J. Agric. Sci. Mansoura Univ., 34 (4): 3223 - 3237, 2009

FERTILIZATION MANAGEMENT TO REDUCING NITRATE ACCUMULATION IN SOME LETTUCE VARIETIES (*Lactuca sativa* L.) GROWN IN SANDY CALCAREOUS SOILS

Refai , E. F. S.* and M. M. M. Ahmed **

*** Hort. Res. Institute A.R.C. Giza, Egypt**

**** Soil, Water and Environ. Res. Institute A.R.C. Giza, Egypt**

ABSTRACT

The present investigation was conducted during the two seasons of 2005/2006 and 2006/2007 at the Desert experimental Farm of Assiut Agric. Res. Station to study the effect of five levels of N-fertilizer (0, 30, 60, 90 and 120 kg N/fed.) and three levels of composted waste farm (Control (zero), Compost (3 ton/fed.) and bio-compost (3 ton /fed. compost with Biogen). Tow varieties were used in this investigation (Latoga and Balady). These varieties were grown in sandy calcareous soil under drip irrigation system. The interaction between the two fertilizer sources was studied. The results indicated that there were significant differences among the five levels of N fertilizer in all studied characters. Increased for both mineral and organic fertilizer were obtained of both lettuce varieties on yield and its components. Meanwhile, application of composted waste farm at a rate of 3 ton/fed in combination with Biogen reduced the application of mineral N to 50% and reduced nitrate concentration in leaves of both lettuce varieties.

Compost and bio-compost as organic and bio fertilizers play an important role in maintaining soil fertility with releasing nutrients in the soil. The most increase in soil N and P content was observed with compost and bio-compost application. The increase percentage in P content over the control was 10.12 and 38.38 in 2006 and 25.58 and 19.08 % in 2007, respectively.

INTRODUCTION

Lettuce (*Lactuca sativa* L.) is one of the most important vegetable crops grown in Egypt for local consumption and export. The total area in Egypt was (13.567 fed.) and the total yield was 136.008 ton/fed.[*] Nitrogen is one of essential elements for growth and development plants and in the nutrition of plants plays a significant role. Plants absorb nitrogen from the soil in the form of nitrate, which are then converted into proteins and other nitrogen-containing substances (Cash *et al*., 2002). Nitrate content in a plant represents a dynamic balance between rate of absorption, assimilation and translocation (Maynard *et al*., 1976). Increasing nitrogen rate increased plant height and number of leaves/plant (Awny and Moursy, 1992), fresh weight/plant and total yield (Shafshank and Abo-Sedera, 1990; Awny and Moursy, 1992; Moussa *et al*., 1993; Gawish, 1997; Cameria *et al*., 2000), nitrate contents in leaves (El-Hassan 1990; Shafshank and Abo-Sedera, 1990; Awny and Moursy, 1992; Bakr and Gawish 1997).

Test of nitrate accumulation in Egyptian vegetables showed considerable high values as compared to those found in vegetables grown in several European countries (Blom-Zandstra, 1989 and Kheir *et al*., 1991). Nitrate accumulation in plant can be hazardous to human health. Because, in

*** Ministry of Agriculture & Land reclamation, Agricultural statistics, second part, 2005.**

the human body nitrate can be reduced to nitrite which may cause methemoglobinemia furthermore, the possible formation of N-nitroso-compounds from nitrite and secondary nitrogen compounds in human stomach constitutes a risk (Breimer, 1982).

Furthermore, the excessive use of nitrogen fertilizers raises the major cost in lettuce production and creates pollution of their agricultural environment as well as affects the soil fertility; therefore it has become essential to use untraditional fertilizers as supplements or substitutes for chemical nitrogen fertilizer. Bio-fertilization and organic fertilizer were the solution to decrease the chemical fertilizer in vegetables production. Farmyard manure as an organic fertilizer was associated with low nitrate concentration in lettuce (Bakr and Gawish 1997). Also, there are many investigations that showed the effect of organic fertilizer on growth and yield of lettuce plants (Smith and Hadley 1989, El-Shinawy *et al*., 1999 , Valšíková and Viteková 2006 and Georgios *et al*., 2007) and bio-fertilizer (Ruiz Lazano *et al.,* 1995, Azcon *et al*., 1996, Chabot *et al*., 1996 and Noel *et al*., 1996). Additionally, organic fertilizers improve soil properties and enhancements its fertility ((Ahmed, 1997; Ahmed, 2001 and Ahmed & Ali, 2005).

The present study was undertaken to investigate the effect of compost application with or without Biogen in the present of mineral N at different rates on soil fertility and nitrate concentration of leaves of some lettuce varieties grown in sandy calcareous soils.

MATERIALS AND METHODS

The present experiment was carried out at the Desert experimental Farm of Assiut Agric. Res. Station in 2005/06 and 2006/07 seasons. This investigation was designed to study the effect of some level mineral, compost and bio compost fertilization on soil fertility and nitrate concentration in leaves of some lettuce varieties (*Lactuca sativa L.*), *i.e.*, Latoga and Balady grown in sandy calcareous soil under drip irrigation system.

Soil mechanical and chemical analysis of the experimental site are shown in Table (1). The treatments were arranged in split plot design with four replicates. The level mineral nitrogen was put in the main plot with five levels, *i.e.,* 0, 30, 60, 90 and 120 kg/fed. While the organic N (Composted Farm Wastes, Table, 2) was allocated in sub plot with three levels, *i.e.,* Control (zero), Compost (3 ton/fed.) and bio-compost(3 ton/fed. compost with Biogen).

Mineral-N was applied in the form of ammonium nitrate (33.5% N) in 6 equal doses during the growth season. Compost was applied at soil preparation before cultivation. Bio-compost treatment represent compost with Biogen (*Azotobacter sp*.) which was applied at a rate of 2 kg/fed after 2 weeks of cultivation.

Physical and chemical analysis of the experimental soil is shown in Table (1). Lettuce seeds were sown on 10 Oct. in both seasons. The seedlings were transplanted to the field after 40 days from sowing in nursery and spacing was 25cm between plants within rows. Plot size was 3 X 3.5 m.

(1/400 /fed.) with four rows. Plant samples were collected from each plot and prepared to analyze for NO_3 concentration according to the procedure described by Keeney and Nelson (1982). Soil samples were taken from surface layers (0-30 cm) at end of harvesting each plot of lettuce cultivars and prepared to analysis according to the procedures described by Jackson (1958).

Table (1): Mechanical and chemical analysis of the experimental soil sites (0-30 cm depth)

Season	Mechanical analysis %			Texture	pH	Ec ds/m	CaCO3 %	O.M %	Total N %	Av.P ppm	Ex.K ppm
	Sand	Silt	clay								
2005/06	92.4	4.3	3.3	Sandy	8.1	0.67	17.1	0.14	0.02	7.8	160
2006/07	92.4	4.3	3.3	Sandy	8.3	0.88	18.7	0.11	0.02	8.6	217

Total N: Total nitrogen Av.P.: Available phosphorous. Ex.K.: Exchangeable potassium

Table (2): Some chemical analysis of composted Farm Wastes.

pH 1:10 suspension	Ec 1:10 extract	O.M	C/N ratio	Total N %	Total P %	Total K %
7.51	6.14	65.61	22.17	1.05	092	1.4

Ten lettuce plants were taken randomly from each sub-plot and the following measurements were recorded:

1-Total plant weight (g) 2- Commercial plant weight (g)
3- Total yield/plot (kg) 4- Head diameter (cm)
5- Head length (cm) 6- Number of leaves/plant
7- NO_3 accumulation

All obtained data were statistically analyzed using Mstat and treatment means were compared by using L.S.D. test according to the procedure outlined by Snedecor and Cochran (1972).

RESULTS AND DISSCUSION

1- Effect of mineral nitrogen, compost and bio-compost on lettuce yield and its attributes.

1.1. Total plant weight (g):

The effect of two sources of nitrogen on grown of lettuce plant under the reclaimed land is presented in Table (3) for cv Latoga and Table (4) for Balady cultivar. The results indicated that there were significant differences among the five levels of nitrogen in this trait in both studied seasons for each lettuce cultivars. Level 120 N unit gave the highest total plant weight in both seasons. Meanwhile, bio-compost was significantly higher than the compost application while the two treatments were significant differences than the control. The interactions between the N levels and organic fertilizer are listed in Table (3) and Table (4) for the lettuce cultivars. The results showed that there were significant differences among the interactions in both seasons for this trait. The highest total plant weight was obtained from the interaction of 120N and bio-compost in both seasons but there were no significant differences among this interaction and both (60N and bio-compost) and (90N and bio-compost) interactions in both seasons in Latoga cultivar. While there were no significant between the interactions (120N and bio-compost), (120N

and compost) and (90N and bio-compost) for Balady cultivar in both studied seasons and these interactions were significantly higher than other interactions. So from the previous results we can suggested that we can use the low level of nitrogen such as 60N level and bio-compost to obtain the good results for weight plant with decrease in use of nitrogen and also for human health. The obtained results are in harmony with those obtain Shafshank and Abo-Sedera, 1990; Awny and Moursy, 1992; Moussa *et al*. 1993; Gawish, 1997; Cameria *et al*. 2000) which they say that increasing in weight of lettuce plant increases with added N level.

1.2. Commercial plant weight (g):

Data in Table (3) studied lettuce cultivars and 4 for Latoga and Balady cultivars respectively showed that there were significant differences for N levels and Organic fertilizer for this trait in both seasons. Both levels 120N and bio-compost gave the highest values for this trait for both seasons 2005/2006 and 2006/2007.The interactions between the N levels and organic fertilizer on effect of commercial plant weight are presented in Tables (3) and (4). The results indicated that there were significant differences among the interactions for both lettuce cultivars in both seasons. The interaction between (90N and bio-compost) and (60N and bio-compost) were significantly higher than the other combinations and gave the highest weight for lettuce plant in Latoga cultivar in both seasons. While, in the Balady cultivar the best combined for this trait was obtained from (60N and bio-compost) interaction in both seasons.

1.3. Total yield/plot (kg):

The results in Table (3) and (4) indicated that there were significant differences among the five levels of N for this trait in both lettuce cultivars. The increased in total yield for lettuce cultivars are depending on the increases in N levels and organic fertilizer. The highest values of total yield were obtained from 120 N and bio-compost in two seasons for both cultivars. The interactions between chemical and organic fertilizer in both Tables (3) and (4) demonstrated that the highest total yield was obtained from interactions (90N and bio-compost) in Latoga cultivar in both seasons. While, in Balady cultivar the interaction (60N x and bio-compost) gave the highest value of total yield/plot in both seasons. Similar results for lettuce yield increases due to N-application were obtained by Richared *et al*. (1985), Sanchez *et al*.(1989) and Custic *et al.*(1994). Also these increases might be due to the fact that bio-fertilizer which gave good root growth and that increase up take of minerals (Pandy and Kumar 1989, Noel *et al*. 1990 and Azcon *et al*. 1996) also, many investigation reported that reduction of N fertilization through the use of bio-fertilizer inoculation such as Kumaraswamy and Madalageri 1990 on tomato, Subbiah 1991 and Ashour *et al*. 1997 on potato.

1.4. Head diameter:

Data in Tables (3) and (4) for head diameter of two lettuce cultivars indicated that there were significant differences for both N levels and organic fertilizer in both seasons. Head diameter in lettuce plant increases with increases in added N levels or organic fertilizer.

T3

t4

The highest values of head diameter were obtained from 120 N level and compost in both Latoga and Balady cultivars. The interaction between the chemical and organic fertilizer are presented in Tables 3 and 4. The results indicated that added 60, 90 and 120 N with and bio-compost gave the highest values for this trait in both lettuce cultivars and there were no significant among these interactions. The present results are in agreement in general with those obtained by Pew *et al.* 1984, Abdel-Razik and Barakat 1990, Walworth *et al.* 1992 and Moussa *et al*., 1993. Also, there were many worker presented the effect of use bio-fertilizer gave the good results with N application such as Barakat and Gaber1998.

1.5. Head length:

The effect of two sources of nitrogen on grown of lettuce plant under the sandy soil was presented in Table (3) for cv, Latoga and Table (4) for Balady cultivar. The results indicated that there were significant differences among the five levels of nitrogen and also for organic fertilizer with or without biogen in both studied seasons for the two lettuce cultivars. The tallest head length for lettuce plant was obtained from the 120N and compost. Also, the results indicated that there are significant differences among the interactions between chemical and organic fertilizer for head length character. Interaction (90N and bio-compost) gave the highest value of head length in both lettuce cultivars in both seasons. Similar finding were obtained by Richared *et al*. (1985), Sanchez *et al*. (1989) and Custic *et al.* (1994).

1.6. Number of leaves/plant:

Data in Tables (3) and (4) showed that there were significant differences among both five level of nitrogen and three levels of organic for the two lettuce cultivars in both studied seasons. The highest values of number of leaves/plant were obtained from the both 120 N level and bio-compost. The interaction (120N and bio-compost) gave the highest value and was significantly higher than other interactions in both seasons for Balady cultivar. While, latoga cultivar gave no significant among the 120N level and the organic fertilizer with or without Biogen and also with (90N and compost or bio-compost) and (60N and bio-compost) in both seasons. The results are in harmony with those reported by Shafshank and Abo-Sedera, 1990; Awny and Moursy, 1992; Moussa *et al*. 1993; Gawish, 1997; Cameria *et al*., 2000 for increasing the vegetative with increasing N application. Also, the results presented that the effect of organic with bio-fertilizer on decreasing the N application and obtaining a high results positive when added with chemical fertilizer. Many workers presented the effect of organic and biofertilizer on growth plant such as Jagnow *et al*. (1991) who reported that inoculation of bacteria as bio-fertilizer increased the surface area per unit root hair which help to increase uptake nutrients led to increased in vegetative growth. Also, Caretti *et al*. 1996 found inoculated plant with biofertilizer showed increases in total root length compared with uninoculated plant.

2- Effect of mineral nitrogen, compost and bio-compost on nitrate concentration in lettuce leaves.

2.1. Effect of mineral nitrogen on nitrate concentration of lettuce leaves.

Data presented in Tables (3 and 4) reveal that nitrate concentration in lettuce leaves was significantly increased for Latoga and Balady cultivars with

increasing mineral N rate fertilization in both as seasons compared to the control. This increase was 23.9, 81.5, 155.5 and 226.9% in 2006 season. While, the increase were 26.0, 89.5, 168.0 and 239.3% over the control due to mineral N application at a rate of 30, 60, 90, and 120 kg N/fed. for latoga cultivar leaves, respectively.

Fig (1) shows clearly the increase in nitrate concentration in both cultivar leaves as affected by mineral fertilization. A linear equation describes a relationship in which the value of nitrate content in lettuce leaves depends on the value of the mineral fertilization rates. Nitrate concentration decreased each seasons with both compost and bio – compost application in both lettuce cultivars with a significant mineral N X compost interaction .Nitrate concentration was significantly grates in zero organic fertilizer than in compost or bio-compost application .This held true under each mineral – N rate .Nitrate $0.oo46N^2 + 3.1122N + 10773$ in the 1st season for Latoga cultivar with an r^2 of 0.9282, Likewise, in the second season the regression relationship was $– 0.0058 N^2 + 3.3177 N + 102.64$ with an r2 of 0.9245. Similar values were obtained in Balady cultivar.

Data proved that there are a positive relationship between nitrate concentration and N fertilization. Similar results were obtained by Hanfy Ahmed (1997) in Jews mallow and radish plants, Porto *et al*. (2008) and Cometti *et al*. (2004) on lettuce plants.

Additionally, it is important that even the highest leaf nitrate content observed here is far below the limit prescribed by the European Union (3.500 to 4.500 mg Kg-1 of fresh matter) Van der Boon *et al.* (1990).

2. 2. Effect of compost and bio-compost on nitrate concentration of lettuce leaves.

Data in Tables (3 and 4) illustrate that nitrate concentration in lettuce leaves was significantly decreased with compost application. The decrease percentage in both 2006 and 2007 due to compost and bio-compost application compared to the control were 9.45, 15.35% in 2006 and 7.01, 12.97% in 2007, respectively. The decrease in nitrate concentration became lower with bio-compost in both seasons. Many researchers reported about reducing nitrate concentration in vegetable crops by organic fertilization. Williams (2002) in leafy vegetables. Vogtmann *et al.,*1993 in cabbage. Hajslova *et al.* 2005 and Malmauret *et al.* 2002 in potato and tomato.

Nitrate accumulation decreased with compost and bio compost application (Fig. 2) each year, but the total amount of nitrate varied from year to year in both lettuce cultivars.

It can be concluded that organic (compost) and bio-organic (compost+ biogen) fertilizer treatment lowered nitrate concentration significantly in lettuce plants. This reduction could be explained under the basis of replacement of simple organic molecules (sugar, free amino acid and total soluble phenols) and solutes with nitrate in the cell vacuoles. These results are in agreements with those reported by Hanfy Ahmed (1997) and Hanfy Ahmed *et al.* (2000).

3- Effect of treatments on soil fertility.

Tables (5 and 6) show the effect of treatments on total N and available P in the soil after harvesting lettuce plants.

3.1. Total-N:

Total-N in the soil significantly increased with increasing mineral-N fertilizer rate. Moreover, the most increase in soil N content was observed with compost and bio-compost. The highest N-content in the soil was obtained with the high rate of N-fertilizer and bio-compost. Compost and bio-compost as organic and bio fertilizer plays an important role in maintaining soil fertility with releasing nutrients in the soil. Several investigators reported about the positive effect of applying organic fertilizer on the soil. El Etr, (2004). Maftoun *et al.* (2004) Mohamed and Hussein (2005), Elsharawy *et al*. (2003), and El bordiny *et al*. (2003). They ascribed to the mineralization of N from compost during its composition and might be the biological fixation of atmospheric N and its reflection on soil fertility.

3.2. Phosphorous:

Available P in the soil followed the same trend as N content. Available-P was significantly increased with increasing either N fertilizer rate or compost either without or with biogen. The highest value of available P was obtained with the application of 120 kg N /fed and bio-compost. The increase percentages in P content over the control were 10.12 and 38.38 in 2006 and 25.58 and 19.08 % in 2007, respectively.

Increasing P soil content due to the application of organic fertilizers might be a result of its decomposition and producing organic acids, which increases the nutrients availability in the soil. It might also, be due to the additions of these nutrients after the composition of the organic fertilizers (Mahmoud, 2000) and preventing fixation of P and probably other nutrients (Ahmed and Osman, 2003). This is in agreement with what have been reported by several researchers (Ahmed, 1997; Ahmed, 2001 and Ahmed and Ali, 2005).

Table (5): Main effect of mineral N, compost and bio-compost and their interaction on total N content in the soil after harvesting in 2006/07 and 2007/08 seasons.

N rates	Organic and bio fertilizer							
	2006/07				2007/08			
	Cont.	Comp.	Bio-comp.	Mean	Cont.	Comp.	Bio-comp.	Mean
Cont.	0.027	0.037	0.041	0.035	0.034	0.043	0.055	0.044
30 kg N	0.035	0.043	0.056	0.045	0.038	0.049	0.060	0.049
60 kg N	0.041	0.061	0.068	0.057	0.045	0.067	0.069	0.060
90 kg N	0.044	0.062	0.065	0.057	0.041	0.068	0.068	0.059
120 kg N	0.041	0.071	0.072	0.061	0.043	0.069	0.071	0.061
Mean	0.038	0.055	0.060		0.040	0.059	0.065	
LSD 0.05 for N	0.003				0.003			
LSD 0.05 for O.M	0.003				0.003			
LSD 0.05 For N X O.M	0.006				0.006			

In general, it could be concluded that applying compost and bio-compost with mineral N fertilization led to decrease the level of mineral N-fertilization and also decrease the No_3 accumulation in lettuce plant without decrease in yield in sandy soil and that help us for exportation and also good for human health.

Latoga Balady

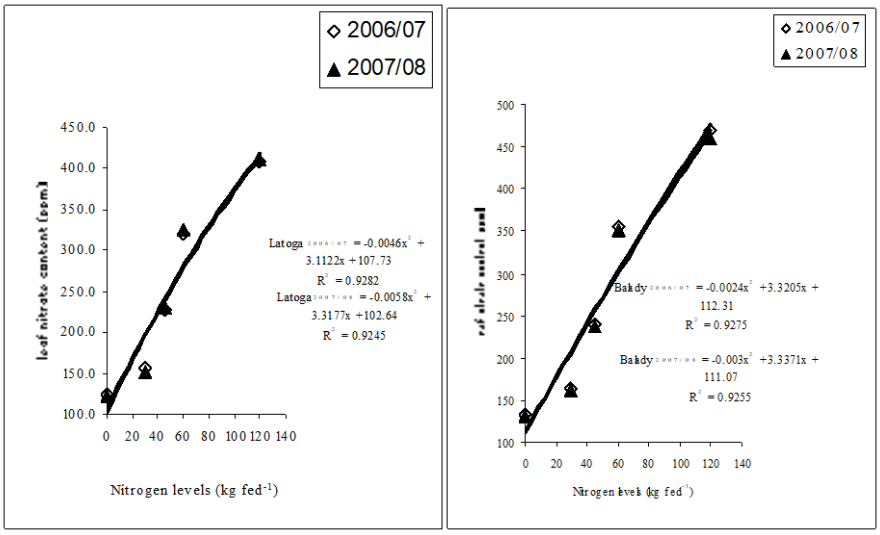

Fig (1): Nitrate concentration in both cultivar leaves as affected by mineral fertilization

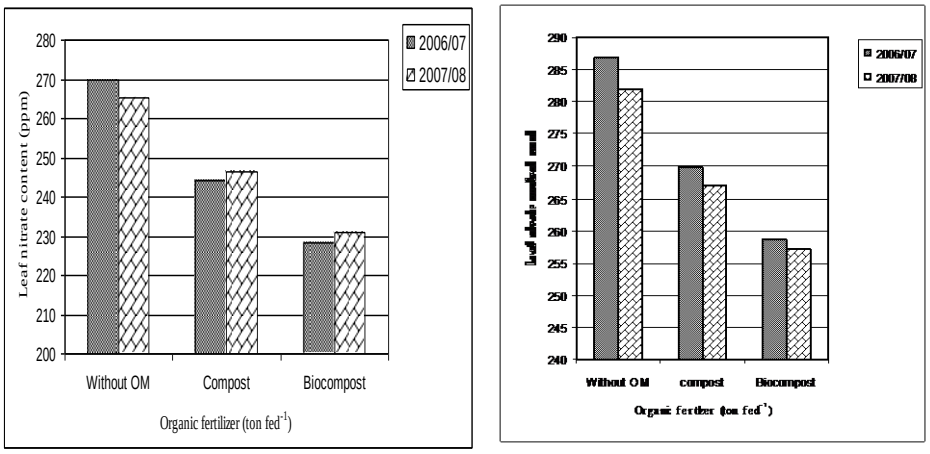

Fig (2): Nitrate concentration in both cultivar leaves as affected by compost and bio-compost application.

Table (6): Main effect of mineral N, compost and bio-compost and their interaction on soil available P in the soil after harvesting in 2006/07 and 2007/08 seasons.

N rates	Organic and bio fertilizer							
	2006/07				2007/08			
	Cont.	Comp.	Bio-comp.	Mean	Cont.	Comp.	Bio-comp.	Mean
Cont.	8.13	8.61	8.97	8.57	910	10.79	11.40	10.43
30 kg N	8.50	9.58	10.37	948	9.42	11.28	12.09	10.93
60 kg N	8.39	10.45	11.28	10.04	9.10	11.81	12.87	11.26
90 kg N	8.64	11.55	12.10	10.76	8.98	12.44	13.78	11.73
120 kg N	10.77	12.16	12.66	11.86	9.89	13.35	14.01	12.42
Mean	8.88	10.47	11.07		9.30	11.94	12.83	
LSD 0.05 for N	0.4				0.2			
LSD 0.05 O.M	0.3				0.3			
LSD0.05NX O.M	0.7				0.6			

REFERANCES

Abd El-Fattah, M.A. and Mervat E Sorial (1998). Efficiency of biofertilization on response of the productivity and chemical composition of lettuce plants grown under different nitrogen levels. Menofiya J. Agric. Res., Vol 23(5): 1185-1207.

Abdel-Razik, A.H. (1996).Response of lettuce to N-rates and Wuxal foliar fertilizer in sandy soil. Alex. J. Agric. Res., 41(2):359-368.

Abdel-Razik, A.H. and M.A.S.Barakat(1990).Effect of nitrogen and GA3 on vegetative growth, head weight and seed production of lettuce. Alex. J. Agric. Res., 35(2):77-87.

Ahmed, M. M. M and E. B. A. Osman. (2003). Response of peanut plants grown a sandy calcareous soil to fertilization with farmyard manure and organo-mineral fertilizer prepared from some sugar cane wastes. Assiut. J. Agric. Sci., Vol.34 (6): 337-347.

Ahmed, M. M. M. (1997). Utilization of certain sugar industry wastes for fertilization of some crops. M. Sc. Thesis, Fac. Agric., Assiut Univ., Egypt.

Ahmed, M. M. M. (2001). Response of some fruit trees grown on the desert soil of Wadi El-Assiti to fertilization using certain sugar industry by-products. Ph. Sc. Thesis, Fac. Agric., Assiut Univ., Egypt.

Ahmed, M. M. M. and Ali, E. A. (2005). Effect of different sources of organic fertilizers on the accumulation and movement of NPK in sandy calcareous soils and the productivity of wheat and grain sorghum. Assiut. J. Agric. Sci., Vol.36 (3): 147-159.

Awny, S.A. and M.M., Moursy (1992). Lettuce and endive plant foliage chemical constituents and nitrate residues as affected by different levels of ammonium nitrate fertilizer at sandy soils. Bull of Suez Canal Univ. Appl. Sci., 1 :515-528.

Azcon, R.; M. Gomez and R. tobar (1996). Physiological and nutritional responses by Lactuca sativa, L. to nitrogen sources and mycorrhizal fungi under drought conditions. Biology and Fertility of Soils, 22(1/2):156-161.

Bakr,A. A. and R.A. Gawish(1997). Trials to reduce nitrate and oxalatc 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.

Barakat , M.A.S. and S.M. Gaber (1988) . Effect of different biofertilizer types and nitrogen fertilizer levels on tomato plants Alex. J. Agric. Res., 43 (1) 149-160.

Bardisi, A. and E.A. Abdel-Bary (2000). Growth and yield of lettuce (*Lactuca sativa* L.) and nitrate and nitrite accumulation as affected by nitrogen sources and rates. Zagazieg J. Agric. Res. Vol. 27(4): 1053-1067.

Cameria, C., ; E. Cainavarro; B. Saltao; J. Moreira; A.A. Monteriro and E.P. Vasconcc;os (2000). Yield and leaf nitrate content of lettuce on response to nitrogen fertilization. Xth International colloquium for the optimization of plant nutrition. Cairo, Egypt.

Cash ,D., R. Funston, M. King and D. Wichman (2002). Nitrate toxicity of Montana forages. Montana State University, Bozeman, MT 59717. http://animalrangeextension.montana.edu/Articales/Forage/General/Nitraite-tox.htm.

Chabot, R.; H. Anttoun and M.P. Cescas (1996). Growth promotion of maize and lettuce by phosphate-solubilizing Rhizobium. Plant & Soil, 184(2):311-321.

Choudhury, B.(1967). Vegetables New Delhi: National Book Trust. Pp. 176-179.

Cometti, NN; Matias GCS; Zontoe; Mary W; Fernades MS. (2004) Compostos nitrogenodos a cueares solureis em tecides de alface organinca hidroponica e convencional. Horticultura Brasileira 22: 748-753

Custic, M.; M. Poliak and T. Cosic (1994). Nitrate content in leaf vegetables as related to nitrogen fertilization in Croalia. Acta Horiculturae, 371:407-412.

Custic, M.; M. Poljak; L. Coga; T., Cosic; N. Toth and M., Pecina (2003). The influence of organic and mineral fertilization on nutrient status, nitrate accumulation and yield of head chicory. Plant Soil Eviron., 49(5):218-222.

Elbordiny, M. M.; T. A. Taha and A. S. El-Sebaay. (2003). Evaluating nitrogen fertilizer sources and scheduling for cotton. Egypt. J. Soil. Sci. 43 (3): 435-445

El-Etr, Wafaa, T.; Laila, K. M and Elham, I. El-Khatib. 2004. Comparative effects of bio-compost and compost on growth, yield and nutrients content of pea and wheat plants grown on sandy soils. Egypt. J. Agric. Res., 82 (2): 73-94.

El-Gamal,A.M.(1996). Response of potato in the newly reclaimed area to mineral nitrogen levels and nitrogen fixing bio-fertilizer Halex 2 .Assiut J. of Agric. Sci., 27(2):89-99.

El-Hassan, E. (1990). Yield and nitrate content of lettuce in relation to some culture practices. Bull. Fac. Agric., Univ. of Cario 41 (2): 407-417.

Elsharawy, M. A. O.; M. A. Aziz and Laila K. M. Ali. (2003). Effect of the application of plant residues composts on some soil properties and yield of wheat and corn plants. Egypt. J. Soil. Sci. 43 (3): 421-434.

El-Shinawy,M.Z., E.M. Abd-Elmoniem, A.F. Abou-Hadid. (1999). The use of organic manure for lettuce plants grown under NFT conditions. International Society for Horticultural Science 6 (1): 491

Gawish, R.A. (1997). Trials to reduce nitrate and oxalate contents in some leafy vegetables. 1. Interactive effect of different nitrogen fertilization regimes and nitrification inhibitor (Nitrapyrin) on growth and yield of both spinach and lettuce. Zagazig J. Agric. 24(1):83-100.

Georgios C. Pavlou , Constantinos D. Ehaliotis and Victor A. Kavvadias.20 Effect of organic and inorganic fertilizers applied during successive crop seasons on growth and nitrate accumulation in lettuce . Scientia Horticulturae Vol. 111: 319-325

Gommez, K.A. and A.A. Gommez (1984).Statistical procedure for Agric. Res. 2nd ed. Johnwiley and Sons Inc. New York, 680 pages.

Hajislova, J.' V. Schulzova; PSlanina; K. Janne; K.E. Hellenas and C., Andersson (2005). Quality of organically and conventionally grown potatoes: Four year study of micronutrients, metals secondary metabolites, enzymic browning and organoleptic properties. Food Addit. Contan. 19:524-532.

Hanafy Amed, A.H (1997). Effect of foliar application of some chemicals on sex expression of squash plants. J. Agric. Sci. Mansoura Univ. 22(3):697-717.

Hanafy Amed, A.H(1996). Physiological studies on tipburn and nitrate accumulation in lettuce plants. J. Agric. Sci. Mansoura Univ. 21(11):3971-3991.

Hanafy Amed, A.H.; J.F. Mishriky and M.K. khalil (2000). Reducing nitrate accumulation in lettuce (*Lactica Sativa* L.) plants by using different biofertilizers. Cairo University, Egypt, September, 2000, page 509-517.

Jackson, M.L. (1958). Soil chemical analysis. Printic-Hall, Englwood Cliffs, New Jersey.

Keeney, D R. and D. W. Nelson(1982). Nitrogen inorganic forms. In A. L. Page et al.,(ed).Methods of soil analysis. Part 2, 2nd ed. Agronomy.

Khier, 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. Buul Fac. Agric Univ. of Cairo. 42(2): 557-576.

Maftoun, M.; F. Moshiri; N. Karimian and A. M. Ronaghi. (2004). Effects of two organic wastes in combination with phosphorus on growth and chemical composition of Spinach and soil properties. J. Plant Nut., 27 (9): 1635-1651.

Mahmoud, M. R. (2000). Improvement of soil fertility and sorghum production as a result of composts and phosphorus fertilizers application. Minia J. of Agric. Res. & Develop., 20 (3): 553-572.

Malmauret,L; D. Parent-Massin;J.I. Hardy and P. Verger (2002). Contaminants in organic and conventional foodstuffs in France. Food Addit. Contam. 19:524-532.

Maynard,D.N.; A.V. Barer; P.L. Minotti and N.H. Peck (1976). Nitrate accumulation in vegetables. Adv. Agron. 28:71-118.

Mohamed, W. H. and M. A. Hussein. 2005. Effect of some organic fertilizers and sulphur application on root yield and nutrient uptake of sugar beet in relation to some soil tests. J. Adv. Agric. Res (Fac. Agric. Saba Basha)., Vol. 25 (6): 3541-3558.

Monica L. Porto; Jailson do Calves; Adalison P. de Souza; Rannira da C Araujo and Jandeilson A de Arruda (2008). Nitrate production and accumulation in lettuce as affected by mineral Nitrogen supply and organic fertilization. Hotic. Bras., vol 26(2):227-230.

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

Noel, T.C.; C. Sheng; C.K. Yost; R.P. Pharis and M.E. Hynes (1996). Rhizobium leguminosarum as a plant growth-promoting rhizobacterium: direct growth promotion of canola and lettuce. Can. Jour. Of Microbiol., 42(3):279-283.

Pandy,A. and S. Kumar(1989). Potential of *Azotobacter* and *Azospirilla* as biofertilizers for upland ariculture: a review. Jour. of Scientific & Industrial Research, 48(3): 134-144(C.F. Hort., Abst., 1990, 60(2):796.

Pew, W.D., B.R. Gardner and PM Bessey (1984). A comparison of controlled-release and certain soluble nitrogen fertilizers on yield and maturity in spring-grown head lettuce. J. Amer. Soc. Hort. Sci., 109 (4): 531-535.

Porto ML; Alves JC; Savza AP; Arruda JA (2008) Nitrate production and accumulation in lettuce as affected by mineral nitrogen supply and organic fertilization. Horticultura Brasilia 26: 227-230

Richared, J.G.; F.J. Sundstrom; J.A. Grimas; J.P. Geaghan and W.W. Etzel(1985). Predicated effect of temprture and N fertilizer on crop response of four cultivars of head lettuce. Commun. Soil Sci. Plant Analysis, 16(6):583-613.

Ruiz-Lozano, J.M.; R. Azcon and M., Gomez (1995). Effect of arbuscular-mycorrhizal Glomus species on drought tolerance: Physiological and nutritional plant response. Applied and Environmental Microbiology, 61(2):456-460.

Sanchez, C.A.; H.W. Burdine; V.L. Guzman and C.B. Hall(1989). Yield, quality and leaf nutrient composition of crisphead lettuce as affected by N,P and K on Histosios. Proc. Of the Ann. Meeting of the Florida Stat Hort. Soc., 101:346-350 (C.F. Hort. Abst., 1991, 61(8):6839).

Shafshank, N. and F.A. Abo-Sedera (1990). Effect of different nitrogen sorces and levels on growth, yield and nitrate accumulation in some lettuce varieties. Ann Agric. Sci. Moshtohor, 28(1): 619-631.

Smith,S.R. and P. Hadley (1989). A comparison of organic and inorganic nitrogen fertilizers: Their nitrate-N and ammonium-N release characteristics and effects on the growth response of lettuce (*Lactuca sativa* L. cv. Fortune). Plant and Soil, Vol. 115: 135-144.

Soundy, P. and I.E. Smith (1992). Response of lettuce to nitrogen and phosphorus fertilization. Jour. South African Soc. For Hort. Sci., 2(2): 82-85 (C.F. Hort. Abst., 1996, 66(7):5845).

Valšíková,M. and A. Viteková (2006). The effect of Lignofert organic fertilizer on formation and quality of head lettuce yield. Hort. Sci. (Prague), 33 (3): 114–118.

Van der Boon, J., J.w. Steenhuizen and E.G. Steingrover(1990). Growth and nitrogen concentration of lettuce as affected by total nitrogen and chloride concentration, NH4/NO3 ratio temperature of the recirculating nutrient soluation. Journal of Horticultural Science 65:309-321

Vogtmann, H., K.,Matthies; B. Kehres and A. Meier-Ploeger(1993). Enhanced food quality: Effects of compost on the quality of plant foods. Compost Sci. Util. 1:82-100.

Wange, S.S. (1996). Effect of biofertilizer under graded nitrogen levels on carrot (*Daucus carota*,L.). Annals of Plant Phsiology, 10 (1):96-98.

Williams,C.M.(2002). Nutritional quality of organic food:shades of grey or shade of green. Proc. Nutr. Soc. 61:19-24.

Walworth, J.L., D.E. Clarting and G.J. Michaelson (1992). Nitrogen sources and rates for direct-seeded and transplanted head lettuce. Hortscience, 27:228-230.

إدارة التسميد لتقليل تراكم النترات فى بعض أصناف الخس

عماد الدين قؤاد سيد رفاعى* ومحمد محمود محمد أحمد**

*** معهد بحوث البساتين مركز البحوث الزراعية ـ جيزة ـ مصر**

****معهد بحوث الاراضى والمياه والبيئة مركز البحوث الزراعية ـ جيزة ـ مصر**

أجريت هذه التجارب بمزرعة محطة البحوث الزراعية بأسيوط في موسمي ٢٠٠٥/٠٦ و٢٠٠٦/٠٧ وذلك لدراسة تاثير التسميد المعدني ، الكمبوست و الكمبوست الحيوى على خصوبة التربة وعلى تركيز النترات فى أوراق أصناف الخس المتزرعة فى أرض رملية جيرية تحت نظام الرى بالتنقيط حيث تم استخدام ٥ معدلات من التسميد الازوتى المعدنى كالاتى (صفر – ٣٠-٦٠-٩٠-١٢٠ كجم نيتروجين/فدان) تم وضعها فى القطع الرئيسية بينما تم وضع التسميد العضوى فى القطع تحت الرئيسية كالآتى (بدون سماد عضوى – اضافة كمبوست مخلفات المزرعة بمعدل ٣ طن/فدان - اضافة كمبوست مخلفات المزرعة بمعدل ٣ طن/فدان + اضافة البيوجبن بمعدل ٢ كجم/فدان.

ودلت النتائج على الاتى:

هناك اختلافات معنوية بين مستويات النيتروجين المستخدمة على النمو والمحصولزيادة المحصول ومكوناته بزيادة التسميد المعدنى والعضوىاضافة كمبوست مخلفات المزرعة بمعدل ٣ طن/فدان، وكذلك فان اضافة كمبوست مخلفات المزرعة بمعدل ٣ طن/فدان + اضافة البيوجبن بمعدل ٢ كجم/فدان قلل من استخدام السماد الازوتى الى ٥٠% وقلل من تركيز النترات فى أوراق الخس تحت الدراسة.

توصى الدراسة الى اضافة كمبوست مخلفات المزرعة أو الكمبوست الحيوى يساعد فى حفظ خصوبة التربة حيث كانت الزيادة فى الفوسفور الميسر ١٠,٢-٣٨,٣٨%.

Table (3): Vegetative and yield characters of lettuce plant cv. Latoga as affected by different nitrogen levels and organic fertilizer treatments and their interactions in seasons 2005/2006 and 2006/2007.

Treatments		Weight of plant (g)		Commercial plant weight(g)		Total yield/plot (kg)		Head diameter (cm)		Head length (cm)		Number of leaves		No_3 accumulation	
N level (Kg/fed.)	Organic	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
0		351.3	347.5	323.4	321.8	19.41	19.29	8.617	8.542	9.483	9.325	29.83	29.08	125.2	121.0
30		566.3	575.8	524.2	527.3	31.45	31.64	10.1000	10.067	11.025	10.883	34.83	34.25	155.2	152.5
60		827.5	816.8	774.8	767.0	46.49	46.02	13.250	13.108	13.850	13.758	39.33	38.83	227.3	229.3
90		979.3	986.3	930.1	927.0	55.81	55.62	15.767	15.742	16.458	16.375	43.58	42.92	319.9	324.3
120		1089.2	1095.0	1032.9	1029.2	61.98	61.75	17.008	17.025	17.150	17.108	44.83	44.50	409.3	410.5
LSD at 0.05		10.5	7.9	4.7	4.5	0.3	0.3	0.1	0.1	0.1	0.1	0.7	0.7	1.2	1.1
	0	572.8	584.8	535.8	539.3	32.15	32.36	11.035	11.055	11.910	11.785	35.40	34.80	269.7	263.2
	3	792.5	788.3	743.3	735.4	44.60	44.12	13.175	13.070	13.865	13.755	38.90	38.40	244.2	246.6
	3+Biogen	923.0	919.9	872.2	868.7	52.33	52.11	14.635	14.565	15.005	14.930	41.15	40.55	228.3	230.8
LSD at 0.05		5.7	4.4	4	2.9	0.2	0.2	0.1	0.1	0.1	0.1	0.4	0.5	0.9	0.7
0	**0**	162.5	157.3	145.5	141.0	8.73	8.46	6.350	6.300	7.450	7.200	26.50	25.50	126.0	122.0
	3	394.5	378.8	360.5	352.3	21.63	21.14	9.250	9.175	10.150	9.975	30.50	29.75	125.0	121.0
	3+Biogen	496.8	506.5	464.3	472.3	27.86	28.28	10.250	10.150	10.850	10.800	32.50	32.00	124.5	120.0
30	**0**	293.5	355.8	263.0	300.5	15.78	18.03	8.650	8.825	9.500	9.375	30.50	30.00	171.5	166.0
	3	615.5	597.3	559.3	548.8	33.56	32.93	9.825	9.700	10.575	10.450	35.50	35.00	153.0	151.0
	3+Biogen	790.0	774.3	750.3	732.5	45.02	43.95	11.825	11.675	13.000	12.825	38.50	37.75	141.0	140.5
60	**0**	549.8	537.0	505.3	496.3	30.32	29.78	9.425	9.400	10.000	9.900	34.00	33.50	251.5	249.5
	3	825.5	815.0	768.0	752.3	46.08	45.14	13.325	12.975	14.700	14.600	39.50	39.00	224.0	230.0
	3+Biogen	1107.3	1098.5	1051.3	1052.5	63.08	63.15	17.000	16.950	16.850	16.775	44.50	44.00	206.5	208.5
90	**0**	803.0	794.5	745.3	741.3	44.72	44.48	13.850	13.800	15.500	15.400	41.50	40.75	351.5	348.3
	3	1030.0	1056.0	987.5	991.0	59.25	59.46	16.450	16.450	16.750	16.675	44.00	43.50	314.5	321.0
	3+Biogen	1105.0	1108.5	1057.5	1048.8	63.45	63.93	17.000	16.975	17.125	17.050	45.25	44.50	293.8	303.5
120	**0**	1055.0	1079.3	1020.0	1017.5	61.20	61.05	16.900	16.950	17.100	17.050	44.50	44.25	447.8	440.0
	3	1096.8	1094.3	1041.3	1032.5	62.48	61.95	17.025	17.050	17.150	17.075	45.00	44.75	404.5	410.0
	3+Biogen	1115.8	1111.5	1037.5	1037	62.25	62.25	17.100	17.075	17.200	17.200	45.00	44.50	375.5	381.5
LSD at 0.05		12.6	9.8	9.0	6.4	0.5	0.4	0.2	0.1	0.2	0.2	1.0	1.1	2.1	1.6

Table (4): Vegetative and yield characters of lettuce plant cv. Balady as affected by different nitrogen levels and organic fertilizer treatments and their interactions in seasons 2005/2006 and 2006/2007.

Treatments		Weight of plant (g)		Commercial plant weight(g)		Total yield/plot (kg)		Head diameter (cm)		Head length (cm)		Number of leaves		No_3 accumulation	
N level (Kg/fed.)	Organic	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
0		245.3	235.3	226.8	214.0	13.61	12.84	10.90	10.71	22.33	21.42	34.33	32.50	132.6	131.3
30		360.8	353.3	334.8	324.9	20.09	19.49	13.75	13.55	27.50	27.17	38.33	37.17	163.3	162.0
60		439.3	425.4	415.1	401.5	24.91	24.09	15.98	15.75	32.08	31.00	42.83	41.67	238.8	237.3
90		480.2	471.3	451.3	442.7	27.08	26.56	17.41	17.35	35.08	34.00	47.17	45.67	354.9	351.9
120		488.7	480.2	457.8	446.8	27.47	26.81	17.65	17.47	36.33	35.92	50.50	49.50	469.1	460.6
LSD at 0.05		0.7	0.7	0.9	0.9	0.1	0.1	0.1	0.1	0.6	0.9	0.6	0.7	0.8	1.0
	0	346.9	337.6	322.3	313.5	19.34	18.81	13.59	13.46	27.60	26.45	38.50	37.30	286.8	281.9
	3	410.2	400.1	384.4	372.1	23.06	22.32	15.29	15.11	31.10	30.75	42.50	41.30	269.9	267.1
	3+Biogen	451.5	441.6	424.8	412.4	25.49	24.74	16.54	16.33	33.30	32.50	46.90	45.30	258.6	256.9
LSD at 0.05		0.6	0.5	0.4	0.5	0.01	0.01	0.1	0.1	0.5	0.5	0.5	0.5	0.9	0.8
0	**0**	141.0	133.8	.126.0	120.0	7.56	7.20	8.60	8.50	18.00	17.00	28.50	27.50	134.0	132.0
	3	250.0	238.0	233.5	220.0	14.01	13.20	11.40	11.13	23.00	21.75	34.50	32.50	132.0	131.0
	3+Biogen	345.0	334.0	321.0	302.0	19.26	18.12	12.70	12.50	26.00	25.50	40.00	37.50	131.8	130.8
30	**0**	261.5	256.0	239.3	228.8	14.36	13.73	11.45	11.30	22.50	21.50	32.50	31.00	178.8	182.0
	3	375.8	369.0	346.5	338.0	20.79	20.28	13.20	13.00	28.00	29.00	37.50	36.50	161.0	159.0
	3+Biogen	445.0	435.0	418.5	408.0	25.11	24.48	16.60	16.35	32.00	31.00	45.00	44.00	150.0	145.0
60	**0**	380.0	365.0	356.8	345.0	21.41	20.70	13.40	13.20	28.50	26.50	37.50	37.00	252.3	249.0
	3	450.0	435.0	425.0	407.5	25.50	24.45	16.75	16.55	32.75	32.00	43.00	41.50	240.0	236.3
	3+Biogen	488.0	476.3	463.5	452.0	27.81	27.12	17.80	17.50	35.00	34.50	48.00	46.50	224.0	226.8
90	**0**	465.0	455.0	435.0	429.0	26.10	25.74	16.93	16.90	33.50	32.00	44.50	43.00	369.8	364.0
	3	486.0	477.8	459.0	448.0	27.54	26.88	17.50	17.45	35.25	35.00	47.00	46.00	354.0	351.0
	3+Biogen	489.5	481.0	460.0	451.0	27.60	27.06	17.80	17.70	36.50	35.00	50.00	48.00	341.0	340.8
120	**0**	486.8	478.3	454.5	444.5	27.27	26.67	17.55	17.40	35.50	35.25	49.50	48.00	499.0	482.5
	3	489.3	480.8	458.0	446.8	27.48	26.81	17.60	17.40	36.50	36.00	50.50	50.00	462.3	458.0
	3+Biogen	490.0	481.5	461.0	449.0	27.66	26.94	17.80	17.60	37.00	36.50	51.50	50.50	446.0	441.3
LSD at 0.05		1.4	1.1	1.0	1.1	0.1	0.1	0.1	0.1	1.1	1.2	1.1	1.2	1.9	1.9