J. Agric. Sci. Mansoura Univ., 31 (2): 1175 - 1184, 2006

IMPACT OF MINERAL AND BIO-NITROGEN FERTILIZATION ON NITRATE ACCUMULATION OF CUCUMBER

Knany, R.E.*and Manal A. Abd Alla**
*** Soils, Water and Environment Ins. Agric. Res. Center, Giza Egypt**
**** Veg. Dept. Hort. Ins. Agric. Res. Center Giza, Egypt**

ABSTRACT

The objective of the present study is to asses the effect of mineral and bio-nitrogen fertilizers on the nitrate content of cucumber fruits. Two field experiments were carried out at Sakha Agricultural Research Station Farm, Kafr El-Sheikh Governorate, Egypt during the two successive summer seasons of 2004 and 2005 using the recommended cucumber hybrid seeds. Split split plot design was used with four replicates. The plot area was 20 squire meter. The main plots were assigned to two inoculation methods of 1- the inoculum was added as liquid and, 2- the inoculum was added as tablets. The sub plots were assigned to three mineral nitrogen levels of 1- zero nitrogen (check treatment), 2- 30 kg N fed^{-1} (fed = 4200 m^2), and 3- 60 kg N fed^{-1}. The mineral nitrogen was added as ammonium nitrate 33%. The sub sub plots were assigned to two inoculation treatments of 1- without inoculation and 2- Inoculation with effective strains of non symbiotic N_2-fixing bacteria. Nitrate content of the cucumber fruits was measured during the early, middle and late cuttings.

The most important results can be summarized as follows:

- Increasing mineral nitrogen levels led to dramatic increase of nitrate content in cucumber fruits and petioles in both seasons.
- Clear increases in nitrate content of cucumber fruits and petioles were detected due to inoculation with non symbiotic N_2-fixing bacteria in both seasons.
- No clear differences in nitrate content of cucumber fruits and petioles were observed due to inoculation methods in both seasons.
- The highest nitrate content was observed in the samples from the early cut and the lowest with the samples of late cut in both seasons.
- Increasing the mineral nitrogen levels led to clear increases of nitrate and nitrite in the soil in both seasons.
- Nitrate and nitrite in the soils were increased by the inoculation with non symbiotic N_2-fixing bacteria.

INTRODUCTION

How and what do we eat affects on our health? What is the best way to eat well and keep our healthy?. Research can help us to find the answer to these questions, by telling us what we eat, it's links with a good health.

Contaminant food is a reason of human diseases. Nitrate is one of the contaminating materials which affect human health. Methemoglobinemia was first recognized by Comley (1945) who related infant illnesses to nitrate contaminated private wells in Iowa. Nitrate can be reduced to nitrite in the digestive tract and nitrite interferes with oxygen transport in the blood. The human saliva plays a vital role in converting nitrates into carcinogens, which come into force at the gastro oesophageal junction.

National Research Council-NRC (1978, 1984) and Council for Agricultural Science and Technology-CAST (1992) reported that the potential for gastric cancer from ingested nitrate and nitrite and subsequent conversion to nitrosamines. Kross *et al.* (1972) stated that the U.S. standard in drinking water (maximum contaminant level) MCL of 10 mg L^{-1} of NO_3-N was established by the United States Environmental Protection Agency (USEPA) in 1977 as a safeguard against infantile Methemoglobinemia. Arnaoot (2001) reported that the highest permissible limit for human total consumption is 3.65 mg NO_3-N and 0.133 mg NO_2-N for adult one.

Nitrate occurs naturally in fruits and vegetables but the use of extra fertilizers was maximised. Olson *et al.* (1971) found that environmental factors favoring the accumulation of nitrate in plants include high level of nitrate in the soil, cloudy periods, shading, drought, excessive temperatures, damage on plants from insects or weed control chemicals and nutrients imbalance in the soil. Knany and Atia (2003) found that the nitrate content of the rice grain collected from Kafr El-Sheikh Governorate districts was between 10.1 and 3.2 µg g^{-1}. This value less than the destructive effects, but it becomes dangerous when there are additional sources entering to the body like, drinking water and vegetables. Weirnin *et al.* (2003) stated that twenty vegetable crops including 29 pak-choi cultivars, inbred lines of spring-summer radish and their F_1 from different ecological area in China were tested for nitrate content, the results indicate that some vegetables such as lettuce, radish, celery and pak-choi accumulated a relatively high nitrate.

Cucumber is one of the most important salad crops which fresh consume daily. It produce along the year in the open field, green house and tunnels.

Many investigator used the organic agricultural for producing the organic food. Organic food would not prove to be a healthier option because it also contained substantial levels of nitrate some of which come from natural fertilizers such as manure.

Biofertilization simply means the use of beneficial microorganisms as a soil or seed inoculant to provide part of the nutrient requirement of the host plant.

The objectives of the present study are investigate to obtain more information about the effects of three nitrogen fertilizer levels, inoculating the soil with some microorganisms and two soil inoculating methods on cucumber nitrate content as well as soil and petioles nitrate content.

MATERIALS AND METHODS

A field experiments was carried out at Sakha Agricultural Research Station Farm during the two successive summer seasons of 2004 and 2005 using the recommended cucumber hybrid to asses the effects of nitrogen fertilizer levels, inoculating the soil by effective strains of non symbiotic N_2-fixing bacteria and two different inoculation methods on the nitrate pollution in cucumber fruits. The plot area was 20 square meter. Split split plot design with four replicates was used. The main plots were assigned to two inoculation methods of 1) Inoculum was added to the soil as a liquid, 2) The inoculum was added to the soil as tablets added beside the plants roots. The sub plots were assigned to three nitrogen levels of 0, 30 and 60 kg N fed^{-1} (fed. = 4200 m^2). The sub sub plots were assigned to two inoculation treatments of 1) With inoculation and 2) Without inoculation. Nitrogen fertilizer was applied as ammonium nitrate 33% N and splited into two equal doses with the first and the third irrigation. The inoculum was a mixture of effective strains of non symbiotic N_2-fixing bacteria prepared by Department of Soil Microbiology-Soil, Water and Environment Institute Agric. Res. Center. The recommended dose of phosphorus and potassium fertilizers were added before seedling. Three cucumber fruit samples were taken from the early, middle, and late cutting as well as samples of the 6^{th} leaves petioles. Nitrate in the fresh samples was extracted by crushing the samples in presence of acetic acid 2%. It was determined colorimetrically in the extracts using N-1 naphthyetheline diamine dihydrochlorid powder mixture indictor according to Singth (1988). soil samples were collected from the experimental soils before seedling to determine some soil physical and chemical properties (Table 1) according to Jackson (1958) and Black *et al.* (1965) and during the season through collecting fruits samples to determine the NO_3 and NO_2 content according to Singth (1988).

Table (1): Some physical and chemical properties of the experimental soils.

Variables	1^{st} season	2^{nd} season
Mechanical analysis		
Clay %	53.21	49.17
Silt %	25.14	26.11
Sand %	21.65	24.72
Texture	Clayey	Clayey
pH (1: 2.5 soil: water suspension)	8.05	8.2
EC dSm^{-1} (soil paste extract)	2.1	2.4
Organic matter	1.70	1.60
Available-N mg kg^{-1} (1 M KCl extracts)	36	28
Available-P mg kg^{-1} (0.5 N $NaHCO_3$ extracts)	6.1	5.8
Available-K mg kg^{-1} (ammonium acetate extracts)	280	214

RESULTS AND DISCUSSION

Data presented in Table 2 show that inoculating the soils cultivated with cucumber by non symbiotic N_2-fixing bacteria increased the nitrate content of cucumber fruits in both seasons. The increases were ranged from 11.48 and 2.63 mg kg^{-1} to 14.90 and 4.61 mg kg^{-1}, from 2.10 and 1.31 mg kg^{-1} to 4.11 and 2.90 mg kg^{-1} and from 0.43 and 0.82 to 0.89 and 1.02 mg kg^{-1} in the early, middle and late cuts, respectively as compared to without inoculation treatment. This impact may be due to that nitrogen fixed by bacteria which increased available soil-N. These results could be enhanced with those obtained by Hagin (1997) who reported that there is much evidence that organic farming may cause the same or greater nitrate pollution than mineral-N application.

Dramatic increase of nitrate content in cucumber fruits was obtained due to increasing the mineral nitrogen fertilizer levels from 0 to 30 and 60 kg N fed^{-1} (Table 2). In the early cuts the increases were from 5.10 mg kg^{-1} to 15.50 and 18.98 mg kg^{-1} in the first season. While, in the second season the increases were from 1.92 mg kg^{-1} to 3.61 and 5.33 mg kg^{-1}. In the middle cuts the increases were from 0.43 to 1.39 and 7.75 mg kg^{-1} in the first season, while in the second season the increases were from 0.57 to 2.05 and 3.70 mg kg^{-1}. In the late cuts the increases of nitrate content in cucumber fruits due to increasing the mineral nitrogen fertilizer from 0 to 30 and 60 kg N fed^{-1} were from 0.18 to 0.59 and 1.22 mg kg^{-1} in the first season, and from 0.36 to 0.83 and 1.57 mg kg^{-1} in the second season. This may be due to that increasing NO_3-N in the soil encourage NO_3 absorption by plants and NO_3 accumulation in the tissues. These results could be supported by those obtained by Prakasa and Puttanna (2000) and Song *et al.* (2002) who concluded that the concentrations of NO_3-N accumulated in plants increased rapidly with increasing N application, they also reported that NO_3-N accumulation had a close relation with soil property.

Data presented in Table 2 show that no clear trend of the differences in nitrate content due to the inoculation methods. In general the nitrate content of cucumber fruits was the highest in the early cuts and decreased in the middle cuts and it was lower in the late cuts with all treatments. This may be due to that the available nitrogen in the root zone was decreased in the middle and late cuts (Table 4). It is noticeable that the nitrate content values were higher in the first season than that of the second season and this may be due to the differences in environmental factor i.e., temperature, drought, shading, etc..

These findings are inagreement with those obtained by Liyanage *et al.* (2000) who reported that three major factors are generally considered to be involved in the accumulation of nitrates by plants are genetic factors, light factors from ecological environment and nutritional factors.

In spite of the high NO_3-N content in some cucumber fruit samples especially in the early cuts (1.6-22.6 mg kg^{-1}) the total NO_3-N reaches to the human body is less because the quantity consume from the cucumber fruits is less. But it become danger when there are additional sources like rice. Usha *et al.* (1993) reported that nitrate content in some varieties of rice in Pakistan have exceeded the permissible level. In Egypt Knany and Alla (2003) found that NO_3 in the rice was between 3.2 and 10.1 mg kg^{-1} and drinking water, other vegetables, Moller *et al.* (1989) in Denmark and Liyanage *et al.* (2000) in Sri Lanka reported that in a rural population drinking water and vegetables were two major sources of nitrates pollution of their diets. In India Usha *et al.* (1993) stated that NO_3 to 270 mg kg^{-1} and roots and tubers 31 to 2043 mg kg^{-1}.

Prakasa and Puttanna (2000) reported that in Poland, maximum acceptable limit of nitrate was exceeded in 8.2% of the samples of radish and 65% of lettuce, in Brazil the legally permissible limit of nitrate in milk is 1000 µg L^{-1}. However, measurements have shown 50 to 180 µg L^{-1} nitrites and 20 to 2100 µg L^{-1} nitrate in pasteurized milk.

Table 2: Effect of biofertilization, inoculation methods and nitrogen levels on nitrate content (mg kg^{-1}) of cucumber fruits in 2004 and 2005 season.

Treatments			NO_3 mg kg^{-1}					
Inoculation methods	Nitrogen levels	Inoculation	Early cuts		Middle cuts		Late cuts	
			1st season	2nd season	1st season	2nd season	1st season	2nd season
Liquid	N_0	Without	3.80	1.60	0.20	0.58	0.00	0.30
		With	6.98	1.83	1.06	0.60	0.62	0.30
	N_{30}	Without	14.70	2.70	0.80	0.95	0.40	0.70
		With	17.18	5.47	1.60	2.90	0.94	0.78
	N_{60}	Without	15.95	3.60	4.44	1.85	0.90	1.33
		With	22.60	8.03	9.70	5.20	1.76	1.60
Tablets	N_0	Without	3.80	1.60	0.20	0.48	0.00	0.30
		With	5.80	2.65	0.26	0.60	0.08	0.55
	N_{30}	Without	14.70	2.70	0.80	1.43	0.40	0.70
		With	15.42	3.55	2.36	2.90	0.66	1.15
	N_{60}	Without	15.95	3.60	5.96	2.55	0.90	1.60
		With	21.42	6.10	9.70	5.20	1.30	1.75
Inoculation		Without	11.48	2.63	2.10	1.31	0.43	0.82
		With	14.90	4.61	4.11	2.90	0.89	1.02
Nitrogen levels		N_0	5.10	1.92	0.43	0.57	0.18	0.36
		N_{30}	15.50	3.61	1.39	2.05	0.59	0.83
		N_{60}	18.98	5.33	7.75	3.70	1.22	1.57
Inoculation methods		Liquid	13.54	3.87	2.97	2.01	0.77	0.84
		Tablets	12.85	3.37	3.21	2.19	0.56	1.01

Table 3 show that inoculating the soil which cultivated with cucumber by non symbiotic N_2-fixing bacteria clearly increased nitrate content of cucumber petioles. Nitrate content of cucumber petioles was highest in the early cuts, moderate in middle cuts and it was lowest in late cuts. This may be attributed to the available nitrogen in the soil. In the same season, high nitrate content of the fruits was attributed with the high nitrate content of the petioles. Increasing the nitrogen levels from 0 to 30 and 60 kg N fed^{-1} led to dramatic increase of nitrate content of the petioles in both seasons. In the early cuts the increases were from 8.0 to 18.51 and 28.33 mg kg^{-1} in the first seasons, while in the second season the increases were from 11.85 to 20.0 and 42.06 mg kg^{-1}. In the middle cuts the increases were from 4.53 to 12.13 and 17.86 mg kg^{-1} in the first seasons, while in the second seasons the increases were from 5.56 to 12.69 and 34.77 mg kg^{-1}. In the late cuts the increases were form 1.65 to 6.80 and 9.90 mg kg^{-1} in the first season, while in the second season the increases were from 2.43 to 6.40 and 32.94 mg kg^{-1}. These results could be enhanced by those obtained by Prakasa and Puttanna (2000) who reported that application of nitrogen fertilizers can cause increase in concentration of nitrates and nitrites in crops. Also, Song *et* al.(2002) found that the concentration of NO_3-N accumulated in plants increased rapidly with increased N application. From the data in Table 3, it is clear that inoculating the soil which cultivated with cucumber by non symbiotic N_2-fixing bacteria as tablets beside the hills roots was effective than the liquid method.

Table 3: Effect of biofertilization, inoculation methods and nitrogen levels on nitrate content (mg kg^{-1}) of cucumber petioles in 2004 and 2005 seasons.

Treatments			NO_3 mg kg^{-1}					
Inoculation methods	Nitrogen levels	Inoculation	Early cuts 1st season	Early cuts 2nd season	Middle cuts 1st season	Middle cuts 2nd season	Late cuts 1st season	Late cuts 2nd season
Liquid	N_0	Without	5.06	2.75	3.10	2.13	1.33	1.92
		With	9.80	14.50	5.05	8.27	2.29	1.99
	N_{30}	Without	12.56	12.25	9.11	6.88	5.65	3.50
		With	18.79	17.00	12.50	11.23	8.41	7.49
	N_{60}	Without	23.80	32.00	14.80	21.69	9.84	13.58
		With	27.86	35.00	18.04	38.90	10.21	46.82
Tablets	N_0	Without	5.06	14.50	3.10	2.13	1.33	1.99
		With	12.09	15.63	6.86	9.70	1.63	3.83
	N_{30}	Without	18.79	17.00	11.76	11.15	4.72	7.10
		With	23.88	33.75	15.13	21.50	8.41	7.49
	N_{60}	Without	27.86	32.00	17.69	27.50	9.71	24.82
		With	33.78	69.25	20.92	50.99	9.84	46.74
Inoculation		Without	15.52	18.42	9.93	11.91	5.43	8.82
		With	21.03	30.86	13.08	23.43	6.80	19.06
Nitrogen levels		N_0	8.00	11.85	4.53	5.56	1.65	2.43
		N_{30}	18.51	20.00	12.13	12.69	6.80	6.40
		N_{60}	28.33	42.06	17.86	34.77	9.90	32.94
Inoculation methods		Liquid	16.31	18.92	10.43	14.85	6.29	12.55
		Tablets	20.24	30.36	12.58	20.50	5.94	15.33

Data presented in Table 4 show that inoculating the soil which cultivated with cucumber by non symbiotic N_2-fixing bacteria led to clear increase of NO_3-N in the soil. In the first season the increases were from 14.52 to 19.40 mg kg^{-1} in the soil samples collected during the early cuts, from 13.01 mg kg^{-1} to 16.85 mg kg^{-1} in the soil samples collected during the middle cuts and from 5.81 to 8.17 mg kg^{-1} in the soil samples collected during the late cuts. In the second season the increases had the same trend. Increasing the nitrogen fertilizer levels from 0 to 30 and 60 kg N fed^{-1} led to increase the NO_3-N in the soil. In the first season the increases were ranged from 5.34 mg kg^{-1} to 17.64 and 27.90 mg kg^{-1} in the early cuts, from 4.33 mg kg^{-1} to 12.70 and 27.78 mg kg^{-1} in the middle cuts and from 2.34 mg kg^{-1} to 6.53 and 12.10 mg kg^{-1} in the late cuts. In the second season the increases had the same trend. From the tabulated data no clear trend was obtained due to the inoculation methods. The increases of soil NO_3-N due to inoculation may be due to that the bacteria fixed N_2 from the atmosphere, then the bacteria died and by the degradation processes nitrogen released to the soil. Also, increasing the nitrogen fertilizer levels increased the NO_3 in the soil because the nitrogen fertilizer was NH_4NO_3.

Table 4: Effect of biofertilization, inoculation methods and nitrogen levels on NO_3 (mg kg^{-1}) in the soil during 2004 and 2005 seasons.

Treatments			NO_3 mg kg^{-1}					
Inoculation methods	Nitrogen levels	Inoculation	First sample		Second sample		Third sample	
			1st season	2nd season	1st season	2nd season	1st season	2nd season
Liquid	N_0	Without	5.28	9.55	3.10	11.40	1.60	3.70
		With	5.60	12.40	5.00	16.35	3.00	6.15
	N_{30}	Without	16.56	13.95	10.88	11.20	4.45	4.60
		With	20.60	16.20	11.50	17.25	6.57	7.53
	N_{60}	Without	23.80	15.30	23.10	12.40	10.45	6.51
		With	35.90	19.40	26.40	22.95	12.25	12.75
Tablets	N_0	Without	4.88	12.40	3.10	7.80	1.60	1.94
		With	5.60	16.10	6.12	11.40	3.16	4.65
	N_{30}	Without	12.78	16.60	11.50	10.40	5.57	5.23
		With	20.60	19.00	16.90	11.20	9.54	6.67
	N_{60}	Without	23.80	19.40	26.40	12.40	11.20	7.20
		With	28.10	20.80	35.20	15.05	14.50	9.54
Inoculation		Without	14.52	14.53	13.01	10.93	5.81	4.86
		With	19.40	17.32	16.85	15.70	8.17	7.88
Nitrogen levels		N_0	5.34	12.61	4.33	11.74	2.34	4.11
		N_{30}	17.64	16.44	12.70	12.51	6.53	6.01
		N_{60}	27.90	18.73	27.78	15.70	12.10	9.00
Inoculation methods		Liquid	17.96	14.47	13.33	15.26	6.39	6.87
		Tablets	15.96	17.38	16.54	11.38	7.60	5.87

Data presented in Table 5 show that inoculating the soil which cultivated with cucumber by non symbiotic N_2-fixing bacteria was increased NO_2-N in the soil compared to without inoculation treatment. In the first season the increases were from 0.31 to 0.53 mg kg^{-1} in the soil samples collected during the early cuts, from 0.33 to 0.88 mg kg^{-1} in the soil samples collected during the middle cuts and from 0.16 to 0.51 mg kg^{-1} in the soil samples collected during the late cuts. In the second season the increases were from 0.94 to 1.28 mg kg^{-1} in the soil samples collected during the early cuts, from 1.29 to 2.04 mg kg^{-1} in the soil samples collected during the middle cuts and from 0.59 to 0.98 mg kg^{-1} in the soil samples collected during the late cuts. Increasing the mineral nitrogen fertilizer increased NO_2-N was observed in the soil samples collected during the middle cuts. No clear trend due to effects of inoculation methods on NO_2-N content in the soil samples was observed.

Table 5: Effect of biofertilization, inoculation methods and nitrogen levels on NO_2 (mg`kg^{-1}) in the soil during 2004 and 2005 seasons.

Treatments			NO_3 mg kg^{-1}					
Inoculation	Nitrogen	Inoculation	First sample		Second sample		Third sample	
methods	levels		1st season	2nd season	1st season	2nd season	1st season	2nd season
Liquid	N_0	Without	0.00	0.36	0.19	0.85	0.10	0.39
		With	0.10	0.80	0.42	1.84	0.26	0.82
	N_{30}	Without	0.27	0.83	0.29	1.30	0.14	0.55
		With	0.36	1.25	0.43	2.28	0.29	1.11
	N_{60}	Without	0.80	1.03	0.73	1.85	0.33	0.77
		With	1.60	1.40	1.80	3.40	0.83	1.41
Tablets	N_0	Without	0.00	0.80	0.16	0.85	0.09	0.40
		With	0.02	1.07	0.42	0.91	0.20	0.51
	N_{30}	Without	0.17	1.30	0.19	1.02	0.10	0.55
		With	0.27	1.49	0.43	1.30	0.25	0.69
	N_{60}	Without	0.60	1.30	0.39	1.85	0.18	0.88
		With	0.80	1.68	1.80	2.49	1.20	1.33
Inoculation		Without	0.31	0.94	0.33	1.29	0.16	0.59
		With	0.53	1.28	0.88	2.04	0.51	0.98
Nitrogen levels		N_0	0.03	0.76	0.30	1.11	0.16	0.53
		N_{30}	0.27	1.22	0.34	1.48	0.20	0.73
		N_{60}	0.95	1.35	1.18	2.40	0.64	1.10
Inoculation methods		Liquid	0.52	0.95	0.64	1.92	0.33	0.84
		Tablets	0.31	1.27	0.57	1.40	0.34	0.73

Conclusion

Increasing the available nitrogen in the soil from any source (organic-bio-mineral) lead to clear increase in NO_3-N accumulation in cucumber fruits. In spite of the high NO_3-N content in some cucumber fruit samples the total NO_3-N reaches to the human body is less because the quantity consume from the cucumber fruits is less. But it become danger when added to additional sources to the human bodies like rice, drinking water, fruits, other vegetables and contamination from the observation during the analysis. NO_3 decreased with the time in cucumber fruits.

Recommendation

The cucumber fruits can be eaten in the second day after cutings to avoid the destructive effects of NO_3.

REFERENCES

Arnaoot, M.E. (2001). Human and Environment Pollution. The Egyptian Home for Books, pp. 229-238 (In Arabic).

Black, C.A.; D.D. Evans; J.L. White; L.E. Ensuminger and F.E. Clark(1965). Method of Soil Analysis. Am. Soc. Agron. Inc. Publisher. Madison, Wisconsin, U.S.A.

Comley, H.H. (1945). Cyanosis in infants caused by nitrate in well water. J. Amer. Med. Assoc. 129: 112-116.

Council for Agricultural Science and Technology, CAST (1992). Water quality. Agricultures role. Task Force Report No. 120, Amess, Iowa, U.S.A.

Hagin, J. (1997). Fertilizers and environment. Dahlia Greidenger International Symposium on Fertilization and Environment. Technion-Israel Institute of Technology Haifa 24-27 March pp. 31-36.

Jackson, M.L. (1958). Soil Chemical Analysis. Prentice Hall Inc. Englewood Diffs, New York, U.S.A.

Knany, R.E. and R.H. Atia (2003). Primary study on nitrate pollution of rice grain in Kafr El-Sheikh Governorate. The 11th Annual Conf. of the Misr Soci. Ag. Eng. 15-16 Oct.: 685-694.

Kross, B.C.; A.D. Ayebo and L.J. Fuortes (1992). Methemoglobinemia, nitrate toxicity in rural America. America Family Physician P. 183-188.

Liyanage, C.E.; M.I. Thabrew and D.S.P. Kuruppuracchchi (2000). Nitrate pollution in ground water of kalpitiya: an evaluation of the content of nitrates in the water and food items cultivated in the area. J. Natn. Sci. Foundation of Sri Lanka 28(2): 101-112.

Moller, H.; J. Landt; P. Jensen; E. Pedersen, H. Autrup and O.M. Jensen (1989). Nitrate exposure from drinking water and diet in a Danish Rural Population. International Journal of Epidemiology. 18: 206-212.

National Research Council, NRC (1978). Nitrates National Academy Press, Washington D.C. 723.

National Research Council, NRC (1981). The health effects of nitrate, nitrite and nitroso compounds. National Academy Press, Washington D.C. 544.

Olson, R.A.; T.J. Army; J.J. Hanway and V.J. Kilmer (1971). Feed and food quality in relation to fertilizer use. Fertilizer Technology and use. Soil Soc. of Amer., Inc. Madison, Wisconsin, U.S.A. pp. 552-554.

Prakasa Rao, E.V.S. and K. Puttana (2000). Nitrates, agriculture and environment. Current Science, Vol. 79 No. 9 pp. 1163-1168.

Singth, I.P. (1988). A rapid method for determination of nitrate in soil and plant extracts. Plant and Soil, 110: 137-139.

Song, S.J.; T.W. Kang; S.M. Sohn and U.Z. Kual (2002). Transformations of ^{15}N-urea and N utilizations and nitrate accumulations of Chinese cabbage in two soils. 17th WCSS Symposium, 14-21 August Thailand Paper No. 1216, p. 1-9.

Usha, G.; A.N. Naidu and K. Kamala (1993). Food Compos. Anal., 6, 242-249.

Weirnin, Z.; L. Shijun; G. Lihong; C. Laibing and Z. Dabiao (2003). Genetic diversity of nitrate accumulation in vegetable crops. ISHS Acta Horticulture. III. International Symposium Diversification of vegetable crops. p. 467.

تأثير التسميد النيتروجينى المعدنى والحيوى على تراكم النترات فى الخيار

رمضان إسماعيل كنانى* و منال عبدالرحمن عبد الله**
* معهد بحوث الأراضى والمياه والبيئة ـ مركز البحوث الزراعية ـ الجيزه ـ مصر.
** قسم بحوث الخضر ـ معهد بحوث البساتين ـ مركز البحوث الزراعية ـ الجيزه ـ مصر.

يهدف البحث إلى معرفة أثر الأسمدة النيتروجينية المعدنية والحيوية على محتوى ثمار الخيار من النترات ولتحقيق الهدف نفذت تجربة حقلية بمزرعة محطة البحوث الزراعية بسخا ـ محافظة كفرالشيخ ـ مصر ، خلال الموسمان الصيفيان ٢٠٠٤م ، ٢٠٠٥م مستخدما بذور خيار هجين أول. استخدم التصميم الإحصائى القطع المنشقة مرتان فى أربع مكررات. وكانت مساحة القطعة التجريبية ٢٠ متر مربع. وقد شغلت القطع الرئيسية بمعاملتين لطرق التلقيح هما:

١- وضع اللقاح فى صورة سائلة بمنطقة الجذور.
٢- وضع اللقاح فى صورة كبسولات بجوار الجور.

وقد شغلت القطع الشقية بثلاث مستويات من السماد النيتروجينى هى:

١- صفر (معاملة المقارنة).
٢- ٣٠ وحدة نيتروجين للفدان.
٣- ٦٠ وحدة نيتروجين للفدان. وقد أضيف السماد المعدنى النيتروجينى فى صورة نترات أمونيوم ٣٣% على دفعتين مع الريه الأولى والرية الثالثة.

وشغلت القطع التحت شقية بمعاملتان للتلقيح:

١- بدون تلقيح (مقارنة).
٢- التلقيح بمخلوط من سلالات نشطة من البكتريا المثبتة للأزوت لاتكافليا تم الحصول عليها من قسم ميكروبيولوجيا الاراضى بمعهد بحوث الأراضى والمياه والبيئة.

وتم فحص عينات من جمعات الخيار المبكرة والمتوسطة والمتأخرة لملاحظة محتواها من النترات ، كما تم تقدير النترات فى أعناق الورقة السادسة للخيار فى نفس توقيت عينة الثمار وكذلك تم تقدير النترات والنيتريت بالاراضى فى نفس التوقيت.

وقد أوضحت النتائج الآتى:

- أدى زيادة مستويات التسميد النيتروجينى المعدنى إلى زيادة واضحة فى محتوى النترات بثمار الخيار فى الموسمين وكذلك محتوى النترات فى أعناق الأوراق (الورقة السادسة من أعلى).
- لوحظ زيادة فى محتوى الخيار من النترات (الثمار وأعناق الأوراق) مع التلقيح بالكتيريا المثبتة للأزوت لاتكافليا فى الموسمين بالمقارنة بالمعاملة الغير ملقحة.
- لم يظهر اتجاه واضح للفروق فى محتوى الخيار من النترات بين طرق التلقيح المستخدمة خلال موسمى التجربة.
- يتضح من النتائج أن أعلى قيم للتلوث النتراتى بالخيار كانت فى الجمعات الأولى المبكرة وأقل قيم للتلوث كانت مع الجمعات المتأخرة وذلك فى الموسمين.
- أدى زيادة مستوى التسميد النيتروجينى المعدنى إلى زيادة تركيز النترات والنيتريت بالأرض خلال الموسمين.
- كما أدى التلقيح بالبكتيريا المثبتة للأزوت لاتكافليا إلى زيادة النترات والنيتريت بالأرض فى الموسمين.
- ومن نتائج البحث يتضح أن زيادة النتروجين الميسر فى منطقة الجذور من أى مصدر (عضوى ـ معدنى ـ حيوى) يؤدى الى زيادة التلوث النتراتى فى ثمار الخيار. وبالرغم من احتواء الخيار على نسب مرتفعة من النترات فى الثمار الا ان الكميات التى تصل جسم الانسان منها لا تصل الحدود المسموح بها بسبب قلة الكمية المستخدمة يوميا منه ولكن تصبح هذه الكميه خطره فى حالة وجود مصادر أخرى للتلوث النتراتى بالوجبات اليوميه مثل الارز (كنانى وعطية ٢٠٠٣) ومياه الشرب والفاكهه والخضر الاخرى واللبن وغيرها.

توصية: من الملاحظ من نتائج التحليل أن المحتوى النتراتى بثمار الخيار يكون أقل فى الجمعات المتأخرة عنه فى الجمعات المبكرة وأنه يقل بترك ملثمار بعد الجمع لفترة قبل الأكل. ومن هذا يمكن التوصية بترك الثمار لليوم الثانى بعد الجمع قبل تناولها.