Effect of Organic Manure and Sulphur Applications on Yield and Yield Components of Maize (*Zea mays* L.) Grown on Calcareous Soils

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ABSTRACT

Two field experiments were conducted during summer seasons of 2002 and 2003 at Nubaria Agriculture Research Station, Northwest of Egyptian Nile Delta, to study the response of maize to organic manure and elemental sulphur applications. A split plot design was used in this investigation with 4 replications. Three rates of organic manure fertilizer included zero, 20 and 40 m^3 fad^{-1}. Five rates of elemental sulphur treatments were zero, 200, 400, 600 and 800 kg fad^{-1}. Recommended fertilizers were applied at the proper time included 120 kg N, 30 kg P_2O_5 and 24 kg K_2O per faddan. Data were recorded for silking date (d), plant and ear heights (cm), ear length and width (cm), 500-kernel weight (g), leaf area (cm^2), leaf dry weight (g), and grain yield in ard fad^{-1}.

The following results were obtained:

1- **Grain yield responded significantly to organic manure and sulphur application for each season. Differences in grain yield between manure treatments at the second season were less than that of first season. However, differences due to sulphur treatments at the second season were more than those of first season. Interaction of manure x sulphur was not significant on each season for grain yield, ear width, ear height and mean of leaf dry weight.**

2- **The role of manure fertilizer was clear at least on first grown season after application. Elemental sulphur was more available at the second season for all studied traits except ear height.**

3- **Grain yield of no manure or sulphur applications (control) was mostly a good yielding because all experimental plots received the recommended amount of mineral fertilizers. Other manure treatments (20 and 40m^3 fad^{-1}) were significantly more than control treatment for both seasons (27.65, 32.26, 24.96 and 27.31, respectively).**

4- **Sulphur treatments were significantly different than control of grain yield on both seasons, but it were not significant between them at first season, where it yielded 28.31, 28.93, 28.99 and 29.11 respectively compared with 25.64 ard fad $^{-1}$ of control treatment. Means of grain yield on second season were 23.13 ard fad^{-1} for control treatment, while the application of 200, 400, 600 and 800 kg fad^{-1} had 24.25, 25.10, 25.93 and 27.41, respectively.**

5- **Relative increasing yield ranged from 7.4 to 30.7 with an average 16.9% of manure applications over seasons, in addition it ranged from 4.8 to 18.5 with average of 10.6% for sulphur treatments. These results reflected that relative increasing yield due to manure application was more than that of sulphur application especially on first growing season. These results also revealed that the manure application is more important to increase yield maize on calcareous soil at least on the first growing season, but sulphur application is more important to corn productivity for few years.**

6- **Phenotypic positive correlation values between grain yield and both of kernel weight, plant height, and leaf area were high positive significant values for both seasons. These results indicated that kernel weight is a main component of yield at first season, while ear length is a main component followed by kernel weight and ear width at the second season. Silking date had negative phenotypic correlation with all studied traits.**

Key words: **Maize, Manure, Sulphur, residual effect, Calcareous soil, correlation.**

INTRODUCTION

Maize is one of the most important strategy cereal crops in Egypt. The total production of maize in 2003 season reached about 5.76 million tons resulted from an area of 1.66 million faddans (faddan = 4200 m^2). Most of that area is planted by high yielding hybrids. Maize productivity increased from 10.8 ard. fad^{-1} (ardab = 140 kg) in 1980 to 24.80 ard. fad^{-1} in 2003. This increase in productivity has been realized as a result of different factors such as release of high yielding hybrids and fertilizers.

Soils of Nubaria area are mainly characterized with low organic matter contents and unstable aggregates. These poor physical conditions limit plant productivity. Sulphur and organic residues are the most important amendments used for soil reclamation and improvement, especially for calcareous soils. Several studies showed that yields of crops were increased by sulphur application. Badr El-Din *et al.* (1981) found that sulphur application at the rate of 480 kg ha^{-1} to calcareous soil had the highest marked affect on yield and P uptake of two-crop rotation (bean and corn). Hilal *et al.* (1990) studied the response of some crops

and vegetables to optimum application rates of sulphur on calcareous soils. They reported that the yield was increased by 38, 40, 77, 51 and 22% for wheaf, corn, fodder beats, garlic and cucumber, respectively. Also, some studies showed that sulphur application with organic manure and NP fertilizer combinations led to decrease in soil pH and increase in the availability of P, Fe, Zn and Mn, in highly calcareous soil at west Nubaria region (Awad *et al.* 1996; El-Fayoumy, 1996 and El-Fayoumy and El-Gamal, 1998).

Great attention is given on new reclaimed lands to raise micronutrients extractability by plants. There has been an increase concern about the role of sulphur application as soil amendment and as a factor increasing fertilizer use efficiency in calcareous soil. Also, elemental sulphur has been used to reduce alkalinity and to reclaim the calcareous soils (Abo-Rady *et al.* 1988 and Modaihsh *et al.* 1989). Elemental sulphur is oxidized by soil microorganisms to sulphate which in turn lowers soil pH, improves soil structure and increases the availability of certain plant nutrients (Abd El-Fattah *et al.*, 1984 and Abd El-Fattah and Hilal 1985).

Dawood *et al.* (1990) reported that it is recommended to apply organic matter with sulphur. In addition, application of organic matter caused a remarkable extra increase in dry matter and seed weight of wheat when applied with sulphur. El-Maghraby *et al.* (1996) found that grain yield of wheat was significantly increased as a result of adding S and organic manure. Also, Ramadan *et al* (1996) reporte fertilizers reduce soil pH and improved the nutrients availability for wheat grown on calcareous soils.

The purpose of this study is to investigate the effect and residual effects of elemental sulphur mixed with organic manure on productivity of corn in calcareous soil at Nubaria area.

MATERIALS AND METHODS

Two field experiments were conducted during summer seasons of 2002 and 2003 at Nubaria Agriculture Research Station, Agriculture Research Center, Northwest of Egyptian Nile Delta, to study the response of maize (*Zea mays* L.) to organic manure and elemental sulphur applications. The physical and chemical characteristics of the experimental site soil (Calciorthids) were determined according to the methods described by page *et al.*, (1982) and presented in table 1.

The first field experiment was carried out by planting maize (white single-cross 123) during summer season of 2002, then in winter season of 2002/2003, maize followed by barely crop to balance the

residual applied treatments in the winter season The same experimental plots of 2002 season were done at the same area during summer season

Table 1. Chemical and physical characteristics of the experimental soil at nubaria agriculture research station.

Characters	Soil pH 1 : 2.5	E.C., * ds/m	$CaCO_3$ %	Organic matter %	$NaHCO_3$ P µg/g soil	K_2SO_4 N µg/g soil	Soluble cations, meq/l *			
							Ca^{2+}	Mg^{2+}	K^+	Na^+
0 – 30	7.85	1.55	26.6	0.70	18.6	28.0	7.58	4.23	0.74	2.95
30 - 60	7.89	1.47	30.0	0.55	28.0	28.0	5.86	5.22	0.67	2.95

Characters	Soluble anions, meq/l *				Mechnical analysis			Soil texture
	CO_3^{-2}	HCO_3^-	SO_4^{-2}	CL^-	Sand%	Silt%	Clay%	
0 – 30	0.0	5.00	1.65	8.85	65.0	12.50	22.50	Sand clay loam
30 - 60	0.0	4.50	2.30	7.90	57.5	18.75	23.75	

* E.C., Soluble cations and anions in soil paste ext.

of 2003 without any application of organic manure or elemental sulphur. Maize variety (white single-cross 123) was planted in the second season to study the residual effect of applied organic manure and elemental sulphur of the first season.

A split plot design was used in each experiment with 4 replications. Three different organic manure rates (zero, 20 and 40 m^3 fad^{-1}) represented the main plots. Five elemental sulphur rates represented the sub-plots. Rates of elemental sulphur were zero, 200, 400, 600 and 800 kg fad^{-1}. The elemental sulphur amounts were well-mixed before application with organic manure and were added approximately 30 cm depth before two weeks of cultivation for each plot. Each sub-plot consisted of 5 rows, 6 m long and 0.7 m width with 25 cm between hills. Recommended fertilizers were applied at the proper time included 120 kg N, 30 kg P_2O_5 and 24 kg K_2O per faddan. All other recommended agricultural practices for corn production were followed as common in the experimental area.

All plants of the 2nd and 3rd rows from each plot were harvested at proper time. All plants in the 4th row were cut at the soil surface, weighted and chopped; a sample of 0.5 kg was kept for chemical analysis. Five green leaves were cut from each plot to measure mean of leaf area after flowering date, and then dried, weighted to calculate mean of leaf dry weight. Data were recorded for silking date (d), plant and ear heights (cm), ear length and width (cm), 500 kernel weight (g), leaf area (cm^2), leaf dry weight (g), and grain yield in kg/plot adjusted at 15.5% grain moisture and converted to ardab per faddan (ard fad^{-1}).

All data were subjected to statistical analysis as outlined by Steel and Torrie (1980) using proc ANOVA at SAS software (SAS user's guide 6.12 ed. 1997).

RESULTS AND DISCUSSION

Grain yield (ard fad^{-1}) responded significantly to organic manure and sulphur application for each season separately (Table 2). Differences in grain yield between manure treatments at the second season were less than that of the first season. On the other hand, differences due to sulphur treatments at the second season were more than that of the first season. Interaction of manure x sulphur was not significant at each season for grain yield, ear width, ear height and mean of leaf dry weight, while it was significantly different for kernel weight, ear length, plant height on both seasons and significantly different for silking date and mean of leaf area at first season only.

The high differences in grain yield and other traits between manure treatments at the first season revealed that the role of manure fertilizer was very important especially after the first time of application. Elemental sulphur was more available at the second season for all studied traits except ear height (Table 2). These results are agreed with those of Bahman *et al.* 2004. They reported that the residual effects of manure on corn production and soil properties can last for several years and the residual affects of N and P based manure application lasted for at least one growing season while the effects on soil properties were longer lasting.

Table 2. Means of square for grain yield and other agronomic traits of manure and sulphur fertilizers at 2002 and 2003 seasons.

S.O.V.	df	Grain yield	Kernel weight	Ear length	Ear Width	Silking date	Plant height	Ear Height	Leaf area	Leaf dry weight
SEASON – 2002										
Replicates	3	2.56	3.25	0.24	0.02	10.91	7.93	186.59	191.83	0.13
Manure (Man)	2	271.51**	2302.84**	2.92**	0.09	11.27	6835.55**	3670.40**	162126.05**	6.59**
Error-a	6	1.01	9.66	0.08	0.09	3.42	55.19	195.51	276.27	0.16
Sulfur (Sul)	4	4.61*	154.93**	1.08**	0.07	0.52	80.18**	772.27**	5692.56**	0.07
Man x Sul	8	0.70	46.35**	0.33	0.01	0.27	93.57**	269.25	928.63*	0.20
Pooled error	36	1.21	12.02	0.20	0.03	0.58	20.12	154.41	364.59	0.14
C.V.		7.48	6.83	4.28	5.48	1.17	6.08	10.98	2.90	8.67
SEASON – 2003										
Replicates	3	0.74	12.51	0.05	0.04	2.06	22.06	3.66	604.58	0.03
Manure (Man)	2	83.98**	445.03**	6.91**	0.04	1.02	1677.72**	858.07**	14024.62**	3.88**
Error-a	6	0.38	14.18	0.25	0.02	2.59	21.96	11.98	957.86	0.08
Sulfur (Sul)	4	31.74**	250.89**	1.96**	0.08*	1.14	428.56**	208.48**	10631.50**	0.49*
Man x Sul	8	1.73	117.41**	0.52*	0.03	1.27	55.26**	39.73	727.14	0.18
Pooled error	36	0.96	9.38	0.20	0.03	0.46	17.43	23.93	499.56	0.18
C.V.		7.89	7.83	4.56	5.45	1.00	6.27	5.39	3.75	5.12

*,** significant and highly significant differences at 0.05 and 0.01 level, respectively.

Grain yield

Mean of grain yield for each season presented in Table 3. Grain yield of no manure application (control) was mostly a good yielding (24.69 ard fad^{-1}) because this treatment received all recommended amount of fertilizers. Other manure treatments (20 and 40 m^3 fad^{-1}) were significantly more than control treatment, 28.65, 32.26 in the first season and 24.96, 27.31 ard. fad^{-1}, in the second season. Sulphur treatments were significantly different than control (no application), but it were not significant between them at the first season, which it has grain yield about 28.31, 28.99 and 29.11 respectively compared with 25.64 ard fad^{-1} of control treatment. This increasing of yield due to manure application was agreed with results of Buresh *et al,* 1997; and FAO, 1999). They reported that organic inputs are needed to maintain the physical and physico-chemical health of the often shallow, sandy to sandy loam topsoil, while fertilizers are needed to supply a sufficient amount of nutrients to the crop.

Significant differences between sulphur treatments were detected at the second season. Means of grain yield were 23.13 ard fad^{-1} for control treatment, while the application of 200, 400, 600 and 800 kg fad^{-1} had 24.25, 25.10, 25.93 and 27.41 ard fad^{-1}, respectively. Hashem *et al* (1997) reported that N fixing bacteria and sulphur oxidizing bacteria were sharply influenced either by levels of residual S and/or level of applied organic manure.

Relative increasing yield ranged from 7.4 to 30.7 with an average of 16.9% for manure applications across two seasons, while it ranged from 4.8 to 18.5 with average 10.6% for sulphur treatments (Table 3). These results showed that relative increasing yield due to manure application was more effective than that of sulphur application especially on the first growing season. These results also revealed that the manure application is more important to increase yield of corn on calcareous soil at least on the first growing season, but sulphur application is more important to corn productivity for few years. A few experiments in the early literature reported significant responses by maize to sulphur, generally in the range of 12 to 20% increases in yield (e.g., Allen, 1976; Grant and Rowell, 1976; and Kang and Osiname, 1976). Also, Omar (2001) found that incorporation of sulphur rates of 100, 200, 300 and 400 kg/faddan increased grain yield by 8.7, 15, 25.3 and 29.3% over control.

Response of grain yield to manure application was clear at the first growing season, but increasing in grain yield was less at second

Table 3. Mean performance of Manure and Sulphur treatments for grain yield, relative yield increased % and yield Components at 2002 and 2003 seasons.

Treatments	Grain yield (ard/fad)		Relative yield increased %		500-kernel weight (g)		Ear length (cm)		Ear width (cm)	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Manure rates										
0 (control)	24.89	23.23	0.0	0.0	176.7	162.3	19.19	16.55	5.02	4.61
20	28.65	24.96	12.0	7.4	195.1	169.9	19.93	17.42	5.15	4.63
40	32.26	27.31	30.7	17.6	195.5	171.9	19.72	17.67	5.13	4.71
LSD $_{0.05}$	0.78	0.48	---	---	2.4	2.9	0.22	0.38	0.23	0.12
Sulphur rates										
0 (control)	27.64	23.13	0.0	0.0	183.7	163.7	19.18	16.65	4.97	4.55
200	28.31	24.25	10.4	4.8	188.2	166.6	19.57	17.18	5.13	4.66
400	28.93	25.10	12.8	8.5	189.3	166.5	19.63	17.12	5.08	4.64
600	28.99	25.93	13.1	12.1	190.9	168.3	19.66	17.35	5.13	4.68
800	29.11	27.41	13.5	18.5	193.5	174.5	20.02	17.77	5.18	4.71
LSD $_{0.05}$	0.91	0.81	---	---	2.87	2.54	0.37	0.37	0.15	0.14
Mean	28.20	25.17	21.4	12.5	189.1	168.0	19.61	17.21	5.09	4.65

season (Fig. 1). Treatment of 40 m^3 manure application had the highest mean of grain yield Response of grain yield to sulphur application was slowly increasing at the first season, but it was more effective at second season (Fig. 2). The same results were obtained by Kayode and Ojeniyi (1990) who reported that the residual effect of sulphur was apparent in the second year. Also, Soliman *et al.* (1992) found that applied S and N fertilizers increased the availability of micronutrients to following crops in calcareous soils.

Kernel weight

Generally, kernel weight on first season was heavier than that on second season, where the mean of 500-kernel weight were about 189.1 and 168 g, respectively (Table 3). Means of kernel weight not significant different between 20 and 40 m^3 manure applications, but they were significantly different than
control treatment on both seasons. Differences between 200, 400 and 600 kg sulphur applications were not significant different for kernel weight at both seasons (188.2, 189.3, 190.9, 166.6, 166.8 and 168.3 g, respectively), but 800 kg sulphur application was significantly different than other sulphur treatments on second season (174.5 g,). No sulphur application was significantly less than other sulphur treatments on both seasons (183.7 and 163.7 g,).

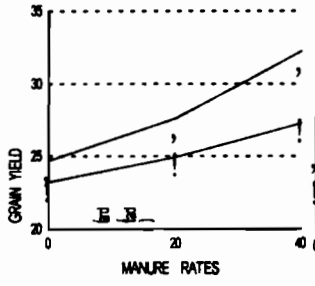

Fig 1. Effect of different manure applications on grain yield.

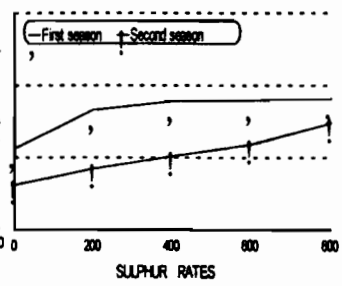

Fig 2. Effect of different sulphur applications on grain yield.

Ear length and width

The mean of ear length, on the first season was higher than that of the second season (19.61 and 17.21 cm,). No manure and sulphur treatments were significantly lower than other treatments for both seasons (Table 3). No significant differences were observed between 20 and 40 m^3 manure applications. Supply of 800 kg sulphur had the highest values of ear length for both seasons (20.02 and 17.77 cm,).

For ear width, manure application was not significant differences for both seasons (Table 3), while sulphur application treatments were significant differences on both seasons. Also, mean of ear width on first season was more than that of second season (5.09 and 4.65 cm, respectively). High value of ear width was observed for high sulphur treatments on both seasons (5.18 and 4.71, respectively).

Silking date

No significant differences were detected between manure or sulphur treatments (Table 4), therefore silking date doesn't affected by these treatments, but plants on second season were later than those on the first season

Plant and ear height

Plants were significantly tallest on first season and also the ears were significantly highest than those on second season (Table 4). Differences due to manure applications were significant different for both seasons. The same trend was observed at each season. Adding 40 m^3 manure had plant height of 233.2 and 191.3 cm, while no manure application had 196.4 and 173.9 cm for both seasons respectively. Application of manure doesn't effective on ear height at the first season, but the differences between manure treatments were significant at the second season. No manure application treatment had significantly lowest ear height (97.6 and 84.2 cm for both seasons), while the highest manure treatments had the biggest ear height for both seasons (119.9 and 97.3 cm, respectively).

On the other hand, the differences due to sulphur application treatments were less at the first growing season than other season. No sulphur application treatment had the lowest value of plant height on both seasons (212.3 and 175.5 cm, respectively), while the highest treatment of sulphur had the tallest plants for both seasons (218.7 and 191.1 cm, respectively).

Table 4. Mean performance of Manure and Sulphur treatments for silking date and other agronomic traits at 2002 and 2003 seasons.

Treatment	Silking date (d)		Plant height (cm)		Ear height (cm)		Leaf area (cm^2)		Leaf dry weight (g)	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Manure rates										
0 (control)	64.25	68.55	196.4	173.9	97.6	84.2	567.1	566.7	7.38	7.74
20	64.95	68.30	217.4	187.4	121.9	90.8	659.4	600.5	8.98	8.41
40	65.75	68.10	233.2	191.3	119.9	97.3	747.1	618.9	9.60	8.57
$LSD_{0.05}$	NS	NS	5.7	3.6	10.8	2.7	12.9	23.9	0.62	0.21
Sulphur rates										
0 (control)	64.67	68.25	212.3	175.5	105.2	86.7	629.4	567.3	8.44	7.95
200	65.00	68.17	214.5	181.4	107.9	89.3	646.1	572.7	8.76	8.15
400	65.00	67.92	214.9	185.5	111.3	88.6	654.8	597.2	8.66	8.24
600	65.00	68.58	217.8	187.4	115.7	91.5	678.2	596.8	8.60	8.42
800	65.25	68.67	218.7	191.1	125.7	97.5	680.8	642.7	8.82	8.44
$LSD_{0.05}$	NS	NS	3.71	3.46	10.3	4.1	15.8	18.5	NS	0.35
Mean	64.98	68.32	215.7	184.2	113.1	90.7	657.9	595.4	8.65	8.24

Leaf area and dry weight

Mean of leaf area was significant highest at the first season than those of the second season (657.9 and 595.4 cm^2). Manure application was significant effects on leaf area especially at the first season (Table 4). Mean of leaf area ranged from 566.7 to 747.1 cm^2 for manure treatments, while it ranged from 567.3 to 680.8 cm^2 for sulphur treatments. Sulphur application effects were less at the first season than the second season. No sulphur application treatment had the lowest significant mean of leaf area for both seasons (629.4 and 567.3 cm^2), while the high application of sulphur had high values of leaf area especially at the second season.

For leaf dry weight, no significant differences were observed between manure treatments, but manure application had significant values of leaf dry weight than control treatment. The mean of leaf dry weight for no manure application were 7.38 and 7.74 g at each season, while it was 9.6 and 8.57 g for the highest treatment of manure. No significant differences were observed for sulphur application at the first season and low significant differences at the second season.

Correlation between traits

Phenotypic positive correlation values between grain yield and both of kernel weight, plant height, leaf area and leaf dry weight were significant on the first season (0.77, 0.91, 0.92 and 0.72, respectively). The same trend was obtained on the second season except for leaf dry weight (Table 5). Also, at the second season, ear length was positive significant correlated with grain yield (0.71). These results indicated that kernel weight is a main component of yield at the first season, while ear length is a main component followed by kernel weight and ear width at the second season.

Silking date had negative phenotypic correlation with all studied traits, but it had high negative significant values with plant height, leaf area and leaf dry weight at the first season (- 0.81, - 0.79 and – 0.67, respectively). Plant height had moderate to high positive significant values of phenotypic correlation with ear height at each season (0.57 and 0.72). Also, moderate values of phenotypic correlation between plant height and ear length on both seasons (0.47 and 0.69) were obtained.

High and moderate significant correlation was obtained between leaf area and leaf dry weight at each season (0.75 and 0.53, respectively). Moderate significant values of correlation were observed for ear length with ear width on both seasons (0.34 and 0.54).

Table 5. Phynotypic correlations between grain yield and other traits for manure and sulphur treatemants at 2002 (above diagonal) and 2003 seasons (below diagonal).

	Grain yield	Kernel weight	Ear length	Ear width	Silking date	Plant height	Ear height	Leaf area	Leaf dry weight
Grain yield	----	0.77	0.40	0.31	- 0.84	0.91	0.51	0.92	0.72
Kernel weight	0.63	—	0.64	0.35	- 0.63	0.81	0.58	0.80	0.73
Ear length	0.71	0.51	-----	0.34	- 0.27	0.47	0.46	0.47	0.45
Ear width	0.61	0.38	0.54	-----	- 0.27	0.31	0.47	0.26	0.30
Silking date	- 0.12	- 0.09	- 0.01	- 0.35	----	- 0.81	- 0.40	- 0.79	- 0.67
Plant height	0.81	0.55	0.69	0.50	- 0.08	-----	0.57	0.92	0.79
Ear height	0.71	0.54	0.63	0.54	- 0.08	0.72	-----	0.55	0.54
Leaf area	0.75	0.60	0.58	0.42	- 0.01	0.69	0.63	-----	0.75
Leaf dry weight	0.58	0.41	0.51	0.39	- 0.13	0.63	0.51	0.53	-----

It could be concluded that organic manure and sulphur fertilizers were significantly effective on grain yield and other yield components of maize. Organic manure application was important for corn productivity, at least on the first growing season after application on calcareous soils. Sulphur fertilizer application was more effective on the second season.

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الملخص العربى

تأثير اضافة السماد العضوى والكبريت على المحصول ومكوناته فى الذره الشاميه المنزرعه فى الأراضى الجيريه

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أجريت تجربتان حقليتان فى موسمى صيف 2002 و2003 بمحطة البحوث الزراعيه بالنوباريه – بهدف دراسة استجابة محصول الذره الشاميه للتسميد العضوى وأيضا اضافة الكبريت فى الأراضى الجيرية بمنطقة النوبارية. استخدم تصميم القطاعات المنشقه فى 4 مكررات وضعت فيها ثلاث معدلات من السماد العضوى (صفر ، 20 و 40 م3 للفدان) فى القطع الرئيسيه بينما وضعت خمس معدلات من الكبريت (صفر ، 200 ، 400 ، 600 و 800 كجم/ف) فى القطع المنشقه. تم اضافة معدلات التسميد المعدنى الموصى بها والتى تشمل 120 كجم نيتروجين ، 30 كجم خامس أكسيد الفوسفور و24 كجم أكسيد البوتاسيوم للفدان في المواعيد المناسبة لإضافتها.

أخذت البيانات على صفات : موعد التزهير ، متوسط ارتفاع النبات والكوز ، متوسط طول وعرض الكوز ، وزن 500 حبه ، متوسط المساحه الورقيه والوزن الجاف للورقه بالاضافه إلي محصول الحبوب مقدراً بالأردب للفدان.

= أوضحت النتائج ما يلى:

كانت استجابة محصول الحبوب للتسميد العضوى و التسميد بالكبريت معنوية في كلا الموسمين لكن كانت الفروق الراجعه الى التسميد العضوى أقل منها فى الموسم الثانى ، بينما كانت الفروق الراجعه الى التسميد بالكبريت أكبر منها فى الموسم الثانى. كان التفاعل بين التسميد العضوى والكبريت غير معنوى لصفات محصول الحبوب ، عرض الكوز ، ارتفاع الكوز وكذلك متوسط الوزن الجاف للورقه.

الدور الراجع الى التسميد العضوى كان أكثر أهميه فى الموسم الأول بينما كان التسميد بالكبريت له دور أكبر فى الموسم الثانى لكل الصفات تحت الدراسه عدا صفة ارتفاع النبات.

كان محصول الحبوب لمعاملة المقارنه (بدون تسميد عضوى أو كبريتى) جيداً وذلك لأن جميع المعملات فى التجربه تم تسميدها بالمعدلات الموصى بها من التسميد المعدنى. تفوقت معاملات التسميد العضوى على معاملة المقارنه وأعطت محصولا يقدر بحوالى 27.65 ، 32.26 ، 24.96 و 27.31 أردب/ف لكلا الموسمين على الترتيب.

تفوقت معاملات التسميد بالكبريت معنويا عن معاملة المقارنه فى كلا الموسمين حيث أعطت محصولا يقدر بحوالى 28.31 ، 28.93 ، 28.99 و 29.11 مقارنة بمعاملة المقارنة (25.64 أردب/ف) فى الموسم الأول. أعطت معاملة المقارنة في الموسم الثاني محصولا يقدر بحوالى

23.13 مقارنة بمعاملات الكبريت الأخرى والتى أعطت محصولا يقدر بحوالى 24.25 ، 25.10 ، 25.93 و 27.41 أردب/ف على الترتيب.

تراوحت الزياده النسبيه لمحصول الحبوب والراجعه للتسميد العضوى من 7.4 الى 30.7 بمتوسط حوالى 16.9% كمتوسط للموسمين بينما تراوحت الزياده النسبيه لمعاملات التسميد بالكبريت من 4.8 الى 18.5 بمتوسط حوالى 10.6%. توضح هذه النتائج أن اضافة التسميد العضوى أعطت زياده فى كمية محصول الحبوب أكبر منها للتسميد بالكبريت خاصة فى الموسم الأول من الاضافه.

ظهرت درجات تلازم معنويه بين صفة محصول الحبوب وكل من متوسط وزن الحبوب ، ارتفاع النبات ومتوسط المساحه الورقيه لكلا الموسمين. يعتبر متوسط وزن الحبوب هو المكون الرئيسى لمحصول الحبوب فى الموسم الأول بينما كانت صفة طول الكوز هى المكون الرئيسى لمحصول الحبوب يليها متوسط وزن الحبوب وعرض الكوز فى الموسم الثانى. أظهرت صفة موعد التزهير علاقات تلازم سالبه مع كل الصفات تحت الدراسه.