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RESPONSE OF ONION PLANTS TO THE FERTILIZATION BY NITROGEN SOURCES AND AGRICULTURAL SULPHUR RATES.

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ABSTRACT

Two field experiments were carried out at the experimental station of National Research Centre, at Shalakan, Kalubia Governorate during the two successive growing seasons of 2004/2005 and 2005/2006 to study the additioneffect of sulphur levels (0, 150 and 300 kg/fed.) and nitrogen source (cattle manure, compost, ammonium nitrate and ammonium sulphate) on growth, yield and bulb quality of onion plants cv. Giza, 20.

Results show that the vegetative growth i.e. plant length, number of leaves, fresh and dry weight of leaves, neck and bulb diameter, bulbing ratio as well as fresh and dry weight of bulb as well as bulb yield and some physical and chemical characteristic (bulb weight, diameter and height as well as bulb content of TSS, N, P, K, total protein and total carbohydrate) were significantiy increased by increasing the level of S-application.

Results also clear that the vegetative growth characteristic and bulb yield and its quality recorded their highest values by using ammonium sulphate as nitrogen source, however, cattle manure gave the lowest values of vegetative growth and bulb yield.

INTRODUCTION

Onion (*Allium cepa L.)* is one of the most important vegetable crops grown in Egypt, not only for local consumption but also for exportation. Sulphur plays an important role in reducing soil-pH and increasing availability of phosphorus and some micronutrients , i. e. Fe, Mn, Zn and Cu (Hetter 1985 and Abd-El-Fatth *et al.*, 1990). In addition, increasing sulphur application resulted an increase in plant uptake of S, N, P and K (Jana *et al* . 1990; Abd-El-Moez *et al*.,1997 and Hanna and Abdoh, 1997). Moreover, many investigators reported that onion plant growth and its productivity were increased by increasing the level of sulphur application (EL-Desuki and Sawan 2001; Channagoudar and Janawade, 2006 and Qureshi and Lawande, 2006).

Nitrogen is essential for synthesis of chlorophyll, enzymes, amino acids and proteins (Devlen and Witham, 1986). So that nitrogen is the most important element for onion growth and productivity (Rizk, 1997; EL-Desuki and Sawan 2001, and EL-Desuki, 2004). Organic fertilizers are less danger for over inorganic fertilizers, it provides a slow release of nutrients as micro-organisms in soil break the organic material down into an inorganic. Added to that, it plays an important role for improving soil physical properties (Awad, 2002 and Rizk *et al.*, 2002). On the other hand, organic fertilizer is not immediately available to the plants and nutrients released from organic fertilizer are not enough for plant requirements. On the other hand, mineral fertilizers (ammonium nitrate or ammonium sulphate) is quick release there for, nitrogen is available to the plants absorption. Many investigators reported

that onion plant growth and its productivity differed according to source of nitrogen application (Iwata, 1983; Gupta *et al.*, 1999; Cabezas-Gutierrez *et al.*, 2007). Moreover, Goncalves *et al.*, (2004) reported that the vegetative growth of onion plant and the relationship between nutrient and disease varied according to mineral and organic sources.

This research aimed to study the effect of the combination between different nitrogen sources and sulphur levels application on vegetative growth of onion plants, bulb yield and quality.

MATERIALS AND METHODS

Two field experiments were carried out at the experimental station of National Research Centre, at Shalakan, Kalubia Governorate during the two successive seasons of 2004/2005 and 2005/2006 to study the addition effect of nitrogen source and sulphur levels on growth, yield and bulb quality of onion plants cv. Giza-20. The soil was clay in texture with pH 8.2 and available N 315 ppm.

Treatments were as follows:

Sulphur level application: Three levels of sulphur were applied (0, 150 and 300 kg s/fed.) which applied during soil preparation before transplanting.

Nitrogen source: Four fertilizers source were used (cattle manure, compost, ammonium nitrate and ammonium sulphate.) which added at recommended doses (100 kg N/fed.). The physical and chemical properties of organic manures used are shown in Table (A). The amounts of ammonium nitrate and ammonium sulphate were divided into two equal portions, first was added during soil preparation but the second one was added at 6 weeks after transplanting. All experimental plots were received the recommended doses of calcium superphosphate and potassium sulphate fertilizers (500 and 200 kg/fed., respectively). Other agriculture practices were carried out as commonly followed in the distract.

Table (A):The physical and chemical analysis of the used organic manures.

Character	Cattle manure	Nile compost
Weight of qubic meter (kg)	750	400
Moisture %	71	30
Ph	7.5	7
Ec (mmhos)	1.4	5
Organic carbon%	7.9	41
Organic matter%	6.5	70
Total nitrogen %	0.5	2
C/N ratio	1:19	1:17
Total phosphoreus %	0.41	0.6
Total potassium %	0.85	6.0
Iron mg/kg	6.5	7900
Manganese mg/kg	1.35	190
Copper mg/kg	11	20
Zinc mg/kg	105	4.75

Onion seedlings cv. Giza-20 were transplanting at the third week of November in the two seasons. Seedlings were planted on ridges of 80 cm width and 3.5 m in length and 10 cm apart. Each plot included 4-ridges and plot area was 11.2 m^2. Treatments were arranged in split-plot design with three replicates. Sulphur treatments were arranged in the main plots, but nitrogen sources were allotted in the sup-plots.

Data recorded:

Vegetative growth: A random sample of 10 plants from each plot was taken at 75 days after transplanting and the following vegetative characters were recorded: plant length (cm), number of leaves(No./plant), fresh and dry weight of leaves (g./plant), neck and bulb diameter (cm), bulbing ratio as well as fresh and dry weight of bulb (g./bulb).

Yield: Total bulb yield was recorded as ton/fed.

Bulb quality: Random sample of 20 bulbs from each plot was taken and the physical properties i.e. average bulb weight, diameter and height were recorded.

Chemical constituents: Bulb content of N, P, K, total protein, total carbohydrate and TSS % were recorded. The methods which were described by Black (1983), Troug and Meyer (1939), Brown and Lilleland (1946) and Dubois et al., (1956) were followed in the determination of total N, P, K and total carbohydrate respectively. However, total soluble solids (TSS %) were determined by using Carl Zies refractometer.

Statistical analysis:

The obtained data were statistically analyzed according to the method described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Vegetative growth:

1. Effect of sulphur level application:

Data in Table (1) show that the vegetative growth of onion plants i.e. plant length, number of leaves, fresh and dry weight of leaves, neck and bulb diameter, bulbing ratio as well as fresh and dry weight of bulb were significantly increased by increasing the level of S-application from 0 up to 300 kg/fed. This result were true in both growing seasons.

This result may be due to the role of sulphur on reducing soil-pH and increasing the availability of phosphorus and some micronutrients (Abd-El-Fatth *et al.*, 1990 ; Jana *et al.*, 1990; Abd-El-Moez *et al.*,1997 and Hanna and Abdoh, 1997. Added to that increasing sulphur application caused an increase in onion plant growth as reported by EL-Desuki and Sawan 2001; Channagoudar and Janawade, 2006 and Qureshi and Lawande, 2006.

2. Effect of nitrogen sources application:

Data in Table (2) show that, the vegetative growth of onion plants were significantly affected by N-source application, except for bulbing ratio as shown in both growing seasons. Results also clear that, the highest values of vegetative growth characters were recorded with that plants fertilized by ammonium sulphate followed by those supplied with ammonium nitrate and then compost. However the lowest values were recorded with that plants received Cow manure as shown in both growing seasons.

Table (1): Effect of sulphur level application on vegetative growth of onion plant during the two seasons of 2004/2005 and 2055/2006.

Sulphur Kg/fed.	Plant Length (cm)	Number of Leaves (No/ plant)	Fresh weight of leaves (g/plant)	Dry weight of leaves (g/plant)	Neck diameter (cm)	Bulb diameter(cm)	Bulbing ratio	Bulb fresh weight (g/plant)	Bulb dry weight (g/plant)
First season (2004/2005)									
0	64.14	8.00	61.68	8.81	1.66	3.19	0.52	75.71	11.25
150	70.88	8.71	69.87	10.12	1.90	3.37	0.56	82.41	12.16
300	73.13	9.17	75.02	10.77	2.13	3.59	0.59	85.90	12.67
L. S. D. at 5%level	0.62	0.70	1.28	0.29	0.02	0.18	0.04	0.64	0.23
Second season (2005/2006)									
0	77.04	9.22	68.52	10.64	1.97	3.66	0.57	88.83	12.58
150	84.88	10.05	77.36	12.14	2.22	3.85	0.61	96.28	13.53
300	87.83	10.67	82.78	12.98	2.51	4.09	0.65	101.14	14.26
L. S. D. at 5%level	0.44	0.62	1.51	0.37	0.06	0.20	0.04	1.62	0.42

Table (2): Effect of nitrogen source application on vegetative growth of onion plant during the two seasons of 2004/2005 and 2055/2006.

N-source	Plant Length (cm)	Number of Leaves (No/plant)	Fresh weight of leaves (g/plant)	Dry weight of leaves (g/plant)	Neck diameter (cm)	Bulb diameter(cm)	Bulbing ratio	Bulb fresh weight (g/plant)	Bulb dry weight (g/plant)
First season									
Compost	66.22	8.44	71.11	10.19	1.76	3.28	0.54	73.81	10.66
Cow-manure	64.44	8.33	55.32	8.08	1.67	2.88	0.50	63.53	9.68
Amm. nitrate	71.37	8.56	72.98	10.48	1.96	3.65	0.58	91.68	13.52
Amm. sulphate	75.49	9.17	76.02	10.86	2.18	3.73	0.62	96.34	14.24
L.S.D. at 5%level	0.80	0.58	1.20	0.15	0.14	0.17	N.S.	0.75	0.13
Second season									
Compost	79.33	9.74	78.48	12.21	2.09	3.73	0.59	86.95	12.00
Cow-manure	77.22	9.57	61.63	9.78	2.00	3.33	0.56	74.88	10.98
Amm. nitrate	85.64	9.86	80.72	12.63	2.28	4.15	0.67	107.00	15.06
Amm. sulphate	90.81	10.73	84.04	13.06	2.55	4.27	0.63	112.83	15.78
L. S. D. at 5%level	1.20	0.67	1.55	0.22	0.18	0.17	N.S.	1.19	0.40

This result may be due to that, ammonium sulphate is suitable for onion plants and great amount of nitrogen is available to the plants absorption which resulted in increasing the vegetative growth. Moreover, Iwata, 1983; Gupta *et al.*, 1999; Cabezas-Gutierrez *et al*, 2007 reported that onion plant growth and its productivity were differed according to source of nitrogen application.

3. Effect of the interaction treatments between sulphur levels and nitrogen sources application:

Results in Table (3) show that vegetative growth parameters were significantly affected by the interaction treatments except for bulb diameter.

neck diameter and bulbing ratio as shown in both growing seasons. Results also clear that, the highest values of onion vegetative growth were recorded with that plants fertilized with the highest level of sulphur application (300 kg/fed.) and ammonium sulphate as nitrogen source. But the lowest values of vegetative growth parameters were recorded with plants received Cow manure without sulphure application.

This result may be due to the role of sulphur application on reducing soil-pH and increasing the availability of phosphorus and some micronutrients which resulted an increase in vegetative growth. Moreover, ammonium sulphate is suitable for onion plants and great amount of nitrogen is available to the plants absorption which resulted in increasing of vegetative growth.

Table (3): Effect of the interaction treatments between sulphur levels and nitrogen source application on vegetative growth of onion plant during the two seasons of 2004/2005 and 2055/2006.

Treatments		Plant Length (cm)	Number of Leaves (No./plant)	Fresh weight of leaves (g/plant)	Dry weight of leaves (g/plant)	Neck diameter (cm)	Bulb diameter (cm)	Bulbing ratio	Bulb fresh weight (g/plant)	Bulb dry weight (g/plant)
Sulphur Kg/fed.	N-source									
First season (2004/2005)										
0	Compost	62.50	7.83	63.42	9.09	1.57	3.03	0.51	70.60	10.05
	Cow-manure	60.50	7.83	53.21	7.60	1.53	2.63	0.48	51.36	8.67
	Amm. nitrate	66.10	7.83	64.63	9.27	1.73	3.50	0.51	85.13	12.30
	Amm.sulphate	67.47	8.50	65.47	9.30	1.80	3.60	0.60	95.73	13.97
150	Compost	65.67	8.50	71.20	10.22	1.73	3.33	0.55	74.06	10.77
	Cow-manure	65.33	8.33	54.53	8.20	1.65	2.93	0.50	64.50	9.51
	Amm. nitrate	73.00	8.67	73.83	10.47	1.93	3.55	0.59	94.54	14.02
	Amm.sulphate	79.50	9.33	79.91	11.61	2.27	3.67	0.62	96.54	14.33
300	Compost	70.50	9.00	78.70	11.25	1.98	3.47	0.57	76.77	11.15
	Cow-manure	67.50	8.83	58.23	8.44	1.83	3.07	0.53	74.72	10.85
	Amm. nitrate	75.00	9.17	80.48	11.71	2.22	3.90	0.63	95.38	14.23
	Amm.sulphate	79.50	9.67	82.68	11.68	2.47	3.93	0.65	96.74	14.43
L. S. D. at 5% level		1.38	N.S.	2.07	0.26	N.S.	N.S.	N.S.	1.30	0.22
Second season (2005/2006)										
0	Compost	75.00	9.01	70.43	10.91	1.89	3.46	0.56	82.94	11.26
	Cow-manure	72.53	8.94	59.19	9.29	1.81	3.07	0.55	61.09	9.94
	Amm. nitrate	79.32	9.01	71.10	11.12	2.06	4.02	0.65	99.61	13.78
	Amm.sulphate	81.29	9.91	73.35	11.26	2.11	4.10	0.52	111.67	15.34
150	Compost	78.40	9.78	78.65	12.20	2.05	3.77	0.59	86.75	12.03
	Cow-manure	78.13	9.62	61.32	9.91	1.98	3.34	0.54	75.47	10.85
	Amm. nitrate	87.60	9.97	81.55	12.66	2.25	4.08	0.64	109.94	15.39
	Amm.sulphate	95.40	10.83	87.90	13.79	2.61	4.21	0.68	112.95	15.87
300	Compost	84.60	10.45	86.37	13.53	2.34	3.95	0.62	91.15	12.72
	Cow-manure	81.00	10.16	64.38	10.13	2.20	3.56	0.58	88.09	12.16
	Amm. nitrate	90.00	10.61	89.53	14.11	2.55	4.35	0.71	111.46	16.03
	Amm.sulphate	95.73	11.45	90.85	14.12	2.94	4.48	0.69	113.85	16.14
L. S. D. at 5% level		2.09	N.S.	2.69	0.38	N.S.	N.S.	N.S.	2.07	N.S.

2. Bulb yield and its quality:

2. 1. Effect of sulphur levels application:

Data in Table (4) show the effect of sulphur application on onion bulb yield as tons/fed and its quality (bulb weight, diameter and height as well as

bulb content of TSS, N, P, K, total protein and total carbohydrate). Results clear that total bulb yield and its quality were gradually and significantly increased with increasing the level of S-application from 0, 150 up to 300 kg/fed. as shown in both growing seasons. This result may be due to the role of sulphur on reducing soil-ph, and increasing the availability of many nutrient elements and increasing the vegetative growth of onion plants (as shown in Table,1) which in turn on increasing bulb yield and improving bulb quality. These results are in harmony with those reported by EL-Desuki and Sawan 2001; Channagoudar and Janawade, 2006 and Qureshi and Lawande, 2006.

Table (4): Effect of sulphur levels application on onion bulbs yield and its quality during the two seasons of 2004/2005 and 2055/2006.

Sulphur Kg/fed.	Bulb yield Ton/fed.	Bulb quality								
		Weight (g)	Diameter (cm)	Height (cm)	TSS (%)	N (%)	P %	K %	Total Protein %	Total carbohydrate (mg/100gD.W)
First season (2004/2005)										
0	12.83	67.63	5.21	5.08	10.67	1.40	0.49	1.14	8.78	10.74
150	13.93	82.74	5.39	5.30	11.92	1.65	0.56	1.38	10.31	11.18
300	15.17	88.73	5.90	5.68	13.17	1.76	0.64	1.53	10.99	11.74
L. S. D. at 5%level	0.24	4.49	0.17	0.08	0.71	0.04	0.03	0.08	0.28	0.37
Second season (2005/2006)										
0	16.40	78.17	5.89	5.89	11.94	1.63	0.57	1.35	10.16	12.29
150	17.64	95.23	6.08	6.08	13.30	1.87	0.66	1.61	11.70	12.83
300	18.96	102.01	6.66	6.50	14.39	1.99	0.76	1.74	12.44	13.42
L. S. D. at 5%level	0.60	3.23	0.16	0.09	0.92	0.12	0.04	0.11	0.77	0.51

2. 2. Effect of nitrogen sources application:

Data in Table (5) showed that, bulb yield and its quality were significantly affected by N-sources. The highest values of onion bulb yield and its quality (bulb weight, diameter and height as well as bulb content of TSS, N, P, K, total protein and total carbohydrate) were recorded with that plants fertilized by ammonium sulphate followed by those received ammonium nitrate. However, the lowest values were recorded with Cow-manure application. This result may be due to that the ammonium sulphate is suitable fore onion plants which resulted an increase in vegetative growth of onion plants (as shown in Table,2) which in turn on increasing the bulb yield and improving bulb quality. This result are in harmony with those reported by Iwata, 1983; Gupta *et* al., 1999; Cabezas-Gutierrez *et al.*, 2007.

2. 3. Effect of the interaction treatments between sulphur level and nitrogen source application:

Data in Table (6) show that, the total bulb yield and its quality were significantly affected by the interaction treatments between sulphur levels and nitrogen sources application, except for bulb diameter and height as well as bulb content of nitrogen, phosphorus, total protein and total carbohydrate in the first season and total bulb yield, bulb diameter, height, phosphorus, and total carbohydrate in the second season. Results clear that, the highest values of bulb yield and quality were recorded with adding the highest level of S-application and fertilized by ammonium sulphate. However, the lowest

values were recorded with that plants fertilized with cow-manure without sulphur application as shown in both growing seasons.

Table (5): Effect of nitrogen source application on onion bulbs yield and its quality during the two seasons of 2004/2005 and 2055/2006.

N-source	Bulb yield (Ton/ fed.)	Bulb quality								
		Weight (g)	Diameter (cm)	Height (cm)	TSS (%)	N (%)	P %	K %	Total Protein %	Total carbohydrate (mg/100g D.W)
First season (2004/2005)										
Compost	13.78	75.89	5.54	4.98	11.44	1.58	0.50	1.23	9.90	11.27
Cow-manure	12.84	73.18	4.84	4.39	10.78	1.19	0.35	1.08	7.43	10.04
Amm. nitrate	14.80	86.93	5.96	6.60	13.11	1.98	0.76	1.73	12.36	12.08
Amm. sulphate	14.47	82.80	5.66	5.45	12.33	1.67	0.65	1.37	10.42	11.49
L. S. D. at 5% level	0.14	3.08	0.22	0.19	0.47	0.13	0.06	0.08	0.84	0.27
Second season (2005/2006)										
Compost	17.22	88.59	6.30	5.77	12.42	1.73	0.59	1.42	10.81	12.40
Cow-manure	16.35	85.11	5.45	5.07	12.28	1.39	0.42	1.26	8.69	11.71
Amm. nitrate	18.93	98.18	6.71	7.53	14.05	2.26	0.88	1.97	14.12	13.70
Amm. sulphate	18.18	95.35	6.37	6.25	4.08	1.94	0.76	1.62	12.12	13.57
L. S. D. at 5% level	0.63	4.09	0.27	0.22	0.51	0.12	0.07	0.09	0.72	0.68

Table (6): Effect of the interaction between sulphur levels and nitrogen sources application on onion bulb yield and its quality.

Treatments		Bulb yield (ton/ fed.)	Bulb quality								
Sulphur Kg/fed.	N-source		Weight (g)	Diameter (cm)	Height (cm)	TSS (%)	N (%)	P %	K %	Total Protein %	Total carbohydrate (mg/100g D.W)
0	Compost	12.40	65.00	5.27	4.77	10.00	1.40	0.37	1.03	8.75	10.87
	Cow-manure	11.80	63.17	4.53	4.20	9.67	1.10	0.30	0.94	6.88	9.68
	Amm.nitrate	13.70	71.17	5.57	6.13	12.00	1.62	0.70	1.40	10.10	11.47
	Amm.sulphate	13.40	71.17	5.47	5.23	11.00	1.50	0.58	1.20	9.38	10.93
150	Compost	14.03	79.50	5.50	4.93	11.67	1.63	0.51	1.25	10.21	11.20
	Cow-manure	12.30	73.67	4.80	4.33	10.67	1.18	0.34	1.12	7.40	10.07
	Amm.nitrate	14.87	91.20	5.73	6.47	13.33	2.08	0.77	1.85	13.02	11.93
	Amm.sulphate	14.50	86.60	5.53	5.47	12.00	1.70	0.63	1.30	10.63	11.53
300	Compost	14.90	83.17	5.87	5.23	12.67	1.72	0.62	1.40	10.73	11.75
	Cow-manure	14.43	82.70	5.20	4.63	12.00	1.28	0.40	1.17	8.02	10.37
	Amm.nitrate	15.83	98.43	6.57	7.20	14.00	2.23	0.83	1.93	13.96	12.83
	Amm.sulphate	15.50	90.63	5.97	5.64	14.00	1.80	0.72	1.60	11.25	12.00
L. S. D. at 5% level		0.24	5.34	N.S.	N.S.	0.81	N.S.	N.S.	0.15	N.S.	N.S.
0	Compost	15.65	75.73	6.02	5.58	11.13	1.54	0.43	1.19	9.61	11.71
	Cow-manure	15.10	73.94	5.12	4.90	10.83	1.32	0.35	1.13	8.25	11.23
	Amm.nitrate	17.70	82.55	6.21	7.02	13.47	1.89	0.78	1.61	11.82	13.42
	Amm.sulphate	17.15	80.46	6.19	6.05	12.32	1.76	0.69	1.46	10.97	12.79
150	Compost	17.64	92.55	6.22	5.67	13.03	1.71	0.61	1.45	10.69	12.10
	Cow-manure	15.74	85.45	5.36	5.02	11.91	1.38	0.42	1.30	8.65	11.78
	Amm.nitrate	19.14	102.46	6.51	7.37	13.34	2.37	0.88	2.11	14.82	13.86
	Amm.sulphate	18.04	100.46	6.25	6.25	14.90	2.02	0.74	1.57	12.64	13.56
300	Compost	18.37	97.47	6.66	6.05	13.11	1.94	0.74	1.62	12.14	13.37
	Cow-manure	18.20	95.93	5.88	5.30	14.09	1.47	0.48	1.35	9.18	12.13
	Amm.nitrate	19.94	109.52	7.42	8.21	15.35	2.51	0.97	2.18	15.71	13.81
	Amm.sulphate	19.34	105.13	6.68	6.45	15.01	2.04	0.84	1.83	12.75	14.35
L. S. D. at 5% level		N.S.	7.08	N.S.	N.S.	0.89	0.20	N.S.	0.15	1.25	N.S.

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استجابة نباتات البصل للتسميد بمصادر مختلفة من السماد النيتروجيني و معدلات مختلفة من الكبريت الزراعي

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أجريت تجربتان حقليتان في مزرعة المركز القومي للبحوث بشلقان – (محافظة القليوبية) خلال موسمي ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦ و ذلك لدراسة تأثير مصادر السماد النيتروجيني (سماد الماشية – الكمبوست – نترات الأمونيوم – كبريتات الأمونيوم) و كذلك إضافة مستويات مختلفة من الكبريت الزراعي (٠ ، ١٥٠ ، ٣٠٠ كجم للفدان) علي نمو ومحصول و جودة البصل صنف جيزة ٢٠. و قد أوضحت النتائج مايلي :

- النمو الخضري لنباتات البصل متمثلا في طول النبات – عدد الأوراق – الوزن الطازج و الجاف للأوراق – قطر عنق البصلة – معامل التبصيل – الوزن الطازج و الجاف للبصلة قد زاد زيادة معنوية بزيادة مستوي الكبريت المضاف حتي ٣٠٠ كجم كبريت زراعي للفدان .
- المحصول الكلي للأبصال زاد بزيادة مستوي الكبريت المضاف . كما تحسنت مواصفات جودة الأبصال (متوسط وزن البصلة – قطر البصلة – ارتفاع البصلة) و كذلك المحتوي الكيماوي للبصلة (النتروجين – الفوسفور – البوتاسيوم – البروتين الكلي – الكربوهيدرات الكلية – المواد الصلبة الذائبة الكلية) بزيادة مستوي الكبريت المضاف.
- أوضحت النتائج أيضا أن مواصفات النمو الخضري لنباتات البصل و كذلك المحصول الكلي للأبصال و جودة الأبصال والمحتوي الكيماوي للأبصال قد زاد زيادة معنوية باستخدام كبريتات الأمونيوم كمصدر للسماد النتروجيني مقارنة بباقي مصادر الأسمدة المستخدمة في ادي استخدام سماد الماشية الي الحصول علي اقل قيم النمو الخضري و كذلك المحصول و جودة الابصال.