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EFFECT OF SOME NITROGEN AND SULPHUR SOURCES ON PLANT GROWTH AND YIELD OF ONION (*ALLIUM CEPA,* L.)

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ABSTRACT

Two field experiments were conducted at the Experimental Farm of the Faculty of Agriculture, Tanta during the winter seasons of 1995/96 and 1996/97, to study the effect of some nitrogen and sulphur sources on plant growth, yield and quality of onion. Nitrogen was supplied at level of 100 kg/fed. from four sources, i.e., urea, ammonium, sulphate, ammonium nitrate and calcium nitrate, while sulphur was supplied as a sulphur powder 50 and 100 kg/fed. or ammonium thiosulphate (ATS) 2 and 4 kg/fed.

Results revealed that, ammonium nitrate increased average bulb weight while calcium nitrate increased the percentage of bolting plants. Addition of sulphur at 50 or 100 kg increased the yield of onion. Results showed also that NO_3-N was more accumulated in green leaves of onion than in its bulbs. The NO_3-N content in both bulbs and leaves was affected significantly by the nitrogen and sulphur sources. Ammonium sulphate as nitrogen source lead to less nitrate accumulation in onion plants followed by ammonium nitrate and urea, while calcium nitrate caused increasing accumulation of NO_3-N in plants. Sulphur treatment decreased the NO_3-N content of onion plants. Values of the interaction showed that ammonium sulphate was more effective on decreasing nitrate accumulation in the presence of sulphur treatments.

INTRODUCTION

Excessive use of nitrogen fertilizers can result in undesirable conditions such as the accumulation of nitrate in plant tissues and contamination of ground water supplies via nitrate leaching. Also, gaseous loss of nitrogen as N_2O has been recognized as a potential factor leading to deterioration of the ozone layer of the atmosphere (Bremner and Blackmer, 1978). Application of ammonical fertilizer would seem to offer a potential means of increasing the utilization of applied nitrogen fertilizer because the ammonium ion is not as readily subject to leaching loss or volatilization losses as the nitrate ion. So, the nitrogen sources can play an effective role on the productivity or the quality, especially the nitrate content of onion. Many investigator stated that nitrogen sources had no effect on vegetative growth and yield of onion (Wiedenfeld and Braverman, 1991, Gunadi and Asandhi 1986, Mazrouh and Abo Waly 1992, Inal *et al.,* 1995).On the other hand, Iwata 1983 reported that onion plants supplied with nitrate N generally showed greater growth than those supplied with ammonium N, while Batal *et al.,* 1994 found that among the different N sources NH_4NO_3 was superior in producing jumbo and large size onions. Inal *et al.,* 1995 and Gunes *et al.,* 1996 showed that onion plants fertilized by nitrogen as NO_3 form had the highest NO_3-N content of onion plants.

Sulphur application plays an important role in soil such as, reducing soil pH, improving soil water relations and increasing availability of nutrient elements, i.e. phosphors, iron, manganese and zinc (Hilal 1990; Hilal *et al.,* 1990; El-Fayoumy, 1996). Sulphur was very beneficial for onion plant growth, total yield and quality (Jana*, et al.,*1990, Rajas *et al.,* 1993, Ismunadje *et al.,* 1987, Paterson 1979, Khalaf and Taha 1988, Hilal *et al.,* 1990, Harendra *et al.,*1996, Hamilton 1997 Meena and Singh 1998). Sulphur also decreased NO_3 content of potato tubers (Radwan 1998).

The purpose of this study was to evaluate the effects of several sources from nitrogen and sulphur on growth, yield, bulb quality as well as nitrate accumulation in onion crop.

MATERIALS AND METHODS

This field experiment was conducted during the two growing winter seasons of 1995/96 and 1996/97 at the Experimental Farm of the Faculty of Agriculture, Tanta University. Seeds of onion cv. Giza 20 were sown in the nursery on 10th of October, whereas transplanting was done on 15th of December in the two growing seasons. The uniform transplants were set at 10 cm apart in both Sids of the ridges. The plot area was 16.8 m^2 which contained 4 rows 7 m in length and 60 cm in width. The soil of this experiment was clay loam. The chemical properties of the soil are presented in Table 1.

Table (1): Some chemical properties of the experimental soil.

Season	pH	Organic matter %	EC 25ºC mmhos/cm	Available N, P and K mg/100 g soil		
				Nitrogen	Phosphorus	Potassium
1995/96	7.81	1.00	2.26	35.0	5.2	1.60
1996/97	7.95	1.05	2.01	37.9	7.5	1.52

Nitrogen fertilizers were added at four sources, i.e., urea, ammonium sulphate, ammonium nitrate, and calcium nitrate at level of 100 unite N/fed. Also, superphosphate was added during soil preparation at level of 60 unite P_2O_5/fed. and potassium sulphate at level of 100 unite K_2O/fed. Nitrogen and potassium fertilizer were divided into two equal parts applied after 4 and 8 weeks from transplanting,respectivly The sulphur fertilizers were added once during soil preparation at two sources, i.e., elemental sulphur at levels 50 and 100 kg/fed. or ammonium thiosulphate (ATS) at levels of 2% and 4% besides untreated control.

Other cultural practices were applied as general practiced by the local growers

The design of this trial was split plot with four replicates where nitrogen sources were assigned in main plots and sulphur sources were arranged in subplots.

After 90 days from transplanting 5 plants were taken randomly from each subplot to measure growth parameters, i.e.., plant height, number of leaves/plant, dry weight/plant and leaf area/plant. Also, the content of N and NO_3-N were determined in both fresh leaves and bulbs in the vegetative sample. At harvest period, the bulbs were digged to determine the total yield. Unmarketable bulbs (double and bolters) were separated and weighted to determine culls yield. The remained bulbs were weighed as marketable yield. A bulb sample from each sub plot were taken to determine average bulb weight, TSS using hand refractometer, vit. C using method described in A.O.A.C. (1975) another bulb sample were oven dried at 70ºC to measure dry matter, plant, then the dry matter was ground and used to determine N according to A.O.A.C. (1975). Nitrate content was estimated also in dry leaves and bulbs (at time of harvesting) according to Salicylic acid method (Cataldo *et al.,* 1975).

RESULTS AND DISCUSSIONS

1. Growth studies:

1.1. Effect of nitrogen sources:

Regarding to the effects of nitrogen sources, i.e. urea, ammonium sulphate, ammonium nitrate or calcium nitrate on growth of onion plants, it is clear from data in Table (2) that addition of nitrogen as ammonium nitrate increased the height of onion plants when compared with the other sources of nitrogen. These results are true in both seasons. Dry matter accumulation on onion plants was significantly increased when the nitrogen was added as ammonium sulphate or ammonium nitrate, the differences between the two above mentioned sources of nitrogen were not significant.

The obtained results are in agreement with those of Moursi (1992) who found that the highest dry weight in tomato leaves was recorded by calcium ammonium nitrate as nitrogen source. He found also that using calcium ammonium nitrate markedly approved more favourable for the dry matter accumulation as measured by crop growth rate comparing with ammonium sulphate or urea. The favourable effect of ammonium nitrate on some growth characters of onion might be done as ammonium nitrate supplied plants with nitrogen in two forms, i.e., NH_4 and NO_3.

Table (2): Vegetative growth of onion as affected by nitrogen source 1995/96 and 1996/97.

N Sources	Plant height (cm)	No. of Leaves /plant	Leaf area Plant (dm^2)	Dry matter/ plant (g)	Plant height (cm)	No. of Leaves/ plant	Leaf area plant (dm^2)	Dry matter/ plant (g)
	1995/96				**1996/97**			
Urea	59.9 c	5.7	6.2	13.8 c	58.4 b	5.9	6.8	12.3 b
$(NH_4)_2 SO_4$	61.5 bc	6.1	6.7	17.0 a	60.0 b	5.8	6.7	13.2 ab
$NH_4 NO_3$	68.7 a	5.9	6.5	16.7 a	62.0 a	6.0	6.7	13.7 a
$Ca (NO_3)_2$	64.6 b	6.5	7.2	15.0 b	63.5 a	6.0	6.6	14.1 a
F. test	*	NS	NS	*	*	NS	NS	*

Means followed by different letters in each column are significantly different at 5% level of probability.

On the other hand, no significant variations were observed between the four sources of nitrogen regarding number of leaves or leaves area/plant. These results are in harmony with those obtained by Osman *et al.* (1987) who observed that no significant effects in number of leaves, foliage weight and leaf: root ratio in sugar beet between the different forms of nitrogen application.

1.2. Effect of sulphur:

With regard to the effect of the two sources of sulphur on growth of onion plants, the obtained data in Table (3) revealed that application of each of ammonium thiosulphate (ATS) at 2% or 4% or elemental sulphur at rate of 50 or 100 kg/fed., generally, increased onion plant growth, i.e., plant height, or dry matter comparing with untreated plants. The tallest plants were observed as the results of application of elemental sulphur at 100 kg/fed. followed by 50 kg and ATS at 4% and 2% in both seasons. Also, dry matter accumulation in onion plants was increased by both sulphur sources when compared with non-treated plants. The obtained results are in agreement with those of Abd El-Hamed (1971) on garlic Jana *et al.,* 1990, Gawish (1997), Sumantra-Kar (1997-1998) and Ali (1998) on onion, who found that sulphur fertilization increased growth characters of these crops when compared with the unfertilized treatment. The promotion effect of sulphur on growth of onion may be attributed to the effect of sulphur on increasing the availability of certain plant nutrients notably phosphorus and several of micronutrients such iron, manganese and zinc (Abd El-Fattah and Hilal, 1984). Other similar results were reported by Blair and Till (1983) and Morris *et al.* (1984). They mentioned that sulphur is one of many elements required for plant growth, it is important in the formation of protein and chlorophylls. In addition, sulphur was found to improve soil structure and to increase water penetration and availability of nutrients under garlic plants (Hilal *et al.*, 1992).

Table(3) :Vegetative growth of onion as affected by some sulphyur treatments 1995/96 and 1996/97.

Sulphur Treatments	Plant height (cm)	No. of Leaves plant	Leaf area\ Plant (dm^2)	Dry matter plant (g)	Plant height (cm)	No. of leaves plant	Leaf area plant (dm^2)	Dry matter Plant (g)
	1995/96				1996/97			
Without sulphur	60.6	5.0	6.0	14.0 b	57.9	5.8	6.3	11.3
2% ATS	62.2	5.9	6.6	16.0 a	59.2	5.9	6.5	12.8
4% ATS	64.4	6.2	6.9	16.2 a	60.6	5.9	6.7	13.2
50 kg S/fed.	64.9	5.9	6.8	16.1 a	62.3	6.1	6.9	13.3
100 kg S/fed.	65.3	6.4	7.0	16.9 a	63.8	6.0	6.9	13.8
F. test	*	NS	NS	*	*	NS	NS	*

Means followed by different letters in each column are significantly different at 5% level of probability.

3.1. Combined effect of nitrogen and sulphur:

Data presented in Table (4) showed that, generally, the interaction between nitrogen and sulphur caused an increase in onion plant height and dry matter per plant, meanwhile, number of leaves and the leaves area/plant were not affected significantly.

2. Yield and bulb quality:

2.1. Effect of nitrogen sources:

Concerning the effect of nitrogen sources on onion bulb yield, data in Table (5) illustrated that the highest yield of onion bulb was obtained from plants fertilized with ammonium nitrate (NH_4 NO_3) comparing with other sources of nitrogen. These results are true in both seasons of study. Average of bulb weight go to the same trend where ammonium nitrate fertilization gave the highest average weight of bulb followed by ammonium sulphate and calcium nitrate.

On the other hand, no significant differences were found on the percent of single and culls yield (Doubles and Bolters bulbs) regarding the different sources of nitrogen,except in the secand season

Table (4): Vegetative growth of onion as affected by nitrogen source and some sulphur treatments 1995/96 and 1996/97.

Nitrogen Sources	Sulphur Treatments	Plant height (cm)	No. of leaves/ plant	Leaf area plant (dm^2)	Dry matter/ plant (g)	Plant height (cm)	No. of leaves/ plant	Leaf area plant (dm^2)	Dry matter/ plant (g)
		1995/96				1996/97			
	Without sulphur	57.8	5.5	6.0	12.8	55.6	5.8	6.4	11.6
	2% ATS	57.8	5.8	6.2	14.3	56.7	5.7	6.7	12.2
Urea	4% ATS	61.4	5.5	6.3	13.8	58.9	5.9	6.9	13.2
	50 kg S/fed.	61.2	5.9	6.4	13.5	59.5	6.0	7.0	13.1
	100 kg S/Fed.	61.5	6.0	6.3	14.4	61.2	6.2	6.8	13.7
	Without sulphur	60.8	5.8	6.1	15.5	57.2	5.7	6.2	12.2
	2% ATS	61.8	5.5	6.8	18.2	57.8	5.7	6.7	13.9
$(NH_4)SO_4$	4% ATS	61.5	6.5	7.0	15.2	59.6	5.8	6.7	13.8
	50 kg S/fed.	61.5	5.6	6.6	18.7	62.0	5.9	6.8	13.4
	100 kg S/Fed.	61.8	6.9	7.2	17.5	63.4	5.9	6.9	14.6
	Without sulphur	65.2	5.8	6.1	15.2	58.8	5.8	6.3	12.9
	2% ATS	65.8	5.9	6.2	18.3	60.2	6.0	6.4	13.7
NH_4 NO_3	4% ATS	71.8	5.9	6.8	15.4	61.6	5.9	6.6	13.8
	50 kg S/fed.	71.1	5.9	6.5	16.6	63.7	6.2	7.0	13.4
	100 kg S/Fed.	69.5	5.8	6.8	17.9	65.8	6.1	7.1	14.2
	Without sulphur	62.1	6.2	6.3	14.0	61.1	5.9	6.3	12.5
	2% ATS	63.2	6.4	7.1	14.8	62.2	6.0	6.3	12.8
$Ca(NO_3)_2$	4% ATS	62.8	6.7	7.4	15.3	63.2	6.1	6.6	13.9
	50 kg S/fed.	65.2	6.5	7.5	15.6	64.8	6.2	6.8	14.2
	100 kg S/Fed.	69.2	6.8	7.8	15.2	65.7	5.8	6.8	13.8
F. test		NS	NS	NS	NS	NS	NS	NS	NS

Table (5): Onion bulb yield, its components and quality as affected by nitrogen source 1995/96 and 1996/97.

Nitrogen Sources	Total yield ton/fed.	Single bulb %	Culls %		Average wt. of bulb	Dry matter/ plant (g)	T.S.S %	Vit. C mg/100 g F.Wt
			Doubles	Bolters				
1995/96								
Urea	10.8 b	99.4	0.2	0.4	91 c	12.1	10.7	11.8
$(NH_4)_2SO_4$	10.6 b	99.5	0.2	0.3	103 b	14.4	11.9	11.9
NH_4NO_3	11.3 a	99.3	0.3	0.4	111 a	14.7	11.7	12.1
Ca $(No_3)_2$	10.8 b	99.2	0.3	0.5	106 b	13.2	11.1	12.1
F-test	*	NS	NS	NS	*	NS	NS	NS
1996/97								
Urea	9.3 b	96.3	0.9	2.8 b	88	12.4	10.6	11.1
$(NH_4)_2SO_4$	9.2 b	98.1	0.4	1.5 a	89	12.6	11.0	11.5
NH_4NO_3	9.9 a	97.4	0.5	2.0 a	90	12.0	10.6	11.9
Ca $(No_3)_2$	9.0 b	96.0	0.8	3.2 b	88	11.6	10.9	11.8
F-test	*	NS	NS	*	NS	NS	NS	Ns

In the same column means followed by the same letter are not significantly different at 5% level of probability.

The obtained results arepartially coincided with those of Krishchenko, 1981; Gibson and Fill, 1983 and Lacascio *et al* 1984 on tomato who found that the best yield of tomato was obtained by using NH_4 NO_3 as N-source. Also, Kwiaton *et al.* (1984) applied ammonium nitrate, urea and agramide (a slow release N fertilizer) to sugar beet and found that ammonium nitrate gave higher root yield. In addition, the greatest weight proportion of jumbo onions was produced by applying NH_4 NO_3, the percentage by weight of premium (jumbo + large) marketable grade produced with NH_4 NO_3 and Na NO_3 applications was higher than with Ca (NO_3) (Batal *et al.,* 1994).

The same data in Table (5) revealed that the differences in dry matter, total soluble solids and vit. C in onion bulb were not significant when plants were fertilized with the four different sources of nitrogen.

2.2. Effect of sulphur:

Regarding the effect of sulphur sources on total, marketable and culls yield of onion as well as average bulb weight, data in Table (6) showed clearly that application of the two sources of sulphur, i.e., elemental sulphur or ammonium thiosulphate significantly increased total and marketable yield and average bulb weight. The highest values of the above mentioned characters were found in plants treated with elemental sulphur at the two rates, i.e., 50 or 100 kg/fed. when compared with ammonium thiosulphate and untreated plants.

Table (6): Onion bulb yield, its components and quality as affected by sulphur treatments 1995/96 and 1996/97.

Sulphur treatments	Total Yield ton/fed.	Single bulb %	Culls %		Average wt. of bulb	Dry matter/ plant (g)	T.S.S %	Vit. C mg/100 g F.Wt
			Doubles	Bolters				
1995/96								
Without sulphur	8.9 c	99.5	0.2	0.3	99 c	11.6	11.0	11.9
2% ATS	9.5 bc	99.2	0.3	0.6	103 ab	12.8	10.6	12.0
4% ATS	10.2 b	99.2	0.3	0.6	101 bc	13.2	11.8	11.9
50 kg S/fed.	12.2 a	99.5	0.2	0.4	105 a	14.0	11.3	12.1
100 kg S/fed.	13.6 a	99.4	0.2	0.3	105 a	14.3	12.0	12.1
F-test	*	NS	NS	NS	*	NS	NS	NS
1996/97								
Without sulphur	7.4 c	96.7	0.7	1.9	83 c	11.4	10.2	11.1
2% ATS	7.8 bc	96.7	0.7	2.6	84 c	11.5	10.6	11.4
4% ATS	8.7 b	96.5	0.7	2.8	87 bc	11.8	10.6	11.4
50 kg S/fed.	10.9 a	97.4	0.6	2.1	92 ab	13.3	11.3	12.2
100 kg S/fed.	12.0 a	97.5	0.6	2.0	97 a	12.9	11.3	11.8
F-test	*	NS	NS	NS	*	NS	NS	NS

In the same column means followed by the same letter are not significantly different at 5% level of probability.

Culls yield (measured as double and bolter bulbs) were not significantly affected by both sulphur sources treatment).

The increment in onion yield in this study as a result of sulphur application are in harmony with those obtained by Khalaf and Taha, 1988; Abd El-Fattah *et al.,* 1990; Abd El-Hamed, 1997, on garlic and Gawish, 1997, Sumantra-KAr 1997-1998 and Ali, 1998 on onion who mentioned that addition of sulphur to garlic or onion increased the yield of these crops.

The promotion effect of sulphur on productivity of onion might be due to the role of sulphur in increasing the availability of many nutrients such as phosphorus, Fe, Zn, Mn and Cu and consequently it may increase metabolic activities in plants (Hilal *et al.,* 1990). Sulphur nutrition was found also to improve plant metabolism, increase photosynthetic rate, chlorophyll content and free amino acid in tea leaves (Young *et al.,* 1994).

Bulb quality, i.e., dry matter content, total soluble solids and vitamin C contents were not significantly responded to sulphur application (Table 6).

2.3. Combined effect of nitrogen and sulphur:

Data presented in Tables (7 & 8) showed that application of nitrogen and sulphur together increased total yield of onion ass well as average bulb weight when compared with also sulphur treatment. Addition of sulphur as elemental sulphur gave the best result when compared with ammonium thiosulphate. The highest total and marketable yield and also average bulb weight were obtained as the results of the combination between sulphur and NH_4 NO_3 comparing with the other combinations. These results are true in both seasons of study.

These results are in agreement with those of Abd El-Fattah *et al.* (1990) who found that average bulb weight and total yield of garlic increased with application of both nitrogen and sulphur. They added that the synergistic relationship between the two elements is dependent upon the level of both sulphur and nitrogen and increased with increasing with level of either sulphur or nitrogen and both together.

The same data in Tables (7 & 8) revealed that the responses of culls yield to the combination between nitrogen and sulphur treatments were not significant.

With regard to the interactive effect of nitrogen and sulphur on bulb quality, i.e., dry matter, T.S.S. and vit. C contents the data in Tables (8 and 9) showed that no significant variations were found in this respect.

Table (7): Onion bulb yield, its components and quality as affected by nitrogen sources and sulphur treatments 1995/96.

Nitrogen Sources	Sulphur Treatments	Total yield ton/fed.	Single bulb %	Culls %		Average wt. of bulb	Dry matter / plant (g)	T.S.S %	Vit. C mg/100 g F.Wt
				Doubles	Bolters				
				1995/96					
Urea	Without lphur	8.8 cd	99.6	0.2	0.2	88.3 e	11.2	10.4	11.8
	2% ATS	9.8 cd	98.9	0.3	0.8	88.5 e	10.8	9.5	11.8
	4% ATS	10.8 cd	99.6	0.1	0.3	94.5 de	11.7	11.3	11.8
	50kg SD/fed	11.2 abc	99.4	0.2	0.4	90.3 e	14.6	10.6	12.1
	100 kg S/fed.	13.6 ab	99.6	0.1	0.3	93.0 de	12.0	11.8	11.6
$(Nh_4)_2$ SO_4	Without lphur	8.6 d	99.8	0.1	0.1	100.3 bcd	14.1	11.3	11.7
	2% ATS	9.6 cd	99.5	0.2	0.3	112.3 ab	12.8	10.6	12.1
	4% ATS	9.6 cd	99.3	0.2	0.5	102.8 b-e	13.6	13.1	11.9
	50 kg SD/fed	11.8 abc	99.6	0.2	0.2	100.0 b-e	15.1	11.0	11.9
	100 kg S/fed.	13.6 ab	99.5	0.2	0.3	97.8 cde	16.2	13.6	12.1
NH_4NO_3	Without sulphur	9.2 cd	99.3	0.3	0.4	110.0 abc	16.8	12.1	12.2
	2% ATS	9.4 cd	99.2	0.3	0.5	107.8 a-d	15.0	11.9	12.0
	4% ATS	9.9 cd	99.2	0.3	0.5	106 a-e	14.9	11.6	11.9
	50 kg SD/fed	13.8 a	99.4	0.2	0.4	118 a	12.5	12.3	12.1
	100 kg S/fed.	14.0 a	99.6	0.2	0.2	111.5 ab	14.3	10.6	12.3
Ca $(No_3)_2$	Without sulphur	9.1 cd	99.2	0.3	0.5	98.6 b-e	12.2	10.3	11.8
	2% ATS	9.0 cd	99.1	0.3	0.6	102.5 bcd	12.6	10.3	12.1
	4% ATS	10.8 bcd	98.6	0.5	0.9	103.2 bcd	12.9	11.2	11.9
	50 kg SD/fed	12.0 abc	99.5	0.2	0.3	109.7 abc	13.7	11.4	12.2
	100 kg S/fed.	13.2 ab	99.5	0.2	0.3	116.2 a	14.8	12.1	12.3
T-test		*	NS	NS	NS	*	Ns	NS	NS

In the same column means followed by the same letter are not significantly different at 5% level of probability.

Table (8): Onion bulb yield, its components and quality as affected by nitrogen sources and sulphur treatments 1996/97.

Nitrogen Sources	Sulphur Treatments	Total yield Ton/fed.	Single bulb %	Culls %		Average wt. of bulb	Dry matter/ plant (g)	T.S.S %	Vit. C mg/100 g F.Wt
				Doubles	Bolters				
1996/97									
Urea	Without sulphur	7.2 d	96.2	0.6	3.2	82.1 e	11.6	10.2	11.2
	2% ATS	7.8 d	95.8	1.1	3.1	83.4 e	11.5	10.4	11.2
	4% ATS	8.3 cd	95.2	1.2	3.6	86.3 cde	11.8	10.5	10.8
	50 kg SD/fed	10.6 abc	97.1	0.9	2.0	90.2 cd	14.0	11.2	11.4
	100 kg S/fed.	12.5 a	97.0	0.8	2.2	98.1 a	13.2	10.8	11.0
$(Nh_4)_2$ SO_4	Without sulphur	7.5 d	98.2	0.5	1.3	83.0 e	11.8	10.3	10.9
	2% ATS	7.9 d	97.9	0.4	1.7	85.7 cde	11.9	10.8	11.2
	4% ATS	8.0 cd	97.7	0.5	1.8	86.8 cde	12.0	10.7	11.6
	50 kg SD/fed	11.1 abc	98.3	0.2	1.5	93.2 abc	13.8	11.6	11.9
	100 kg S/fed.	11.7 ab	98.5	0.3	1.2	95.8 ab	13.6	11.8	11.9
NH_4NO_3	Without sulphur	7.4 d	97.1	0.6	2.2	83.4 e	11.2	9.9	10.9
	2% ATS	7.6 d	97.2	0.5	2.3	84.6 de	11.4	10.6	11.6
	4% ATS	9.9 bcd	97.2	0.6	2.2	89.2 cd	11.6	10.6	11.7
	50 kg SD/fed	11.8 ab	97.8	0.4	1.8	91.1 cd	13.0	10.9	13.2
	100 kg S/fed.	13.0 a	97.9	0.4	1.7	99.4 a	12.8	11.1	11.8
Ca $(No_3)_2$	Without sulphur	7.03 d	95.4	0.9	3.7	81.6 e	10.9	10.4	11.2
	2% ATS	7.8 d	96.0	0.8	3.2	83.4 e	11.2	10.4	11.6
	4% ATS	8.6 cd	95.8	0.6	3.6	86.2 cde	11.6	10.7	11.5
	50 kg SD/fed	10.2 bcd	96.4	0.7	2.9	93.1 abc	12.4	11.6	12.4
	100 kg S/fed.	10.9 abc	96.4	0.9	2.7	95.7 ab	12.1	11.3	12.5
T-test		*	NS	NS	NS	*	Ns	NS	NS

In the same column means followed by the same letter are not significantly different at 5% level of probability.

3. Chemical constituents studies:

3.1. Effect of nitrogen sources:

Concerning the effect of nitrogen sources on the content of nitrogen it is clear from data in Table (9) that non-significant differences on the contents of nitrogen in each of leaves or bulbs of onion on both seasons. The non-significant variations on the contents of nitrogen in this study may be due to using one level of N (90 unite) from all sources of nitrogen. The obtained results go along with those of Locascio *et al.* (1984) who found that leaf nitrogen concentration was not consistently affected by the N-source.

The same data in Table (9) revealed that the concentration of NO_3-N (nitrate) was varied in onion leaves and bulb as a result of N-sources.

Fertilization onion plants with ammonium sulphate $(NH_4)_2$ SO_4 gave the lowest values of nitrate in each of leaves or bulbs in the two growing seasons. Meanwhile, application of calcium nitrate (Ca $(NO_3)_2$ increased the accumulation of NO_3-N in the leaves and bulbs of onion followed by urea and ammonium nitrate respectively. These results are in agreement with those of Mills *et al.* (1976) who found that the use of ammonium sulphate virtually eliminated nitrate accumulation in spinach and radish. In addition, Barker *et al.* (1971) showed that urea, ammonium nitrate and potassium nitrate side dressed to a rapidly growing spinach crop increased the nitrate concentrations in its leaves. Lorenz and Weir (1974) also showed that nitrate sources led to higher nitrate accumulation in vegetables than did ammonical sources of N. Inal *et al.,* 1995 and Gunes *et al.,* 1996 showed that onion plants fertilized by nitrogen as NO_3 form had the highest NO_3-N content of onion plants. The reduction in accumulation of NO_3-N found in this study may be due to the role of SO_4 ion which promote the slow release of NH_4 through delaying its hydrolysis conserving it in the vicinity of the roots for longer time (Broadbent and Nakashima, 1968).

Table (9): Total N and NO_3-N contents in both onion leaves and bulbs as affected by sources of nitrogen (1995/96 and 1996/97).

N Sources	Total-N % DW		No_3-N mg/kg F.W.		Total-N % DW		No_3-N mg/kg F.W.	
	Leaves	Bulbs	Leaves	Bulbs	Leaves	Bulbs	Leaves	Bulbs
	1995/96				**1996/97**			
Urea	2.79	2.07	831 c	516 c	2.35	2.07	622 c	290 c
$(NH_4)_2$ SO_4	3.23	2.24	647 a	420 a	2.29	2.15	424 a	242 a
NH_4 NO_3	2.95	2.01	729 b	450 b	2.42	2.01	478 b	271 b
Ca $(NO_3)_2$	2.22	1.89	961 d	644 d	2.02	1.98	693 d	370 d
F-test	NS	Ns	*	**	NS	NS	**	**

In the same column means followed by the same letter are not significantly different at 5% level of probability.

3.2. Effect of sulphur sources:

Data presented in Table (10) showed that no significant differences were found on the contents of nitrogen in each of leaves or bulbs of onion by application of all sulphur treatments.

The same data revealed that addition of sulphur, generally, decreased the accumulation of NO_3-N in both bulb and leaves comparing with untreated control. Application of sulphur as ammonium thiosulphate ATS at 4% or elemental sulphur at 100 kg/fed. gave the least concentrations of nitrate in each of leaves and bulbs in the two growing seasons. The obtained results are in harmony with those of Evans and Nason (1953) who stated that nitrate reduction extracted from higher plants had a sulfhydryl requirement. Schrader *et al.* (1968) indicated that the sulfhydryl group is essential for NR activity with NADH as the factor. Sulphur deficiency may therefore interfere with NR activity in vivo and led to nitrate accumulation. Also, Arora and Luthra (1971) found that S deficiency was associated with nitrate accumulation in mung bean leaves.

Table (10): Total N and NO_3-N contents in both onion leaves and bulbs as affected by some sulphur treatments (1995/96 and 1996/97).

Sulphur Treatments	Total-N % DW		No_3-N mg/kg F.W.		Total-N % DW		No_3-N mg/kg F.W.	
	Leaves	Bulbs	Leaves	Bulbs	Leaves	Bulbs	Leaves	Bulbs
	1995/96				1996/97			
Without sulphur	2.45	1.93	850 c	555 c	2.09	1.92	600 b	313 b
2% ATS	2.68	2.05	789 b	515 b	2.27	2.06	558 a	290 a
4% ATS	3.08	2.12	756 a	470 a	2.33	2.11	535 a	288 a
50 kg S/fed.	2.84	2.07	788 b	503 b	2.34	2.06	540 a	289 a
100 kg S/fed.	2.93	2.10	778 b	495 b	2.34	2.10	539 a	286 a
F-test	NS	NS	*	*	NS	NS	*	*

In the same column means followed by the same letter are not significantly different at 5% level of probability.

3.3. Combined effect of nitrogen and sulphur:

Regarding the effect of the interaction between nitrogen and sulphur on the content of nitrogen in each of leaves and bulbs of onion, the results in Table (11) showed that no significant differences were observed in this respect.

The same data in Table (11) revealed that application the nitrogen and sulphur together significantly decreased the accumulation of NO_3-N in each of bulbs and leaves. Fertilization onion plants with both ammonium sulphate $(NH_4)_2$ SO_4 and each of elemental sulphur at 100 kg/fed. or ammonium thiosulphate at 4% gave the lowest concentrations of nitrate in leaves and bulbs of onion in the two growing seasons comparable with the other sources of nitrogen (urea, ammonium nitrate and calcium nitrate. In this respect, most commercial fertilizers contain N as nitrate ammonium or urea. Due to minimization and nitrification, nitrate is the primary soil derived N form regardless of the source of N applied, therefore, within limits as much nitrate may be accumulate from organic or ammonical fertilizers as from nitrate carriers (Peck *et al.,* 1971 and Barker, 1975). The obtained results go along with the late conclusion where ammonium sulphate caused a reduction in nitrate accumulation when compared with nitrate fertilizers [NH_4 NO_3, (Ca $NO_3)_2$] or urea. Also, sulphur works as mineralize slowly and lead to lesser nitrate accumulation in vegetables. Sulphur is currently used to coat urea fertilizer to reduce the rate of its hydrolysis and consequently increase the use efficiency by plants (Svensson and Soderlund, 1976). Also, Goos, 1985 and Goos *et al.,* 1986 showed that ATS has been recently shown to possess some ability to inhibit nitrification and urea hydrolysis in soil. Hence, mixing both sulphur and nitrogen specially ammonium sulphate in this study decreased the accumulation of nitrate in onion bulbs and leaves (Table 11).

Table (11): Total N and NO_3-N contents in both onion leaves and bulbs as affected by source of nitrogen and sulphur treatments (1995/96 and 1996/97)

Nitrogen Sources	Sulphur treatments	1995/96				1996/97			
		Total -N % DW		No_3-N mg/kg F.W.		Total-N % DW		No_3-N Mg/kg F.W.	
		Leaves	Bulbs	Leaves	Bulbs	Leaves	Bulbs	Leaves	Bulbs
Urea	Without sulphur	2.52	1.96	880 gh	580 F	2.06	1.82	670 g	320 e
	2% ATS	2.78	2.01	855 Fg	530 e	2.21	2.13	640 Fg	290 de
	4% ATS	3.12	2.07	780 de	460 d	2.52	2.21	590 e	285 cd
	50 kg S/fed.	2.91	2.11	830 Fg	510 e	2.57	2.09	610 eF	275 cd
	100 kg S/Fed.	2.62	2.20	810 eF	500 e	2.38	2.08	600 eF	280 cd
$(NH_4) SO_4$	Without sulphur	2.75	2.11	6.90 bc	460 d	2.23	1.98	480 cd	270 bcd
	2% ATS	2.92	2.24	640 a	420 bc	2.46	2.17	420 ab	225 a
	4% ATS	3.56	2.32	615 a	380 a	2.28	2.24	400 a	230 a
	50 kg S/fed.	3.18	2.23	650 ab	430 bcd	2.19	2.13	410 a	245 abc
	100 kg S/Fed.	3.22	2.28	640 a	410 ab	2.32	2.21	410 a	235 a
$NH_4 NO_3$	Without sulphur	2.71	1.86	770 de	495 e	2.22	1.95	520 d	280 cd
	2% ATS	2.86	1.98	730 cd	450 cd	2.46	1.98	480 cd	275 cd
	4% ATS	3.17	2.07	705 bc	420 bc	2.39	2.06	460 bc	260 bc
	50 kg S/fed.	2.92	2.04	720 c	440 bcd	2.50	2.01	460 bc	270 bcd
	100 kg S/Fed.	3.08	2.08	720 c	445 bcd	2.57	2.05	470 c	270 bcd
$Ca (NO_3)_2$	Without sulphur	1.81	1.77	1060 j	685 I	1.86	1.94	730 h	380 F
	2% ATS	2.15	1.96	930 hI	660 h	1.95	1.95	690 gh	370 F
	4% ATS	2.48	2.03	925 hI	620 g	2.12	1.92	690 gh	375 F
	50 kg S/fed.	2.36	1.88	950 I	630 gh	2.08	2.02	680 gh	365 F
	100 kg S/Fed.	2.28	1.83	940 I	625 g	2.11	2.05	675 g	360 F
F. test		NS	NS	*	*	NS	NS	*	*

In the same column means followed by the same letter are not significantly different at 5% level of probability.

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تأثير بعض مصادر النتروجين والكبريت على النمو والمحصول فى البصل.

عادل يوسف مزروع و البيلى عبد العزيز رجب
كلية الزراعة بطنطا قسم البساتين و كلية الزراعة بطنطا قسم الاراضى

اجريت تجربتان حقليتان بهدف تحسين انتاج وجودة محصول البصل فى موسمى ١٩٩٦/٩٥ ، ١٩٩٧/٩٦ وتم دراسة تأثير النتروجين بمعدل ١٠٠ كجم/فدان من مصادر مختلفة وهى اليوريا وسلفات النشادر ونترات النشادر ونترات الكالسيوم وكذلك تأثير بعض معاملات الكبريت مثل الكبريت الزراعى بمعدل ٥٠ ، ١٠٠ كجم للفدان وثيوسلفات الامونيوم بمعدل ٢ ، ٤ كجم للفدان بالاضافة الى عدم إضافة الكبريت (الكنترول).

أظهرت النتائج ان نترات الامونيوم قد زادت من معدل وزن الابصال بينما ادت نترت الكالسيوم فى زيادة نسبة الابصال الحنبوط. بينما ادت زيادة إضافة الكبريت بمعدل ٥٠ ، ١٠٠ كجم للفدان الى زيادة محصول الفدان.

كما أظهرت النتائج ان كمية النترات كانت مرتفعة فى ابصال الاوراق الخضراء بالمقارنة بالابصال عند النضج. وكان اعلى معدل تراكم للنترات ناتج عن التسميد بنترات الكالسيوم ثم اليوريا ثم نترات الامونيوم واقل معدل تراكم للنترات ناتج عن التسميد بسلفات الامونيوم.

كان اقل تراكم للنترات فى انصال الاوراق وكذلك فى الابصال الجافة عند اضافة ٤ كجم من ثيوسلفات الامونيوم.