same soil.

Keywords: Calcareous soil, cattle waste, sulphur, nitrogen, phosphorus

INTRODUCTION

Policy of the Egyptian government aims at attaining self sufficiency in food production. Although total area of Egypt is about one million km², only 4% of this area is cultivated mainly in the Nile Delta and the narrow strip of the Nile Valley. To increase its cultivated area, Egypt started to reclaim desert regions outside the Nile Delta and the Valley.

Calcareous soils suffer from deficiency in its content of organic matter which is the main source of N in soil besides the nitrogenous fertilizers applied to these soils are subject to chemical reactions might affect the form of the added fertilizer and consequently its fertilization value (Balba, 1995). In view of the current word food crisis, there is a renewable interest in recycling organic wastes to improve fertility and productivity of soil (Negm *et al.*, 2002; Rehan *et al.*, 2004; Negm *et al.*, 2005, El-Sayed *et al.*, 2005 and Farid *et al.*, 2006).

However, sulphur is often referred as the fourth major plant element as it is a component of important metabolic and structural compounds (Thomas *et al.*, 2003). Yield and quality responses to sulphur have been reported for crops such as wheat (Rehan *et al.*, 2004) and faba bean (El-Sayed *et al.*, 2005).

Lu *et al.* (2005) reported that inorganic nitrogen (N) and phosphorus (P) fertilization increased grain yields in China by 50–60%. According to Ahmad *et al.* (1999) applications of N in split doses and S as a basal dose may create imbalance in the supply of these nutrients during the growth and development of the crop.

MATERIALS AND METHODS

Two field experiments were conducted on calcareous soil of a private farm located western to El-Noubaria city (El-Boheira governorate). Some physical and chemical properties of the investigated soil are presented in Table (1).

In the first experiment, the soil was manured with cattle wastes (CW) applied to soil during its preparation for cultivation at a rate of 12 ton fed⁻¹. The main characteristics of cattle manure were determined and results obtained on the dry weight basis are presented in Table (2).

The investigated field was divided into three equal divisions received elemental sulphur at a rate of 0, 50 or 100% of the recommended dose (100 kg fed⁻¹ during the preparation before planting. Each division was subdivided into three equal areas each of which received 120 kg N/fed either in forms of urea (46% N), NH₄NO₃ (33.5% N) or (NH₄)₂SO₄ (20.5% N). Finally, each area was further subdivided into 3 plots received the calcium superphosphate

fertilizer (15.5 P_2O_5) at a rate of 0, 50 or 100% of the recommended P dose (150 kg P_2O_5 /fed). Each treatment was replicated three times. Each plot was represented by an area whose dimensions are 3.5×3.5 m i.e. a total area of about 12.5 m². Accordingly, the experimental work involved 81 plots [3 rates of elemental sulphur × 3 mineral nitrogenous fertilizers × 3 rates of P× 3 replicates). The experimental plots were distributed in a split-split design. Wheat (*Triticum aestivum* L., Giza 163) was cultivated within the first half of November 2005 then harvested in the first week of May 2006. The second experiment was conducted to study the residual effect of the aforementioned treatments on maize (*Zea maize* L., single hybrid 10) cultivated at the same experimental plots at the 2nd half of May 2006 and harvested after 110 day of planting. Some of plant growth parameters were recorded. Finally, the grain and straw yields of both cultivated plants were estimated and plant uptake values of N, P and K were determined.

Table (1): Some physical and chemical properties of the studied calcareous soil.

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Soil properties	Soil depth (cm)				
Particle size distribution (%):					
Total sand	52.28				
Silt	20.34				
Clay	27.38				
Texture class	Sandy clay loam				
Bulk density (g cm ⁻³)	1.44				
Field capacity (%)	19.52				
Wilting point (%)	9.43				
Available water (%)	10.09				
pH (Soil paste)	7.79				
Total CaCO₃ (%)	34.09				
Organic matter (%)	0.61				
EC (dS m ⁻¹ , soil paste extract)	4.38				
SAR	5.15				
Soluble cations and anions (mmol _c L ⁻¹)					
Ca ²⁺	15.48				
Mg ²⁺	9.30				
Na ⁺	18.13				
K ⁺	1.13				
CO ₃ ²⁻					
HCO₃-	5.30				
CI ⁻	22.07				
SO ₄ ²⁻	16.67				
Available nutrients (mg kg-1 soil)					
N	38.54				
P	5.60				
K	81.35				

Table (2): Some chemical properties of the studied cattle waste.

Property	Value
pH (H ₂ O) 1:5	7.35
EC (dS m ⁻¹) 1:5	2.42
Organic matter (%)	43.64
Total carbon (%)	25.37
Total nitrogen (%)	0.44
C/N ratio	57.65
Total phosphorus (%)	0.56
Total potassium (%)	0.68

Soil, manures and plant analyses:

Particle size distribution was determined, using the international pipette method as described by FAO (1970). In soil paste extract, pH and electrical conductivity (EC_e) were determined as described by Page *et al.* (1982). Soil organic matter was determined by using Walkley and Black method according to Jackson (1973). Total calcium carbonate was estimated using Collins' calcimeter, Page *et al.* (1982).

The used cattle waste was chemically analyzed according to Brunner and Wasmer (1978) and data obtained are presented in Table (2). Some of plant growth characters were recorded through out the maturity stage for both wheat and maize. In addition, the plant samples were digested with acids mixture (HC1O₄-H₂SO₄) following the method reported by Van Schowenburg (1968) and used for the determination of total nitrogen using kjeldahl method as described by Cottenie *et al.* (1982), total phosphorus according to the method of ascorbic acid described by Frie *et al.* (1964), total potassium using Flame Photometer model (ANA-10B). The obtained data were statistically analyzed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Effect of the different fertilization treatments on plant growth parameters:

1- Plant height:

Data presented in Tables (3 & 4) and Figs. (1 & 2) reveal that both maize and wheat plant heights responded to sulphur application and the response was more obvious by increasing rate of the applied sulphur. Such a finding was true regardless of form of applied nitrogen or even rate of the applied phosphorus. However, away from rate of the applied sulphur, the nitrogen applied as ammonium sulphate could result in the highest values of plant height whereas that applied as urea resulted in the lowest values of plant height. Nitrogen applied as ammonium nitrate fertilizer caused values of plant height to become inbetween.

Increasing rate of the applied phosphate was significantly associated with increases in plant height where the highest rate of the applied phosphate was associated with the highest values of plant height.

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Table (3): Effect of different applied fertilizers treatments on wheat yield

narameter under cattle waste annlications

parameter under cattle waste applications.								
	Applied Plant height Straw Grain Biological Weight							
	treatments		(cm)	ton/fed	ton/fed	ton/fed	grain (g)	
		P (0)	86.00	2.82	1.31	4.13	26.75	
	Urea	P (50)	87.50	3.55	1.52	5.07	27.50	
		P (100)	88.00	3.52	1.53	5.05	27.75	
(%	mean		87.17	3.30	1.45	4.75	27.33	
9	Λ	P (0)	87.00	3.51	1.52	5.03	27.00	
בַּ	Am. Nitrate	P (50)	89.00	3.83	1.51	5.34	27.75	
Sulphur (0%)	willate	P (100)	89.50	3.87	1.62	5.49	27.75	
Su	n	nean	88.50	3.74	1.55	5.29	27.50	
	Am.	P (0)	89.00	3.52	1.53	5.05	27.50	
	Aiii. Sulphate	P (50)	90.50	4.05	1.57	5.62	28.00	
	Juipilale	P (100)	91.00	4.60	1.73	6.33	28.25	
	n	nean	90.17	4.06	1.61	5.67	28.13	
		P (0)	91.00	3.31	1.79	5.10	28.00	
	Urea	P (50)	93.00	4.04	2.01	6.05	28.75	
		P (100)	95.00	4.03	2.02	6.05	28.75	
%	n	nean	93.00	3.79	1.94	5.73	28.50	
Sulphur (50%)	Am.	P (0)	94.00	3.97	2.01	5.98	28.75	
'n	Nitrate	P (50)	97.00	4.31	2.03	6.35	29.75	
bh		P (100)	97.50	4.37	2.11	6.48	29.50	
Jn.	mean		96.17	4.22	2.05	6.27	29.33	
0,	Am.	P (0)	96.00	4.24	2.03	6.28	29.00	
	Am. Sulphate	P (50)	98.00	4.53	2.06	6.60	29.75	
		P (100)	99.00	5.09	2.22	7.31	30.00	
	n	nean	97.67	4.62	2.10	6.73	29.88	
		P (0)	93.00	3.56	2.04	5.59	29.00	
	Urea	P (50)	96.00	4.28	2.26	6.54	30.00	
		P (100)	98.00	4.25	2.27	6.51	30.25	
Sulphur (100%)	n	nean	95.67	4.03	2.19	6.22	29.75	
10	Am.	P (0)	95.00	4.24	2.26	6.50	29.75	
<u> </u>	Am. Nitrate	P (50)	99.00	4.56	2.28	6.85	30.50	
)ht	14III ale	P (100)	101.00	4.60	2.36	6.97	31.00	
풀	mean		98.33	4.47	2.30	6.77	30.42	
S	Am. Sulphate	P (0)	98.00	4.49	2.32	6.81	30.50	
		P (50)	100.00	4.80	2.31	7.12	31.25	
		P (100)	102.00	5.35	2.46	7.81	31.50	
	mean		100.00	4.88	2.36	7.24	31.08	
L.S.D	at 0.05	S*N*P	2.448	0.502	0.253	0.399	2.191	

2- Weight of 100 grain: Tables (3 and 4) illustrate that weight of 100 grains of wheat or maize responded positively and significantly to application of the elemental sulphur especially by increasing rate of its application. Also, nitrogen applied in the form of ammonium sulphate resulted in the highest values of this parameter whereas its application in the urea form was associated with the lowest ones. Meanwhile, increasing rate of the applied P seemed to be associated with corresponding increases in weight of 100 grain values.

Effect of the applied different fertilization treatments on wheat and maize yields:

Data presented in Tables (3 and 4) reveal that both grain and straw yields as well as the biological yield were significantly affected by rate of the

applied sulphur, form of the applied nitrogen and rate of the applied phosphate. The higher the rate of the applied sulphur, the higher the grain, straw and biological yields. These results are in agreement with those obtained by Khalifa et al. (2007) who found highly significant increases in straw, grain and biological yields of both wheat and maize plants grown on the studied calcareous soil.

Table (4): Effect of different applied fertilizers treatments on maize yield parameter under cattle waste applications

parameter under cattle waste applications.								
	Applied		Plant height	Straw	Grain	Biological	weight of 100	
	treatments		(cm)	ton/fed	ton/fed	ton/fed	grain (g)	
		P (0)	170.00	8.08	5.15	13.23	42.10	
	Urea	P (50)	184.00	8.22	5.52	13.74	42.40	
		P (100)	198.00	8.88	5.86	14.74	42.50	
%	mean		184.00	8.39	5.51	13.90	42.33	
ಲ	Am.	P (0)	177.00	8.17	5.34	13.51	43.35	
<u> </u>	Nitrat	P (50)	189.00	8.37	5.76	14.13	43.60	
Sulphur (0%)	IVILI at	P (100)	215.00	8.92	6.11	15.03	43.75	
Su	me	an	193.67	8.49	5.74	14.22	43.57	
	Λ	P (0)	188.00	8.18	5.63	13.81	43.55	
	Am. Sulphate	P (50)	195.00	8.75	5.80	14.55	43.75	
	Suipriate	P (100)	216.00	8.85	6.37	15.22	43.90	
	me		205.50	8.80	6.09	14.89	43.73	
		P (0)	186.00	8.22	6.13	14.35	43.50	
	Urea	P (50)	197.00	8.37	6.89	15.26	44.00	
		P (100)	206.00	9.11	7.11	16.22	44.60	
%	me	an	196.33	8.57	6.71	15.28	44.03	
Sulphur (50%)	Am.	P (0)	194.00	8.18	6.77	14.95	44.00	
'n	Nitrate	P (50)	202.00	9.27	7.15	16.42	45.20	
선		P (100)	218.00	9.33	7.32	16.65	45.45	
l lig	mean		204.67	8.93	7.08	16.01	44.88	
0,	Am.	P (0)	198.00	9.17	7.01	16.18	44.50	
	Sulphate	P (50)	217.00	9.85	7.35	17.20	45.70	
		P (100)	222.00	9.88	7.56	17.44	45.90	
	me		219.50	9.87	7.46	17.32	45.37	
		P (0)	195.00	9.45	7.44	16.89	45.00	
	Urea	P (50)	206.00	9.88	7.93	17.81	45.39	
		P (100)	211.00	10.12	8.27	18.39	45.80	
%	me		204.00	9.82	7.88	17.70	45.40	
1 5	Am.	P (0)	197.00	10.27	7.77	18.04	45.50	
=	Nitrate	P (50)	209.00	10.33	7.93	18.26	45.30	
Sulphur (100%)	Milate	P (100)	215.00	10.62	8.45	19.07	46.70	
	me		207.00	10.41	8.05	18.46	45.83	
	Am.	P (0)	205.00	10.22	8.16	18.38	46.00	
	Am. Sulphate	P (50)	224.00	10.65	8.56	19.21	46.90	
	Juipilate	P (100)	233.00	10.72	8.90	19.62	47.20	
	mean		220.67	10.53	8.54	19.07	46.70	
L.S.D	at 0.05	S*N*P	42.410	0.103	0.198	0.395	0.453	

Likewise, yield response to applied S has been reported for crops such as oilseed rape, barley, wheat and grass (Syers et al., 1987, Mc Grath and Zhao, 1995 a, Mc Grath et al., 1996; Zaho et al., 1999). Also, El-Syed et al. (2005) found that the dry matter yield of faba bean seeds, straw and the whole plant increased significantly due to application of S.

The nitrogen applied in the form of ammonium sulphate was of a superior effect on yield components than that applied in the form of ammonium nitrate. Also, the nitrogen applied in the ammonium nitrate resulted in higher yield components than that applied in the form of urea which resulted in the lowest yield components.

Application of phosphorus was of an obvious effect on the yield components, yet the effect became more pronounced by increasing rate of the applied phosphate. A similar finding was attained by Khalifa *et al.* (2007) who declared that grain yield exhibited a similar trend to that of straw yield in relation to P fertilization rate.

Effect of the applied fertilization treatments on NPK uptake: 1-Effect on N uptake:

Effects of the applied cattle waste (CW) as well as sulphur, nitrogenous form and phosphorus on values of N, P and K uptake by both wheat and maize plants are shown in Tables (5 and 6).

It is obvious that, applied sulphur could result in increases in nitrogen uptake values by grains and straw of both the investigated plants. The increases become more obvious with increasing rate of the applied sulphur. This result stand in well agreement with that of El-Sayed *et al.* (2005) who found that N-uptake by faba bean seeds, straw and whole plant increased significantly due to application of sulphur. Khater *et al.* (2002) assured the aforementioned finding where they declared that nutrient uptake values of N, P and K by wheat grain and straw were significantly increased due to application of the elemental sulphur.

Application of N, regardless of its applied form resulted in higher N-uptake values by grains and straw of both the studied plants as compared with the corresponding N-uptake values attained in control treatment which did not receive N-fertilizer. Generally, values of N uptake by grains were obviously higher than the corresponding values of N uptake by straw. A similar finding was reported by Khalifa *et al.* (2007) who attributed that to the higher concentration of N in grains than in straw. Likewise, values of N uptake by both grains and straw of maize plants were obviously higher than the corresponding values of N uptake by wheat. The higher dry matter yield of maize plant may account for such a result.

The nitrogen fertilizer applied as urea resulted in N uptake values lower than those achieved due to its application in the form of ammonium nitrate, however, the highest values of N uptake by both grains and straw of both the investigated plants were attained due to application of N as ammonium sulphate.

A positive effect on values of N uptake by both grains and straw of the investigated plants was exerted due to application of phosphorus; the effect seemed markedly higher upon application of the higher rates of P. This result stands in well agreement with that of Khalifa *et al.* (2007) who stated that N-uptake by grains and straw of wheat increased significantly and progressively by application of P in both absence and presence of applied S. However, the presence of sulphur enhanced the effect of the applied P on N uptake. Negm *et al.* (2001, 2002 and 2003) went almost to similar results where they found that application of compost, S and P increased N-uptake by tested crops.

Table (5): Effect of different applied fertilizers treatments on NPK uptake (kg/fed) under cattle waste manure applications.

	(Kg/red) under cattle waste manure applications.							
	Applie	2 a	NPK uptake in wheat (kg/				/rea) K	
	treatments							_
		D (0)	Grain	Straw	Grain	Straw	Grain	Straw
		P (0)	24.72	16.50	6.96	2.45	8.62	39.69
	Urea	P (50)	30.49	26.89	9.25	3.93	10.47	59.06
		P (100)	33.92	30.41	9.95	4.24	11.48	66.95
%	n	nean	29.71	24.60	8.72	3.54	10.19	55.23
ě	Am.	P (0)	32.23	24.01	9.48	3.88	10.79	73.77
≒	Nitrat	P (50)	35.36	31.71	10.46	4.99	10.88	82.49
h		P (100)	39.54	36.41	12.16	6.20	12.64	86.99
Sulphur (0%)	n	nean	35.71	30.71	10.70	5.02	11.44	81.08
0,	Am.	P (0)	35.96	31.54	9.56	4.61	12.55	81.11
	Sulphat	P (50)	38.71	36.90	12.14	7.30	13.20	97.70
	•	P (100)	44.13	43.41	14.54	9.68	14.73	109.70
	mean		39.60	37.28	12.08	7.20	13.49	96.17
		P (0)	36.72	22.76	11.13	4.87	12.96	85.71
	Urea	P (50)	45.03	44.73	14.27	6.99	15.07	102.60
		P (100)	47.67	45.57	14.54	7.25	16.42	86.53
%	n	nean	43.14	37.68	13.31	6.37	14.82	91.62
Sulphur (50%)	Am.	P (0)	44.36	44.22	14.00	6.87	15.47	97.28
<u> </u>	Nitrat	P (50)	55.56	51.74	15.27	8.22	15.87	97.35
ם	Milial	P (100)	59.95	51.64	17.43	9.63	17.73	91.35
읔	n	nean	53.29	49.20	15.57	8.24	16.36	95.32
งิ	Am.	P (0)	49.85	48.56	14.59	8.07	18.30	96.20
	Sulphat	P (50)	54.95	54.33	17.91	10.94	18.71	96.95
	Suipiiai	P (100)	65.01	63.34	20.24	13.75	20.21	112.70
	mean		56.61	55.41	17.58	10.92	19.07	101.95
		P (0)	43.48	27.45	11.23	7.25	15.96	97.33
	Urea	P (50)	49.70	48.10	15.70	9.99	18.33	108.02
		P (100)	50.45	49.09	16.38	10.18	19.81	104.03
6	mean		47.88	41.55	14.44	9.14	18.03	103.13
10	Δ	P (0)	38.97	51.30	16.87	9.88	18.81	100.93
	Am.	P (50)	51.47	55.84	18.55	11.41	19.18	105.71
Sulphur (100)	Nitrat	P (100)	55.87	56.82	20.14	12.89	21.28	107.55
읔	mean		48.77	54.65	18.52	11.39	19.76	104.73
Š	Am.	P (0)	59.66	54.18	17.92	19.41	20.86	112.43
		P (50)	60.84	58.97	20.41	14.74	22.36	106.35
	Sulphat	P (100)	68.57	67.03	22.81	17.63	23.90	115.17
	mean		63.02	60.06	20.38	17.26	22.37	111.32
L.S.D. at 0.05		6.437	5.456	1.452	5.349	12.740	1.565	

2-Effect on P uptake:

Results illustrated in Tables (5 and 6) reveal that applied sulphur increased values of P uptake by grains and straw of both maize and wheat plants. The highest rate of the applied sulphur i.e. 100% of the recommended dose was associated with the highest P uptake values regardless of form of the applied N, rate of the applied P. Sulphur might be biologically oxidized to sulphur trioxide:

$$2S + 3O_2 \xrightarrow{Bacillus} 2SO_3$$

Sulphur trioxide reacts with water resulting in sulphuric acid, which in turn causes soil pH to be reduced and phosphate availability and hence its uptake to increase:

 $SO_3 + H_2O \longrightarrow H_2SO_4$

As it is expected, the higher the rate of the applied sulphur, the higher the concentration of the resulted sulphuric acid and consequently the higher the available content of available phosphate and its uptake values by plants. These results are in accordance with those of Khalifa *et al.* (2007) who indicated that application of sulphur enhanced availability of P and hence its uptake by plant.

Table (6): Effect of different applied fertilizers treatments on NPK uptake (kg/fed) under cattle waste manure applications.

	Applied NPK uptake in maize (kg/fed)							
			N		P		,, К	
	treatme	nts	Grain	Straw	Grain	Straw	Grain	Straw
		P (0)	148.39	60.01	12.37	11.84	121.06	115.41
	Urea	P (50)	166.24	69.93	13.09	11.52	131.49	125.03
	ľ	P (100)	181.33	80.81	15.25	14.21	144.17	133.47
~	mean		165.32	70.25	13.57	12.52	132.24	124.64
%	A	P (0)	157.46	62.95	13.35	13.90	92.01	119.89
	Am.	P (50)	178.71	72.87	16.13	13.69	138.75	130.64
ļ ļ	Nitrat	P (100)	193.04	85.64	17.75	15.77	152.24	138.28
Sulphur (0%)	m	nean	176.41	73.82	15.74	14.46	127.67	129.60
Ō	Α	P (0)	170.43	66.25	15.21	15.82	135.07	122.41
	Am. Sulphat	P (50)	184.14	77.89	17.35	18.67	143.49	138.55
	Suipnat	P (100)	204.45	85.85	19.58	14.18	156.83	140.73
	mean		186.34	76.66	17.38	16.22	145.13	133.90
_		P (0)	215.55	62.52	18.43	11.24	142.92	115.14
	Urea	P (50)	248.66	75.39	16.32	12.85	163.91	121.42
		P (100)	265.74	90.20	18.26	13.97	171.20	135.75
્ર	m	nean	243.32	76.03	17.67	12.69	159.35	124.10
Sulphur (50%)	Λ	P (0)	238.07	66.26	17.63	15.00	161.23	116.66
1	Am. Nitrat	P (50)	243.44	70.15	18.86	16.14	167.54	122.01
þ		P (100)	255.48	84.72	17.87	19.48	169.87	138.19
윽	m	mean		73.71	18.12	16.87	166.21	125.62
รัง	Am.	P (0)	264.20	90.51	20.06	18.05	179.19	145.57
	Sulphat	P (50)	253.44	77.11	20.50	21.11	167.93	139.50
	Sulphat	P (100)	283.73	93.20	20.10	26.21	183.31	152.07
	mean		267.13	86.94	20.22	21.79	176.81	145.71
		P (0)	298.52	97.79	21.45	12.85	191.79	161.01
	Urea	P (50)	279.02	71.58	24.58	13.24	170.29	133.94
		P (100)	296.75	93.88	19.01	15.82	190.79	147.24
6	mean		291.43	87.75	21.68	13.97	184.29	147.39
9	Am.	P (0)	312.09	109.31	19.89	15.28	197.01	154.80
Sulphur (100)	Nitrat	P (50)	285.77	89.39	22.78	18.50	184.51	146.92
	ivilial	P (100)	304.12	98.68	21.12	24.46	196.41	152.65
	m	nean	300.66	99.13	21.26	19.41	192.64	151.46
တ	Am. Sulphat	P (0)	323.09	103.70	22.58	17.95	198.30	159.25
		P (50)	310.24	88.29	22.45	21.14	198.09	154.05
		P (100)	336.37	109.74	24.33	28.41	217.22	173.97
	mean		323.23	100.58	23.12	22.50	204.54	162.43
	L.S.D. at	0.05	6.540	3.721	2.539	2.479	3.502	7.452

Tables (5 and 6) illustrate that form of the applied N was of an obvious effect on values of P taken up by grains and straw of the investigated plants. In this concern, it could be observed that the studied forms could be arranged according to their effect on increasing P uptake values in the following descending sequence: ammonium sulphate> ammonium nitrate> urea. The residual acidic effect of the ammonium sulphate might contribute to improve P availability and consequently its uptake by plant. However, the enhancing effect of applied N on plant growth as a whole and its dry matter yield should have participated in increasing P-uptake values.

Application of phosphate was noticed to be associated with corresponding increases in its uptake values by grains and straw of the investigated plants (Tables, 5 and 6). Increasing rate of the applied P was associated with corresponding increase values of its uptake by both the investigated plants. These results agree with those of Khalifa *et al.* (2007) who reported that values of P-uptake responded positively to increasing rates of the applied P and S.

The same abovementioned tables illustrate that values of P uptake by grains were, generally, higher than the corresponding ones of straw. On the other hand, Khalifa *et al.* (2007) pointed out that values of P-uptake by grains were almost equal to the values of P-uptake by straw. Furthermore, these values were higher in wheat than maize.

3-Effect on K uptake:

Data presented in Tables (5 and 6) reveal that values of K uptake were in direct proportion to rate of the applied sulphur where these values were highest when applied sulphur was at 100% of its recommended dose i.e. Kuptake values by both wheat and maize plants showed almost similar trends to those of N and P. This observation hold true for both grains and straw of the cultivated plants. These results are in accordance with those of Khalifa *et al.* (2007).

Form of the applied nitrogen seemed of an obvious effect on K uptake values. The ammonium sulphate form resulted in the highest K uptake values whereas urea fertilizer was associated generally with the lowest K uptake values while ammonium nitrate fertilizer resulted in K uptake values inbetween those attained due to the two aforementioned N fertilizers. Such a finding characterized both grains and straw of both cultivated plants, yet it is worthy to indicate that values of K uptake differed according to type of the cultivated plant and organ of the plant. The values of K uptake by grains of the maize plant exceeded the corresponding ones that were taken up by straw. On the other hand, values of K uptake by straw of the wheat plant were far higher than values of the K uptake by grain.

Rate of the applied P seemed to be of a pronounced effect on values of K uptake. The increase in rate of the applied P was associated with a corresponding increase in P uptake values by both grains and straw of both maize and wheat plants. The increase in applied rate of P must have provided a more favorable effect for plant growth, consequently K uptake increased probably due to increase in dry matter yield. Similar results were obtained by Khalifa *et al.* (2007) who found that K-uptake values tended to increase with increasing rate of the applied P.

The aforementioned results showed that the beneficial effect of the used fertilization treatments on growth of wheat plant grown on the calcareous soil was highest upon of S at its recommended rate, N in the ammonium sulphate form and P at its recommended rate. The applied cattle waste material seemed to be of an enhancing effect on action of the abovementioned fertilization treatments. It is of importance also to indicate that effects of the used fertilization treatments extended to the maize plants which were cultivated succeeding wheat on the same soil.

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الأثر الناجم عن إضافة مخلفات الماشية مقترنة بكل من الكبريت والنتروجين والفوسفور على محصولى القمح والذرة المنزرعة بأرض جيرية حسن حمزة عباس' ، أبو النصر هاشم عبدالحميد' ، عصمت حسن عبدالحميد نوفل' ، سمير محمد عبدالعزيز و محمد فؤاد عبدالعزيز المسمير محمد عبدالعزيز و محمد فؤاد عبدالعزيز المسمير محمد عبدالعزيز و محمد فؤاد عبدالعزيز المسمير محمد الزراعية – المبيزة . الم

أجرى هذا البحث بهدف دراسة التأثير المباشر والآثر المتبقى لإضافة سماد مخلفات الماشية، ومعدلات مختلفة من عنصرى الكبريت والفوسفور إلى جانب صور مختلفة من الأسمدة النيتروجينية على نمو محصولى القمح والذرة ومكوناتهما المنزرعة بأراض جيرية. ولتحقيق هذا الهدف، أقيمت تجربة حقلية بأحد المزارع الخاصة بالنوبارية والتي تحتوى على نسبة 37% من كربونات الكالسيوم. أضيف سماد مخلفات المواشى بمعدل 11 طن/فدان وأضيف الكبريت العنصرى بمعدلات 11 من أو 11 من الجرعة الموصى بها 11 كجم/فدان)، بينما أضيفت الأسمدة النتروجينية في ثلاثة صور هي اليوريا ونترات الامونيوم وكبريتات الامونيوم بمعدل 11 كجم المربية سماد السوبرفوسفات (P_2O_5) بمعدلات 11 من أو 11 من الجرعة الموصى بها 11 من الموصى بها (11 كما أضيف سماد السوبرفوسفات التجربة في تصميم القطع المنشقة مرتين.

رَرعُ القمح (Triticum aestivum L) ، الجيزة ١٦٣) خلال النصف الأول من نوفمبر ٢٠٠٥ ثم حصد في مايو ٢٠٠٦. و لدراسة الأثر المتبقي من المعاملات المذكورة آنفا تم زراعة الذرة (Zea maize صنف فردى هجين ١٠) في نفس القطع التجريبية خلال النصف الثاني من أبريل ٢٠٠٦ وحصاده في نهاية أغسطس.

أظهرت النتائج المتحصل عليها زيادة معنوية لكلا من طول النبات ووزن المائة حبة والمحتوى من العناصر الغذائية NPK نتيجة إضافة مخلفات الماشية إلى جانب المعدل الأعلى من الكبريت والفوسفور في وجود سماد كبريتات الامونيوم. أرتفع محصول كل من الحبوب والقش وكذلك المحصول البيولوجي لكلا المحصولين.

أدت إضافة الكبريت العنصرى إلى زيادة قيم النيتروجين الممتص بكل من محصولى الحبوب والقش للقمح والذرة. و بغض النظر عن الصورة المضافة من النيتروجين فقد زادت قيم النيتروجين الممتص في حبوب وقش كلا المحصولين مقارنة بتلك القيم في معاملة الكنترول. وقد كانت أعلى قيمة للنيتروجين الممتص عند إضافة النيتروجين في صورة كبريتات الأمونيوم.

أيضاً، كان لإضافة الكبريت العنصرى أبلغ الأثر فى زيادة تيسر الفوسفور وبالتالى إمتصاصه. ويمكن ترتيب الصور النيتروجينية وفقاً لتأثير هاعلى زيادة قيم الفوسفور الممتص كما يلى: كبريتات الأمونيوم> نترات الأمونيوم> اليوريا. علاوة على ذلك، تلاحظ أن أضافة الفوسفات كان مرتبطاً بزيادة إمتصاصه بكل من حبوب وقش القمح والذرة. ومن جهة أخرى، تناسبت قيم البوتاسيوم الممتص كانت تسير فى البوتاسيوم الممتص كانت تسير فى نفس إتجاه كلا من النيتروجين والفوسفور.

بلغت قيم للبوتاسيوم الممتص أعلى قيمة لها عند إضافة السماد النيتروجيني في صورة كبريتات الأمونيوم بينما كانت أقل قيمة عند إضافة سماد اليوريا.

والجدير بالذكر التأكيد على الآثار المفيدة لإضافة المعاملات السمادية على نباتات الذرة عقب زراعة القمح وبنفس القطع التجريبية.