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EFFECT OF DIFFERENT SOURCES AND RATES OF NITROGEN ON GROWTH, YIELD AND ITS QUALITY OF LETTUCE PLANT.

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ABSTRACT

Two field experiments were conducted during the two successive winter seasons of 2001 and 2002 to investigate the performance of lettuce plant (*Lactuca sativa L.*) cv. Balady in relation to different nitrogen sources, i.e. ammonium sulphate, ammonium nitrate, urea and calcium nitrate as minerals as well as town refuse and cattle as organic manures at rates of 20, 40 and 60 N unit/fed. on the growth, yield of lettuce and its some physical and chemical properties.

The important results could be summarized as follows :-

1- Increasing levels of nitrogen fertilizers up to 60 N unit/fed. increased vegetative growth characters, i.e., plant length, stem length, number and area of leaves/ plant and its pigment content, fresh and dry weights of whole plant and its differents organs as well as total yield (ton/fed.).
2- The vigor plant growth as expressed as length of plant, number and area of leaves as well as head yield, all of them registrated their highest values with addition of ammonium nitrate as chemical nitrogen fertilizer. Moreover that plants received cattle manure had a superior in its growth if compared with that plants applied by town refuse manure.
3- Addition of ammonium nitrate as inorganic fertilizer at the highest rate of nitrogen (60 N unit/fed.) gave the best growth characters and heads yield as ton per feddan.
4- Increasing nitrogen fertilizer rates up to 60 N unit/fed. significantly increased chlorophyll content, nitrate, N, P and K contents of leaves tissues.
5- Addition of ammonium nitrate as chemical fertilizer at 60 N unit/fed. increased chlorophyll content, nitrate and N contents of leaves while ammonium sulphate at 60 N unit/fed. increased P and K cntents. Using cattle manure as organic fertilizer at 20 N unit/fed. significantly decreased chlorophyll content, nitrate, N, P and K contents of leaves.

INTRODUCTION

Lettuce (*Lactuca sativa L.*) is one of the most popular leafy vegetables grown in Egypt and represents good source of calcium, vitamin A and C as well as niaseen acid, raiboflavin acid and iron. Lettuce plant as leafy crop is influenced by nitrogen fertilizer. Nitrogen is highly effective on its vegetative growth and its yield. However, increasing nitrogen fertilizer increases plant growth which consequently increases the yield of lettuce (Shafshak and Abo-sedera, 1990; Vielemeyer *et al.* , 1991; Walworth *et al.* , 1992).

Growth and yield of lettuce are also affected by different sources of nitrogen as indicated by Kheir *et al.* , 1991; Myczkowski *et al.* , 1991; Moussa *et al.* , 1993).

Organic fertilization is very important method of providing the plants with their nutritional requirements without having an undesirable impact on the environment. For many years organic fertilization have been used basically as means of alleviation of the problem of chemical residues in the export market commodities.

Organic manures differ in their elemental contents depending on the sources whereas, organic fertilizer improves the physical and chemical properties of soil. Whereas good plant nutrition had better vegetative growth and increased the quantitative and qualitative characteristics of vegetable crops (Melloni *et al.* , 1995 ; Eissa, 1996 ; Abd El-Aty, 1997 ; Pinamonti *et al.* , 1997 ; Shafeek and El-Habbasha, 2000) .

From other side nitrogen supply is one of the most important factors affecting nitrogen accumulation in growing plants. Several investigators reported that, nitrate content of plants rose with increasing the dose of nitrogen application (Shafshak and Abo-Sedera, 1990; Vielemeyer *et al.* , 1991).

In addition, nitrate content was increased by mineral fertilizer , but decreased by manure application (Gianquinto and Borin, 1992). From the stand point of human health, high nitrate level in vegetables are considered undesirable (Hill, 1990).

The aim of present study was to investigate the performance of lettuce plant as a leafy vegetable crop to different sources and rates of nitrogen fertilizers.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental station of the National Research Center, Shalakan, (Kalubia Governorate) during the two successive winter seasons of 2001 and 2002 to investigate the effect of different sources and rates of nitrogen fertilizers on the growth, yield and its some physical and chemical properties of lettuce plant.

The physical and chemical characteristics of the experimental soil site are demonstrated in Table (1), while chemical analysis of cattle manure and town refuse compost are given in Table (2).

The experimental design used in the two growing winter seasones was split plot with three replicates, where six different sources of nitrogen, i.e., cattle manure and town refuse as organic fertilizers and ammonium sulphate (20.6% N) urea (46%N), calcium nitrate (15.5%N) and ammonium nitrate (33.5%N) as mineral fertilizers were laid out in the main plots, while the three rates (20, 40 and 60 N units/fed.) of nitrogen application were distributed randomly in the subplots. Each experiment included 18 treatments with three replicates. Each sub-plot consisted of 4 rows, 5 m long and 0.6 m apart, occupying an area of 12m².

Cattle manure and town refuse compost were added during preparing the soil for transplanting but mineral fertilizers, ammonium sulphate, urea, calcium nitrate and ammonium nitrate were added at two

equal doses, the first was after three weeks from transplnting and the second was added 15 days later.

Table (1) : Physical and chemical analysis of the experimental soil (2001 and 2002 seasons).

Physical properties Soil texture	2001 Clay	2002 Clay
Clay (%)	48.0	47.07
Silt (%)	27.50	28.61
Fine sand (%)	21.14	20.84
Coarse sand (%)	2.82	2.65
Chemical analysis		
Available (K) (mg/100g soil)	0.58	0.60
Available (P) (mg/100g soil)	6.31	5.27
Total nitrogen (mg/100g soil)	137.26	139.93
Cl (meq/L.)	1.65	1.74
Co3 (meq/L.)	5.13	4.74
Na2CO3 (meq/L.)	3.82	3.74
CaCO3 (meq/L.)	1.65	1.71
Organic matter (%)	2.52	1.84
SO4 (ppm)	95.41	85.72
Ec (mmhos/cm/25ºC)	1.83	2.42
PH	7.8	7.6

Table (2) : The chemical analysis of the used cattle manure and town refuse.

Character	Cattle	Town refuse
Weight of qubic meter (Kg)	750	500-650
Moisture (%)	71	20-33
pH	7.5	7-8.6
Ec (mmhos)	1.4	4-6
Organic carbon (%)	7.9	12-25
Organic matter (%)	6.5	32-45
Total nitrogen (%)	0.5	1-1.6
C/N ratio	1:19	10.12:10.16
Total phosphorus (%)	0.41	0.4-0.6
Total potassium (%)	0.85	0.4-0.6
Iron (mg/Kg)	650	5000-8000
Manganese (mg/Kg)	1.35	200-400
Copper (mg/Kg)	11	300-500
Zinc (mg/Kg)	105	1000-1500

Seedling lettuce (21 days old) cv. Balady were carried out in the first week of November at both sides of ridges in both seasons. Spacing between plants within rows was 20 cm. Pest control and other cultural practices, such as cultivation and irrigation were applied whenever it was necessary and as commonly recommended for the commercial lettuce production.

Harvesting was carried out 75 days after transplanting in both seasons. During the two experimental seasons a random of representative sample of 4 plants were taken from each sub-plot at harvesting time meanwhile the following criterias were recorded:

Plant length (cm), stem length (cm), leaves number/plant, leaf area/plant, fresh and dry weights of stem (g), fresh and dry weights of whole plant and its different organs (g) and total fresh yield of head as tons/fed.
Total chlorophyll content in fresh leaves tissues was measured using Minolta chlorophyll Meter Spad-501.
Total nitrogen, phosphorus and potassium contents were determined by using the methods as described by Black, 1983; Troug, 1939 and Brown, 1946 respectively. Nitrate content was estimated in dry weight according to Cataldo *et al.*, 1975.
All the obtained data were statistically analysed according to the presedure of Gomes and Gomez, 1984.

RESULTS AND DISCUSSION

I- Vegetative growth characters.

1- Effect of nitrogen sources:-

Data of Table (3) illustrated that using mineral nitrogen fertilizers in the form of ammonium nitrate (33.5%N) gave the best values of vegetative growth characters as expressed by plant length, leaf number and area/plant, fresh and dry weights of whole plant and its leaves and stems followed in descending order by that plants which received calcium nitrate (15.5%N). On the contrary, the addition of nitrogen fertilizer in the form of ammonium sulphate (20.6%N) gave the poorest lettuce plant growth. Moreover, plants which received cattle manure resulted in better plant growth compared to those plants which supplied by town refuse manure. The above mentioned findings were true in both experiments. The statistical analysis of the obtained data revealed significant differences among the different nitrogen sources in both seasons.
It could be concluded that, addition of ammonium nitrate as inorganic nitrogen fertilizers resulted in the best plant growth characters if compared with applying other sources of organic and / or inorganic fertilizers. Whereas, the supperiority of lettuce plants which received ammonium nitrate over the other sources may be attributed to the availability of both ammonium and nitrate, where the plant can absorbed them directly. On the contrary, the poorest lettuce plants when ammonium sulphate used might be own to the less solubility of this form of nitrogen fertilizer. For the superiority of that plants when the cattle manure are used compared the application of town refuse may be refered to some toxicity in town refuse which turn on plant growth (Galla, 2002).

The obained results are in accordance with other invetsigators (Nakagawa *et al.*, 1992; Walworth *et al.*, 1992; Moussa *et al.*, 1993; Abd El-Moniem *et al.*, 1996; Shehata *et al.*, 2001; Saglam *et al.*, 2002; Shehata, 2002; Ahmed, 2003).

Table (3):Effect of different sources of nitrogen fertilizers on the vegetative growth characters of lettuce plant in 2001 and 2002 seasons.

Nitrogen sources	Plant length (cm)	Leaves/plant				Stem/plant		
		Number	Area (cm^2)	Fresh weight (g)	Dry weight (g)	Length (cm)	Fresh weight (g)	Dry weight (g)
			First season (2001)					
Ammonium sulphate	40.00	37.44	2351.40	269.84	23.84	11.44	64.90	6.09
Urea	40.89	38.56	2547.83	362.03	26.47	11.89	71.24	6.29
Calcium nitrate	42.22	40.33	2671.64	397.60	29.78	13.11	79.22	6.71
Ammonium nitrate	45.44	43.00	2865.86	460.78	33.51	14.56	84.70	7.72
Town refuse	38.00	32.78	1929.92	201.27	18.77	9.11	39.30	4.54
Cattle manure	39.89	35.33	2218.63	237.09	21.82	10.56	55.17	5.33
L.S.D at 5% level	0.53	0.36	34.27	4.42	0.46	0.52	1.69	0.23
			Second season(2002)					
Ammonium sulphate	39.11	37.11	2033.99	296.61	22.28	9.78	54.99	5.70
Urea	39.56	38.33	2257.30	356.39	26.34	10.44	65.44	6.16
Calcium nitrate	42.22	40.78	2569.68	391.74	30.04	12.11	73.66	6.72
Ammonium nitrate	44.11	41.78	2923.96	457.46	34.10	13.33	77.43	7.10
Town refuse	37.11	30.44	1727.42	253.58	16.68	9.22	37.62	3.54
Cattle manure	38.56	33.44	1979.54	267.43	21.38	10.01	42.91	4.56
L.S.D at 5% level	0.41	0.54	34.00	2.93	0.74	0.32	1.49	0.30

2- Effect of nitrogen rates :-

It is obvious from the data of Table (4) that vegetative growth characters of lettuce plants significantly enhanced by increasing nitrogen rates up to 60 units of nitrogen/ feddan. Whereas, plant length, stem length, leaf number and area/ plant, fresh and dry weights of whole plant and its leaves. All of them gradually increased by increasing the application of nitrogen rates. The obtained data revealed that the highest values of the vegetative growth characters were obtained with the highest nitrogen rate (60 unit/fed.).

Table (4): Effect of different rates of nitrogen fertilizers on the vegetative growth characters of lettuce plant in 2001 and 2002 seasons.

Nitrogen rates (unit/fed.)	Plant length (cm)	Leaves/plant				Stem/plant		
		Number	Area (cm^2)	Fresh weight (g)	Dry weight (g)	Length (cm)	Fresh weight (g)	Dry weight (g)
			First season (2001)					
20	38.44	34.78	2011.31	273.99	22.70	9.78	49.37	4.64
40	40.72	37.22	2528.62	314.39	24.13	11.17	65.36	6.09
60	44.06	41.72	2752.72	379.26	29.93	14.39	82.54	7.27
L.S.D at 5% level	0.51	0.28	15.22	7.29	0.33	0.24	1.95	0.37
			Second season (2002)					
20	36.89	34.28	2061.44	306.90	22.71	8.87	41.84	4.01
40	40.83	37.83	2270.63	331.00	25.18	10.64	59.31	5.87
60	42.61	39.44	2414.14	373.71	27.53	12.94	74.88	7.02
L.S.D at 5% level	0.22	0.60	37.24	3.94	0.32	0.38	1.72	0.32

It could be summarized that vegetative growth of lettuce plant was associated with nitrogen application at highest rate (60 unit/fed.). These results are in good accordance with those results were obtained by Shafshak and Abo- Sedera (1990), Van Der Boon *et al.* (1990), Masson *et al.* (1991) and Walworth *et al.* (1992). Recently, on spanich plant, Abd El-Rahman *et al.* (2001) and Ahmed (2003) obtained the same trend. In such case, the increase in plant growth may be due to the beneficial effect of nitrogen on stimulating the meristematic activity for producing more tissues of the new organs, since nitrogen is a constituent of proteins, nucleic acid and many other important substances of plant cell (Moussa *et al.*, 1993).

3- The interaction effect of N- sources and rates :-

Data of Table (5,6) showed that all vegetative growth parameters significantly affected by the interaction treatments in both seasons. Whereas, the vigor lettuce showed from that plants which supplied with ammonium nitrate at the rate of 60 N unit/ feddan. On the contrary, the poorest plant growth criteria which mentioned above were recorded with those plants which supplied with town refuse compost as organic fertilizer at the rate of 20 N unit/ feddan. These findings were true significant in both experimental seasons.

Table (5):Effect of the interaction between different sources and rates of nitrogen fertilizers on the vegetative growth characters of lettuce plant in 2001 season.

Treatments		First season (2001)							
			Leaves/plant				Stem/plant		
Nitrogen sources	Nitrogen rates (unit/fed.)	Plant length (cm)	Number	Area (cm^2)	Fresh weight (g)	Dry weight (g)	Length (cm)	Fresh weight (g)	Dry weight (g)
Ammo-nium sulphate	20	37.67	34.67	1737.20	215.20	21.33	9.67	40.80	4.63
	40	40.00	36.33	2603.20	232.20	22.20	10.33	67.53	6.47
	60	42.33	41.33	2713.80	362.13	28.00	14.33	86.37	7.17
Urea	20	38.67	34.67	2167.97	288.80	23.10	10.00	48.57	4.87
	40	40.67	37.00	2635.30	388.17	25.20	11.33	70.20	6.73
	60	43.33	44.00	2840.23	409.13	31.10	14.33	94.97	7.27
Calcium nitrate	20	39.00	36.67	2297.57	325.97	25.20	11.00	65.20	5.07
	40	41.33	40.33	2695.53	407.70	30.90	12.33	75.13	7.07
	60	46.33	44.00	3021.83	459.13	33.23	16.00	97.33	8.00
Ammo-nium nitrate	20	42.67	38.67	2713.80	429.70	30.27	11.33	67.67	6.13
	40	44.00	43.33	2818.73	466.67	33.97	13.33	87.80	7.30
	60	49.67	47.00	3065.03	485.97	39.30	19.00	98.63	9.73
Town refuse	20	35.33	30.33	1453.73	175.10	16.90	7.67	35.83	3.37
	40	38.67	31.67	2030.27	181.53	17.33	9.33	39.93	4.63
	60	40.00	36.33	2305.77	247.17	22.07	10.33	42.13	5.63
Cattle manure	20	37.33	33.67	1697.60	189.20	19.40	9.00	38.13	3.80
	40	39.67	34.67	2388.67	210.07	20.17	10.33	51.53	5.37
	60	42.67	37.67	2569.63	312.00	25.90	12.33	75.83	6.83
L.S.D at 5% level		0.91	0.62	59.36	7.66	0.80	0.91	2.92	0.40

Table (6):Effect of the interaction between different sources and rates of nitrogen fertilizers on the vegetative growth characters of lettuce plant in 2002 season.

Second season (2002)									
Treatments			Leaves/plant				Stem/plant		
Nitrogen sources	Nitrogen rates (unit/fed.)	Plant length (cm)	Number	Area (cm^2)	Fresh weight (g)	Dry weight (g)	Length (cm)	Fresh weight (g)	Dry weight (g)
Ammo-nium sulphate	20	37.00	34.33	1826.53	271.03	20.13	8.00	41.43	3.87
	40	39.33	37.00	2022.43	294.20	22.93	9.00	57.20	6.00
	60	41.00	40.00	2253.00	324.60	23.77	12.33	66.33	7.23
Urea	20	37.33	34.67	2112.63	329.07	25.23	8.33	41.47	4.43
	40	40.00	38.67	2302.67	349.67	26.07	10.00	69.30	6.77
	60	41.33	41.67	2356.60	390.43	27.73	13.00	85.57	7.27
Calcium nitrate	20	37.67	37.67	2369.63	364.13	28.07	9.67	51.27	4.57
	40	43.33	41.33	2643.60	372.70	29.20	12.00	72.23	6.97
	60	45.67	43.00	2695.80	438.40	32.87	14.67	97.47	8.63
Ammo-nium nitrate	20	40.67	40.33	2679.13	409.93	30.03	10.67	55.07	4.70
	40	44.67	41.33	2945.70	448.23	33.93	13.00	74.97	7.77
	60	47.00	43.67	3147.03	514.20	38.33	16.33	102.27	8.83
Town refuse	20	33.00	28.00	1606.10	217.97	13.87	8.00	30.47	2.70
	40	38.67	30.33	1703.53	251.20	17.10	9.67	37.07	3.57
	60	39.67	33.33	1872.63	291.57	19.07	10.00	45.33	4.37
Cattle manure	20	35.67	30.67	1774.64	249.27	18.90	8.50	31.37	3.77
	40	39.00	34.33	2004.23	270.00	21.83	9.82	45.07	4.13
	60	41.00	35.33	2159.77	283.03	23.40	11.33	52.30	5.77
L.S.D at 5% level		0.71	0.93	58.88	5.08	1.28	0.55	2.59	0.52

II- Yield and its quality.

1- Effect of nitrogen sources :-

Data of Table (7) demonsrated that yield of lettuce plants were significantly affected by different nitrogen sources, i.e., inorganic (ammonium sulphate, ammonium nitrate, urea and calcium nitrate) and organic (cattle and town refuse manures). Whereas, plants which received ammonium nitrate as inorganic nitrogen fertilizers yielded the highest yield 35.340 and 32.711 ton/fed. in 1st and 2nd seasons respectively. On the opposite, using town refuse as organic fertilizer gave the lowest yield 19.911 and 19.318 ton/fed. respectively for 1st and 2nd experiments.

Moreover, the obtained results reveals that, using cattle manure had a better yield than using town refuse manure. The response of chlorophyll content to the sources of nitrogen took the same trend of yield as mentioned previosly. These findings are true in both seasons of the experiments.

It could be concluded that the superiority in the yield of lettuce plants which supplied by ammonium nitrate may be attributed to more availability and solubility of that nitrogen form compared with other at least under the conditions of this experiments.

In the same time the superiority of using mineral fertilizers compared the organic ones might be attributed to its more solubility and availability.

The obtained results are in good accordance with those which recorded by other investigators (Walworth *et al.*, 1992; Buchanan, 1993; Moussa *et al.*, 1993; Abd El-Rahman *et al.*, 2001; Shehata *et al.*, 2001; Shehata, 2002; Ahmed, 2003).

Table (7):Effect of different sources of nitrogen fertilizers on the yield and its some chemical composition of lettuce plant in 2001 and 2002 seasons.

Nitrogen sources	Average weight of plant (g)	Total yield (ton/fed.)	Chlorophyll content (spad)	NO3 (ppm)	N%	P%	K%
First season (2001)							
Ammonium sulphate	425.67	28.526	20.56	100.59	3.963	0.765	4.974
Urea	446.56	29.770	21.89	113.97	4.615	0.569	4.444
Calcium nitrate	487.89	32.622	23.33	147.20	5.011	0.630	4.776
Ammonium nitrate	527.89	35.340	24.00	163.70	5.509	0.656	4.875
Town refuse	300.00	19.911	16.67	77.07	3.792	0.474	4.048
Cattle manure	393.33	26.192	18.44	65.33	3.179	0.509	4.330
L.S.D at 5% level	26.40	1.167	0.29	0.07	0.116	0.014	0.036
Second season (2002)							
Ammonium sulphate	390.00	26.000	21.22	107.20	3.857	0.740	4.862
Urea	437.11	29.140	22.22	114.20	4.508	0.542	4.330
Calcium nitrate	459.67	30.689	23.44	145.27	4.903	0.604	4.668
Ammonium nitrate	490.67	32.711	24.44	170.27	5.403	0.629	4.749
Town refuse	289.78	19.318	17.44	87.40	3.320	0.445	3.947
Cattle manure	321.11	21.407	19.11	75.57	3.072	0.496	4.220
L.S.D at 5% level	12.09	0.648	0.53	0.07	0.072	0.018	0.072

Also, the obtained data revealed that ammonium nitrate significantly increased the content of nitrate and N in leaf tissues compared with different sources of nitrogen fertilizers (Table 7). On the other hand, the lowest values were correlated with that plants which received cattle manure as organic fertilizer. With regard to the contents of P and K, the obtained data indicated that the highest values were determined in the tissues of that plants which supplied ammonium sulphate. On the contrary, the lowest values were found in plants received town refuse as organic fertilizer. These findings were true in the two experimental seasons and are in harmony with those reported by Gianquinto and Borin, 1992; Abd El-Moniem *et al.*, 1996; Bakr and Gawaish, 1997.

2- Effect of nitrogen rates :-

Data of Table (8) showed that increasing nitrogen rates up to 60 N unit/fed. significantly increased yield and chlorophyll content of lettuce plant in both experimental seasons. Whereas, the highest values of yield (35.177 and 31.248 ton/fed.) for 1st and 2nd seasons respectively and chlorophyll content (24.83 and 23.56 spad value for the same respective) were obtained with the application of the highest nitrogen rate (60 N unit/fed.). On the other hand, the lowest values were noticed with the lowest nitrogen rate (20 N unit/fed.). These results are in harmony with those reported by several investigators (Moussa *et al.*, 1993; Abd El-Fattah and Sorial, 1998; Abd El-Rahman *et al.*, 2001; Ahmed, 2003).

Nitrate, N, P and K content of lettuce leaf tissues significantly increased by increasing N- rates up to 60 N unit/fed. in both seasons. These findings were true in both experimental seasons.

The obtained results are in harmony with those reported by Huett and White, 1992; Bakr and Gawaish, 1997; Ansary, 1998 and Abd El-Rahman *et*

al., 2001. They found that there was a consistent increase in the concentration of the mineral elements by increasing nitrogen fertilizer rates.

Table (8): Effect of different rates of nitrogen fertilizers on the yield and its some chemical composition of lettuce plant in 2001 and 2002 seasons.

Nitrogen rates (unit/fed.)	Average weight of plant (g)	Total yield (ton/fed.)	Chlorophyll content (spad)	NO3 (ppm)	N%	P%	K%
			First season (2001)				
20	338.39	22.559	17.22	87.91	3.885	0.565	4.396
40	426.78	28.444	20.39	113.02	4.328	0.600	4.563
60	525.50	35.177	24.83	133.01	4.821	0.636	4.765
L.S.D at 5% level	19.45	0.546	0.34	0.04	0.106	0.015	0.047
			Second season (2002)				
20	328.33	21.889	19.00	95.47	3.725	0.536	4.288
40	397.44	26.496	21.39	117.28	4.092	0.578	4.447
60	468.39	31.248	23.56	137.20	4.715	0.613	4.653
L.S.D at 5% level	9.13	0.384	0.30	0.03	0.053	0.008	0.060

3- Effect of the interaction between N-sources and rates :-

Data presented in Table (9,10) indicated that there were significant differences between nitrogen sources and rates on the total yield (ton/fed.) and chlorophyll content of lettuce plants.

Table (9):Effect of the interaction between different sources and rates of nitrogen fertilizers on the yield and its some chemical composition of lettuce plant in 2001 season.

Treatments				First season (2001)				
Nitrogen sources	Nitrogen rates (unit/fed.)	Average weight of plant (g)	Total yield (ton/fed.)	Chlorophyll content (spad)	NO3 (ppm)	N%	P%	K%
Ammo-nium sulphate	20	316.33	21.089	17.00	75.43	3.067	0.710	4.869
	40	446.67	29.777	20.67	105.70	4.138	0.748	4.910
	60	514.00	34.711	24.00	120.65	4.684	0.838	5.143
Urea	20	323.67	21.577	17.00	90.60	4.368	0.495	4.397
	40	459.67	30.644	21.67	115.70	4.446	0.589	4.427
	60	556.33	37.089	27.00	135.60	5.031	0.623	4.507
Calcium nitrate	20	379.67	25.311	20.00	115.50	4.559	0.614	4.550
	40	470.00	31.622	23.00	150.30	4.871	0.625	4.658
	60	614.00	40.933	27.00	175.80	5.603	0.651	5.120
Ammo-nium nitrate	20	458.00	30.533	20.33	135.30	5.165	0.638	4.648
	40	501.00	33.399	24.33	165.20	5.508	0.652	4.840
	60	624.67	42.088	27.33	190.60	5.854	0.677	5.137
Town refuse	20	269.67	17.978	13.67	60.40	3.272	0.454	3.785
	40	300.00	19.666	15.33	75.50	4.047	0.479	4.143
	60	330.33	22.089	21.00	95.30	4.056	0.488	4.206
Cattle manure	20	283.00	18.866	15.33	50.20	2.882	0.481	4.116
	40	383.33	25.555	17.33	65.70	2.960	0.505	4.397
	60	513.67	34.155	22.67	80.10	3.696	0.542	4.478
L.S.D at 5% level		45.72	2.021	0.50	0.12	0.202	0.024	0.062

Table (10):Effect of the interaction between different sources and rates of nitrogen fertilizers on the yield and its some chemical composition of lettuce plant in 2002 season.

Treatments		Second season (2002)						
Nitrogen sources	Nitrogen rates (unit/fed.)	Average weight of plant (g)	Total yield (ton/fed.)	Chlorophyll content (spad)	NO3 (ppm)	N%	P%	K%
Ammo-	20	332.67	22.178	18.67	85.40	2.960	0.685	4.760
nium	40	416.00	27.733	21.33	110.60	4.030	0.722	4.775
sulphate	60	421.33	28.089	23.67	125.60	4.580	0.812	5.050
	20	335.67	22.377	19.00	95.80	4.258	0.468	4.295
Urea	40	442.00	29.466	22.33	115.90	4.340	0.562	4.320
	60	533.67	35.577	25.33	130.90	4.925	0.596	4.375
	20	380.33	25.355	21.33	120.30	4.450	0.581	4.445
Calcium	40	460.00	30.666	22.67	145.20	4.760	0.606	4.550
nitrate	60	538.67	36.044	26.33	170.30	5.500	0.625	5.010
Ammo-	20	395.33	26.355	22.33	140.10	5.060	0.612	4.527
nium nitrate	40	465.00	31.000	24.33	170.30	5.400	0.628	4.700
	60	611.67	40.777	26.67	200.40	5.750	0.648	5.020
	20	247.67	16.511	15.33	70.70	2.840	0.423	3.690
Town	40	286.33	19.088	17.67	85.90	3.170	0.450	4.050
refuse	60	335.33	22.355	19.33	105.60	3.950	0.461	4.100
	20	278.33	18.555	17.33	60.50	2.780	0.447	4.010
Cattle	40	315.33	21.022	20.00	75.80	2.850	0.502	4.285
manure	60	369.67	24.644	22.00	90.40	3.585	0.538	4.365
L.S.D at 5% level		20.94	1.123	0.92	0.12	0.124	0.032	0.124

Whereas, the highest significant values of yield and chlorophyll content were obtained with that plants which received ammonium nitrate as mineral nitrogen fertilizer at the rate of 60 N unit/fed. On the other hand, the lowest values were recorded with that plants which supplied town refuse compost at the lowest rate 20 N unit/fed. These results were true in both seasons.

Regarding to the effect of the interaction between N-sources and N-rates on the chemical composition of lettuce leaves, data of Table (9) and (10) showed clearly that ammonium nitrate at 60 N unit/fed. significantly increased nitrate and N contents in leaf tissues compared to other different inorganic and organic fertilizer sources. However, using ammonium sulphate at 60 N unit/fed. increased P and K contents. The addition of cattle manure at rate of 20 N unit/fed. resulted in the lowest values of nitrate, N, P and K contents in both experiments. Similar results were obtained by Myczkowski *et al.*, 1991; Gianquinto and Borin, 1992; Bakr and Gawaish, 1997 and Abd El-Rahman *et al.*, 2001.

REFERENCES

Abdel-Aty, S. (1997). Influence of some organic fertilizers on the growth and yield of pepper plants (*Capsicum annum L.*) cultivated under plastic house. M. Sc. Thesis, Fac. Agric. Ain Shams Univ., Cairo, Egypt.

Abd El-Fattah, M.A. and M.E. Sorial (1988). Efficiency of biofertilization on responses of the productivity and chemical composition of lettuce plants grown under different nitrogen levels. Menofiya J. Agric. Res., 23 (5) : 1185-1207.

Abd El-Moniem, E.M.; A.F. Abou- Hadid; M.Z. El-Shinawy; A.S. El-Beltagy and A.M. Eissa (1996). Effect of nitrogen form on lettuce plant grown in hydroponics system. Acta Hort. 434 : 47-52.

Abd El-Rahman, M.M.; R.A. El-Shabrawy; M.E. Abou El-Nasr and M.A. El-Saei (2001). Response of two spinach cultivars (*Spinacia oleracea L.*) to different N-source and levels in relation to vegetative growth, yield, chemical composition, nitrate and oxalate. J. Agric. Sci. Mansoura Univ., 26 (4) : 2235-2262.

Ahmed, A.A. (2003). Effect of organic and inorganic nitrogen fertilizers on spinach plant growth, yield and quality. Egypt. J. Appl. Sci., 18 (12) : 316-329.

Ansary, E. M. (1998). Effects of nitrification inhibitors and NH4-N /NO3 ratios on vegetative growth, physiological, behaviour and hazardous compounds in spinach and lettuce plants. J. Agric. Sci. Mansoura Univ., 23 (12) : 5939-5954.

Bakr, A.A. and A.R. Gawaish (1997). Trials to reduce nitrate and oxalate content in some leafy vegetables. 2. Interactive effects of the manipulating of the soil nutrient supply, different blanching media and preservation methods followed by cooking process. J. Sci. Food. Agric., 73 : 169-178.

Black, C.A. (1983). Methods of plant Analysis. Part I and II Amer. Soc. Agron. Inc. Publ., Madison, Wisc, USA.

Brown, J. D. and O. Lilleland (1946). Rapid determination of potassium and sodium in plant material and soil extracts by Flame photometry. Proc. Amer. Soc. Hort. Sci., 48 : 341-346.

Buchanan, M. (1993). Study examines efficient use of compost. Cultivar (Santa Cruz) 11 (1) : 9-10.

Cataldo, Q.A.; M. Harnon; L.E. Schrader and V.L. Youngs (1975). Rapid colorimetric determination of nitrate in plant tissue by nitration of salicylic acid. Commun Soil Sci. and Plant Analysis, 6 (1) : 71-80.

Eissa, N.M. (1996). Studies on sustainable agriculture for some vegetable crops using animal manure. M. Sc. Thesis Institute of Environmental studies and Research, Ain Shams Univ., Cairo, Egypt.

Galla, M.A., 2002. The organic farmins, principles, Regulation and quality of products. Egypt boox home, for 1st edition, 308 p.

Gianquinto, G.P. and M. Borin (1992). Nitrate content in vegetable crops as affected by soil characteristics, rate and type of fertilization. In Proceeding, second congress of the European Society for Agronomy, Warwick University 23-28 Augest 1992. Wellesbourna, UK; European Society for Agronomy 256-257.

Gomez, K.A. and A.A. Gomez (1984). Statistical procedures for Agriculture Research. 2nd Ed. Willey Inter Science Publ. P. 357-423.

Hill, M.J. (1990). Nitrate and nitrites in food and water. Ellis Horwood in food Science and Technology. 193 pp.

Huett, D.O. and E. White (1992). Determination of critical nitrogen concentrations of lettuce grown in sand culture. Australian J. Exp. Agric. 32 (6) : 759-764.

Kheir, N.F.; A.H. Hanafy Ahmed; E.A. Abou El-Hassan and E.M.Z. Harb (1991). Physiological studies on the hazardous nitrate accumulation in some vegetables. Bull Fac. Of Agric. Univ. of Cairo 42 (2) : 557-576.

Masson, J.; N. Tremblay and A. Gosselin (1991). Effects of nitrogen fertilization and HPS supplementary lighting on vegetable transplant production. II. Yield. J. Amer. Soc. Hort. Sci. 116 (4) : 599-602.

Melloni, R.; C.M.R. Duate and E.J. Cardoso (1995). Influence of compost and/or effective microorganisms on the growth of cucumber rand on the incidence of Fusarium wilt. Summaphytopathological, 21 : 1, 21-24.

Moussa, A.G.; M.A. El-Shal; A.H. Abdel-Razik and H. Abdel-Razak (1993). Efficiency of organic and inorganic fertilization on yielding of lettuce (*Lactuca sativa L.*). Zagazig J. Agric. Res., 20 (5) : 1583-1592.

Myczkowski, J.; S. Rozek and W. Sady (1991). The effect of fertilization with different forms of nitrogen on yield and nitrate metabolism in leaves of greenhouse lettuce. II.. Effect of growth regulators. Folia Horticulturae 3 (1) : 13-25.

Nakagawa, J.; L.I. Prochnow; L.T. Bull and R.L. Boas (1992). Effects of organic composts on a lettuce crop. Ciertifica (Jaboticabal) 20 (1) : 173-180.

Pinamonti, F.; G. Stringari and G. Zorzi (1997). Use of compost in soilless cultivation. Compost Science and Utilization 5, 38-46.

Saglam, N.; N. Gebologlu; E. Yilmaz and A. Brohi (2002). The effects of different plant growth regulators and foliar fertilizers on yield and quality of crisp lettuce, spinach and pole bean. Acta Hort. 579, 619-623.

Shafeek, M.R. and K.M. El-Habbasha (2000). Productivity of climbing bean (*Phaseolus vulgaris L*) grown under plastic house as affected by organic manures. Egypt. J. Appl. Sci., 15 (12) : 192-210.

Shafshak, N.S. and F.A. Abo-Sedera (1990). Effect of different nitrogen sources and levels on growth, yield and nitrate accumulation in some lettuce varieties. Annals of Agric. Sc. Moshtohor 28 (1) : 331-343.

Shehata, S.M. (2002). Influence of seed coating treatments and nitrogen fertilizer source on yield and its components, chemical composition and nitrate accumulation in spinach plants. Egypt. J. Appl. Sci. 17 (9) : 253-270.

Shehata, S.M.; W.A. El-Tohamy and S.M. El-Ashry (2001). An attempt to reduce nitrate hazard in spinach plant by using foliar application treatments under two sources of nitrogen fertilization. Egypt. J. Hort. 28 (4) : 447-462.

Troug, E. and A.M. Meyer (1939). Improvement in disness colorimetric method for phosphorus and aesenic 2nd Eng. Chen. Annals. Ed. 1 : 136-139.

Van Der Boon, J. and J. W. Steenhuizen and E. G. Steingower 1990. Growth and nitrate concentration of lettuce as affected by nitrogen and chloride concentration, NH4/NO3 ratio and temperature of the recirculating nutrient solution. J. Hort. Sci. 65 (3) : 309-321.

Vielemeyer, H.P.; I. Hundt and B. Anding (1991). Checking the nitrate content of head lettuce by the producer. Gartenbau Magazin 38 (4) : 8-9.

Walworth, J.L.; D.E. Carling and G. J. Michaelson (1992). Nitrogen sources and rates for direct-seeded and transplanted head lettuce. Hort Science 27 (3) : 228-230.

تأثير مصادر التسميد النيتروجينى ومعدلات الاضافة على نمو ومحصـــول نبـات الخس

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أجريت تجربتان حقليتان بمزرعة المركز القومى للبحوث بشلقان (محافظة القليوبية) فى عـــامين متتاليين ٢٠٠١،٢٠٠٢ لدراسة تأثير مصادر مختلفة من السماد المعدنى (سلفات نشادر ، يوريـــا ، نـترات كالسيوم ، نترات امونيوم) والسماد العضوى (سماد القمامة ، سماد الماشية) تحت ثـــلاث معـدلات إضافـة مختلفة (٢٠ ، ٤٠ ، ٦٠ وحدة نيتروجين/فدان) على النمو الخضرى و المحصـــول والـتركيب الكيمـاوى (الكلوروفيل ، النيتروجين ، الفوسفور ، البوتاسيوم ، النترات) لأوراق نبات الخس.
وتتلخص أهم النتائج المتحصل عليها فيما يلى:-

١- أدت زيادة معدلات السماد الازوتى الى زيادة قيم صفات النمو الخضرى لنبات الخس متمثلة فـى طـول النبات ، عدد الاوراق/نبات ، مساحة الاوراق/نبات ، المحصول الكلى (طن/فـدان) وكذلـك محتـوى اوراق النبات من الكلوروفيل.

٢- ازدادت قيم صفات النمو الخضرى و المحصول وكذلك محتوى الاوراق من الكلوروفيل مـع اسـتخدام التسميد المعدنى فى صورة نترات الامونيوم (٣٣,٥% نيتروجين) مقارنة ببقية مصادر التسميد المعدنيـة و العضوية الاخرى. وسجل التسميد بسماد الماشية أفضل قيم فى الصفات المتحصـل عليـها مقارنـة بسماد القمامة.

٣- أدى استخدام السماد المعدنى (نترات الامونيوم) بمعدل ٦٠ وحدة نيتروجين/فدان الـى الحصـول علـى افضل قيم للنمو الخضرى و المحصول وكذلك محتوى الاوراق من الكلوروفيل.

٤- أدت زيادة معدلات السماد الازوتى من ٢٠ الى ٦٠ وحدة نيتروجين/فدان الى زيادة محتوى الاوراق مـن النترات و النيتروجن والفوسفور والبوتاسيوم.

٥-أدى استخدام السماد الكيماوى (نترات الامونيوم) بمعدل ٦٠ وحدة نيتروجين/فدان الـى زيـادة محتـوى الاوراق من النترات والنيتروجين بينما ادى استخدام سلفات النشادر بمعدل ٦٠ وحدة نيـتروجين/فـدان الى زيادة محتوى الاوراق من الفوسفور و البوتاسيوم. وأدى استخدام السماد العضوى (سماد الماشـية) بمعدل ٢٠ وحدة نيتروجين/فدان الى انخفاض محتوى الاوراق من النترات و النيـتروجين والفوسـفور والبوتاسيوم.