EFFECT 0F LONG-TERMAPPICATION OF ANHYDROUS AMMONIA PHYSICOCHEMICAL PROPERTIES OF SOIL AND NEMATODE

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El-Kassas, H. I.[1]; Darwish, D. S.[2]; Ramadan, E.[3]
and Abdel Wahab, Amal, A.[1]

1) Institute of Environmental Studies and Research, Ain Shams University 2) Faculty of Agriculture, Ain Shams University 3) Agriculture Research Centre

ABSTRACT

This study was carried out investigate the effect of long – term treatments with anhydrous ammonia on physicochemical properties of soil and soil micro flora. Soil samples were collected from different localities at fayom governorate. Results revealed that two soil texture were recorded being sandy clay soil for Hossam farms site and sandy clay loam soil for both of Rahil and Tamialocations .Soil of highest Rahil and Tamialocaties gave the values of EC . All tested soil collected from different localities were slightly alkaline . High percentage of Organic matter was detected at depth 15 -30 Cm of all sites treated with ammonia. The highest Sodium percentage was noticed at Tamia site. The highest amount of N and K was recorded in soil collected form HossamNassar (10 years long –term). The Total microbial count was recorded at the second depth (15 -30 Cm) than that observed at the first one. Total fungal counts recorded the highest values in soil Rahiland Tamia treated with ammonia - Asymbiaticaerbic nitrogen fixers showed high percentage at soil treated with urea . Clear retardation of harmful Nematodes was recorded in soil treated with ammonia at different sites and at different depths.

Key Words: Anhydrous Ammonia, Physical and Chemical porpertes of soil , Micro flora, Nematodes.

INTRODUCTION

Soil health indicators are a composite set of measurable physical, chemical and biological attributes which relate to functional soil processes and can be used to evaluate soil health status. It is realized that the former term (soil health) gives greater emphasis on soil biodiversity and ecological functions that make soil a dynamic living resource with capacity for self-organization. Diane *et al*., 2011.sorbed on colloidal systems by chemical or physical mechanisms or a combination of them.Gros (1951) showed that the proper depth of anhydrous ammonia is 6 inches below the surface of the soil. On the other hand, Baker *et al*. (1959) revealed that depths of 2 to3 inches were completely adequate for maximum retention of anhydrous ammonia at usual field application rates.Fenn and Kissel (1976) mentioned that the objective of this study was to determine the influence of soil cation exchange capacity (CEC) and depth of incorporation on NH_3-N volatilization from NH_4^+-N compounds applied to calcareous soil.Vitosh. (1982) reported thatanhydrous ammonia (AA) is a widely used N fertilizer because of the many positive agronomic and logistical characteristics of the product. The effects of AA on the soil are generally minimal with regard to soil physical and chemical properties when compared to other N fertilizer sources.Sommer and Christensen (1992) reported that the losses form a dry and a wet soil were 20% and 50% of injected ammonia, respectively. Intrawech *et al*. (1982) investigated the influence of various N sources including anhydrous ammonia on soil physical properties. They found that such properties as hydraulic conductivity, bulk density, water-stable aggregates, compatibility and penetrometer resistance at field capacity were unaffected by fertilizer treatment. Schmitt and Rehm (1993) reported that anhydrous ammonia is often perceived as being detrimental to several physical and chemical soil properties. Results from a long-term (10yr) study comparing the effects of several N sources and a control (no N) revealed that none of the N sources were significantly different from each other or the control (no N). Tisdale *et al*. (1999) reported that several long-term studies have shown no differences among N sources included anhydrous ammonia on soil physical properties.Brouder and Joern (1998) stated that conversion of anhydrous ammonia to nitrate occurs more slowly because the anhydrous ammonia band itself is toxic to the soil microbes responsible for the conversion. The soil microbial population must rebuild over a several weeks period before the conversion to nitrate can begin and so nitrification is delayed from two to six weeks. A rather rapid recovery in numbers of bacteria and actinomycetes were recorded. Nitrification is restricted by the condition that arises in soil zones affected by addition of ammonium-forming or ammonium- containing fertilizers. As a consequence, production of both nitrite and nitrate will be reduced until condition return to normal. Yutaka Okano *et al.* (2003) reported that ammonium oxidation by autotrophic ammonia-oxidizing bacteria (AOB) is a key process in agricultural and natural ecosystems and has a large global. Biederbeck *et al.* (1996), observed that generally, effects were greater in the 7.5- to 15-cm depth, where N was placed. The soil, which was already acidic pH after fertilization to assess the impact of applied N on microbial populations and soil biochemical properties.Siam*et al* .(2009)carried out two field experiments at Demo village, El-Fayoum Governorate during 2009 and

2010 seasons to study the effect of different nitrogen levels (100, 120 and 140kg N/fed) as ammonia gas by injection methods in soil, and micronutrients as Fe, Mn and Zn at a rate of 6 mg kg^{-1} as soil application or 0.6 g/kg of seeds coating or 0.6 g/L as foliar spray and their combination on growth characteristics and nutrient uptake of maize plants (Zea mays Mill, cvs Single hybrid 10).The main objective of this study was to investigate the effect of a long–term application of anhydrous ammonia as nitrogen fertilizer on the physicochemical properties of soil at different depths.

MATERIALS AND METHODS

Three areas were selected for the study of different construction zone in areas treated with ammonia, urea fertilizers EL-Fayom governorate by choosing three locations, namely Tamia, Rahil and Hossam Nassar. These locations were fertilized with a long–time application of anhydrous ammonia and urea for 5,10,15 years respectively (100-150 L ammonia/Feddan, i.e. 82.35-182.15 N/fed). Representative samples of soil were taken at two depths 0-15 and 15- 30 cm. These soil samples were directly transferred to the lab in icebox and subjected to analysis for physicochemical properties, microbiological determinations and nematodes.

Soil analysis

Determination of physical properties:

Particle size distribution:

A detailed analysis of the particle size distribution of the collected soil samples was carried out by the international pipette method as described Klute (1986).Soil texture class was recorded.

Determination of chemical properties:

1-pH values: pH values of soil samples were measured in saturated soil – water paste using Beckman pH meter according to Page *et al* (1982)

Electrical Conductivity (EC):

Electrical conductivity values were determined in the saturated soil water paste extract as d S/m, CM25 conductivity meter according to was used Page *et al*. (1982).

Determination ofcation and anions:-

1- Soluble cation:

Soluble cation was determined in soil sample as follows:

a) Calcium plus magnesium:

Calcium plus magnesium were determined by the vresenate method using Eriochrome Black –T as an indicator, calcium by the versenate method using ammonium purpurate as an indicator, and magnesium was then calculated by the difference between calcium plus magnesium and calcium as described by Page *et al*. (1982).

b) Sodium and Potassium:

Sodium and Potassium were determined using the Perkinelemer flame photometer as described by Page *et al*. (1982).

2- Soluble anions:-

a) Carbonates and bicarbonates

Carbonates and bicarbonates were determined by titration with 0.01 N sulfuric acid using phenolphthalein as described by Page *et al*. (1982).

b) Chloride:

Chloride was determined using moh's method as described by Page *et al*. (1982).

c) Sulphate :

Sulphate was calculated by the difference between Cations and anions.

Total calcium carbonates:

Total calcium carbonates were determined using Collin's calciminer method as described by Page *et al*.(1982).

Soil organic matter contents:

Soil organic matter contents were determined using the wet combustion method according to Walkly and Black's method Page *et al*. (1982).

Total nitrogen:

Total nitrogen was determined using micro keldahl method (Black, 1965). The digestion was carried out using a K_2 SO_4 –catalyst mixture (an intimate mixture of 200 g of K_2 $SO_4$20 g of $CuSO_4.5H_2o$ and 2 g of Se Powder and concentrated H_2SO_4).

Available phosphorus:

Available P was extracted by 0.5 N (Na HCO_3) solution as described by Olson et al.(1954) then the extracted P was measured calorimetrically (Jackson,1967).

Available Potassium:

Available potassium was extracted by ammonium acetate solution at pH 7.0 and determined flam photometrical as described by (Page *et al*. 1982).

Available micronutrients:

Available micronutrients (Fe, Zn, Cu and Mn) were extracted by using DTPA method according to Lindsay and Norvell (1978). Then, the extracted Fe and Mn was measured using atomic absorption spectrophotometer.

Extraction, counting and identification of nematodes

Each soil sample was carefully mixed and a volume of 250 cm^3 soil was used to extract nematodes using sieving and Barman pan technique (Barker *et al.,* 1985). The extracted nematodes were counted by using 1 ml counting slide under stereoscopic microscope and identified to the generic level based on the morphology of adult females and juvenile forms according to (Mai & Lyon, 1975 and Muller *et al*., 1981).

Determination of bacterial and fungal counts:

1. Total bacterial and fungal counts.

Ten grams of rhizosphere soil were suspended in 90 ml sterilizedwater in conical flask (250 ml), thoroughly shaken for 15 min. and dilution series up to 10^{-7} were prepared. Dilutions from each soil sample were plated (in triplicate) on two different media, i.e., nutrient agar and potato dextrose medium. Plates were incubated at 28◦C ±2 for 3 and 7 days to count bacteria and fungi, respectively.Difco, (1985)

2. Asymbiotic nitrogen fixers

Asymbiotic nitrogen fixers were counted using the Most Probable Number technique (MPN). From each dilution of soil rhizosphere (previously mentioned) five tubes containing modified Ashby medium were inoculated with 1m1. Tubes were incubated at 30◦C ±2 for 7 days and counted by Table of Most Probable Number (MPN).according to Abd-El-Malek and Ishac (1968).

RESULTS AND DISCUSSION

The physicochemical properties of soil and biodiversity of soil micro flora as affected by ammonia and urea the fertilizer for 5 to 15 years at El-Fayom governorate were elucidated.

Soil texture:

The analysis of soil particles of samples collected at different depths and different treatments (ammonia and urea) are presented in Results clearly showed that two soil texture were recorded according to the soil samples collected from different sides being sandy clay soil for HossamNassar farms (15 years) and sandy clay loam soil for both of Rahil (10 years) and Tamia (5 years) farms. Soil samples collected at different depths did not show a clear difference in the soil particles, approximately where contents showed the same ratio of soil particles. The treatment of soil with ammonia did not show a clear effect on soil texture as compared with soil texture with urea (control), (Tables 1, 2 & 3).

pH and Electrical Conductivity:

The effect of ammonia treatment for 5-15 years on the pH and electrical conductivity of soil samples comparing with urea (control) were elucidated in this study. Results showed that all tested soils from different localities

(HossamNassar ,Rahil and Tamia farms) at El-Fayom governorate were slightly alkaline of pH values from 7.60 to 8.15. The application of anhydrous ammonia and deferent depths of soil did not show clear difference in pH values. On the contrary, EC showed a distinct difference as effected by location and soil depths where the highest values were recorded at 0 - 15 cm depth for HossamNassar farm (15 years a long term application) treated with ammonia having 5.5 dSm^{-1} whereas soil samples collected from Rahil (10 years a long- term application) and Tamia (5 years a long- term application) localities gave the highest values at 15 -30 cm depth having 6.52 and 5.90 dSm^{-1} respectively. It could be stated that the a long-term application of anhydrous ammonia led to increase the electrical conductivity (EC) where the highest values were recorded at 0-15 cm depth in soil samples collected from HossamNassar locality which applied with a long-term of anhydrous ammonia (Tables 1,2 & 3).

Organic matter and Calcium Carbonate:

Results show that the samples of soil collected from different sites contained approximately higher amount of organic matter as compared with other soils. The highest percentage of organic matter was recorded at depth 15 -30 cm of all sites treated with ammonia being 2.55, 2.52 and 2.06 % for Hossam Nassar, Rahil and Tamia sites receptivity. The control (urea treatment) exhibited the same trend of Rahil and Tamia sites. With respect to $CaCO_3$, soil samples collected from Rahil site contained the highest percentage comparing with the other two sites. No distinct clear differences between the different depths and different treatments (ammonia and urea) were observed, (Tables 4, 5 & 6).

Soluble Cations:

It is clear from the data presented in (Tabls 4, 5 & 6) that all samples collected from different sites contained higher percentage of sodium and this value was more pronounced in the case of Tamia (5 years application) sites ranging from 16.62 to 19.90 meq/Kg Soil. Calcium cation was in higher amount in Hossam Nassar (15 years application) site as compared with the other sites. No constant trend for different cations was observed as affected by soil depths and different treatments. (Tables 4, 5 & 6).

Soluble anions:

Result clearly showed that the highest amount of HCO_3 was recorded in soil samples collected from HossamNassar site as compared with otherlocalities ranging from 12.24 to 12.50 meq/kg soil. A considerable amount of SO_4= was observed in soils collected from Rahil and Tamia sites. Results also did not show a distinct variation in anions as affected by depth of samples and different treatments (Tables 4, 5 & 6).

N P K and micro nutrients:

Data presented in Table (6), show N P K and microelements (Fe, Mn, Zn, and Cu) contents of soil samples collected from different sites at El- Fayom governorate as affected by the application of ammonia and urea and soil depth. Results depicted that most soil samples collected from HossamNassar (15 years a long-term application) farm injected with anhydrous ammonia contained the higher quantity of N, K and micro nutrients at the depth of 15 - 30 cm than that recorded at 0 - 15 cm depth where 12.18 mg/kg , 29.33 mg/kg, 11.98 ppm 0.99 ppm and 3.52 ppm for N, K, Mn, Zn and Cu respectively whereas P and Fe did not exhibited the same trend showing the highest amount at 0 -15cm depth . In the case of soil treated with urea, N, P, Fe, Mn, and Cu gave the highest amount at the second depth. Other soil samples collected from other farms did not show a constant trend comparing to Hossam Nassar farm. These results are in agreement with many investigators such as Vitosh. (1982) who reported that the effect of anhydrous ammonia was generally minimal with regard to physical and chemical properties. Interwech *et al* (1982) investigated the influence of various N sources including anhydrous ammonia on soil physical properties. They said that such properties as hydraulic conductivity, bulk density, water stable aggregates, compatibility and penetrometerresistance at field capacity were unaffected by fertilizer treatment. Darusman *et al*. (1991) observed that the comparisons of anhydrous ammonia, ammonium nitrate, urea and urea elucidated that ammonium nitrate solution in four Kansas sites at N rates 112 – 224 kg ha^{-1} showed no difference among N fertilizers on soil application. They also added that no effects on soil physical properties were observed after 20 years & annuals application & these N sources. The obtained results in this investigation are in agreement with that observed by Schmitt and Rehm (1993) who stated that anhydrous ammonia was detrimental to several physical and chemical properties. Tisdel *et al* (1999) reported that the application of anhydrous ammonia resulted in substantial transitory rises in levels of ready extractable phosphorous (Tables 4 ,5 & 6).

Biodiversity of soil micro flora and nematodes:

It is well known that the biodiversity of soil microorganisms and nematodes are highly affected by many factors .So it was found valuable to study the effect of a long term application of anhydrous ammonia on these micro-organisms as compared with soil treated with urea at different long–term application.

Total microbial count:

The soil samples collected from Hossam Nassar (15 years application) farm were analyzed for total microbial flora either soil treated with anhydrous ammonia or urea (control). Results in (Tables 7, 8 & 9) showed that the density of this group was higher at the second depth (15-30 cm) being 185.6 $\times 10^4$ cfu / g soil than that observed at the first depth being 163.30 $\times 10^4$ cfu/g soil. On the contrary, total microbial count (TMC) was higher at the first depth than the second one in soil samples collected from soil treated with urea. On the other hand, TMC were in higher values at the first depths of soil treated with urea than soil treated with anhydrous ammonia being 231.60 and 163.30 $\times 10^4$cfu/g soil respectively soil samples collected from Rahil farm (Tables 7, 8 & 9) TMC significantly higher in soil treated with urea than that treated with anhydrous ammonia for both depths. Whereas Tamia samples (Tables 7, 8 & 9) exhibited the same trend at the first soil depth. Generally, it could be concluded that the counts of total microorganisms were highly reduced in soil treated with anhydrous ammonia as compared with soil treated with urea (Tables 7, 8 & 9).

Total fungi (TF):

Results in (Tables 7, 8, & 9) demonstrated that the total fungal counts (TF) recorded the highest density in soil samples collected from Rahil and Tamia farms treated with anhydrous ammonia as compared with soil treated with urea. With respect to soil of HossamNassar farm, TF was found in higher densities at the second soil depth for both treatments being 17.0 and 36.00×10^4 cfu/ g soil for ammonia and urea treatments respectively (Tables 7, 8 & 9).

Asymbiotic aerobic nitrogen fixers (ANF):

This group of microorganisms comprises the bacteria which have a high efficiency to fix nitrogen such as different Azotobacter species. These bacteria play an important role to increase the nitrogen content of soil to be more healthy soil. Results clearly showed that the ANF counts were found in high density in soil treated with urea collected from HossamNassar farm (Tables 7, 8 & 9). In soil samples collected from Rahil farm did not show a clear variation of ANF densities in both treatments and both depths, whereas Tamia samples gave highest density of this bacterial group at the first depth for ammonia and urea treatments being 2.20, 3.13×10^4 MPN/g soil respectively. Biederbeck *et al.* (1996) came to the same conclusion. They reported that fungal and bacterial population (Plate count) was positively treated with anhydrous ammonia than for urea. In this study, the same soils treated with anhydrous ammonia supported microbial growth either total microbial count, fungi and aerobic diazotrophes (asymbiotic). This may be due the assimilation of anhydrous ammonia as a good source of nitrogen leading to form high densities of tested organisms. Yukata and Okano (2003) stated that the population size of total bacteria remained between 0.7 * 10^9 and 2.2 * 10^9 cells/g of soil; regard Len of the ammonia concentration. Strong (1995) reported that within the zone of influence of anhydrous ammonia, number of fungi, nematodes and bacteria were reduced temporarily during several days after application; the number of bacteria had increased between 6 and 25 fold of untreated soils (Tables 7, 8 & 9).

Nematodes:

Phytopathogenic nematodes (harmful nematode) and free nematodes (beneficial nematodes) play an important role in soil healthy. Phytopathogenic nematodes cause deleterious effects on many crops leading to sharply decreases the yield, whereas beneficial nematodes have the ability to decompose of organic matter and attack some pathogenic nematodes. So, in this investigation a trial was carried out to study the effect of anhydrous ammonia on the biological activities of both type of nematodes. Tables (10, 11 and 12) show the effect of soil treated with a long-term anhydrous ammonia for 5-15 years on the total count of nematodes, harmful nematode and free nematodes comparing with soil treated with urea as control. In general, a clear retardation of harmful nematodes was recorded in soil treated with anhydrous ammonia at different sites and at different depths. This deleterious effect was more pronounced in soil samples collected from Rahial site treated with anhydrous ammonia being 20 juveniles / 250 g soil for both depths as compared with soil treated with urea (control). Free nematodes also exhibited the same trend of this effect for samples collected from other two sites. General speaking, the anhydrous ammonia showed a deleterious effect on phytopathogenic nematodes as compared with urea. This may be attributed to the toxicity of anhydrous ammonia on the viability of harmful juvenile. It means that the continuous application of anhydrous ammonia as a long-term period treatment (5 to 15 years) led to the decrease the harmful nematodes and consequently improves the soil healthy (Tables 10, 11 & 12).

Table (1): Some physical properties of the studied soils (Tamia samples)

Soil properties	Anhydrous ammonia		Urea	
	Depth , cm			
	0-15	15-30	0-15	15-30
particel size distribution (%)				
Coarse sand	1.95	8.25	1.45	1.35
Fine sand	52.35	51.28	49.3	55.65
Silt	9.42	18.23	18.8	15.44
Clay	36.28	28.24	30.45	27.56
Texture	sandy clay loam	sandy clay loam	Sandy clay loam	sandy clay loam
pH (1:2.5, soil: water suspension)	8.1	7.7	7.9	8.1
EC (ds/m, soil paste extract)	2.7	5.9	4.28	2.75

Table (2): Some physical properties of the studied soils (Rahil samples)

Soil properties	Anhydrous ammonia		Urea	
	Depth , cm			
	0-15	15-30	0-15	15-30
particel size distribution (%)				
Coarse sand	2.55	1.45	1.3	2.65
Fine sand	63.45	60.55	54.75	50.79
Silt	7.27	22.85	11.8	20.07
Clay	26.73	15.15	32.15	26.49
Texture	sandy clay loam	sandy clay loam	sandy clay loam	sandy clay loam
pH (1:2.5, soil: water suspension)	8.15	7.6	7.8	7.75
EC (ds\m, soil paste extract)	2.44	6.52	4.66	2.55

Table (3): Some physical properties of the studied soils (Hossam Nassar samples)

Soil properties	Anhydrous ammonia		Urea	
	Depth , cm			
	0-15	15-30	0-15	15-30
particel size distribution (%)				
Coarse sand	1.15	1.75	2.15	2.05
Fine sand	46.35	48.8	48.25	47.95
Silt	8.32	6.81	7.19	3.74
Clay	44.18	42.64	42.19	46.36
Texture	sandy clay loam	sandy clay loam	sandy clay loam	sandy clay loam
pH (1:2.5, soil: water suspension)	7.45	7.55	7.65	7.8
EC (ds\m, soil paste extract)	5.5	3.39	0.96	1.04

Table (4): Some Chemical properties of the studied soils (Tamia samples)

Soil properties	Anhydrous ammonia		Urea	
	Depth , cm			
	0-15	15-30	0-15	15-30
Total $CaCO_3$(%)	8.74	9.68	8.1	9.3
Organic matter (%)	1.72	2.06	1.5	1.76
Soluble cations (meq^{l-})				
Ca^{2+}	4.16	4.5	5.3	5.3
Mg^{2+}	3.07	5.7	4.7	4.11
Na^+	19.9	18.7	19	16.62
K^+	6.26	0.32	0.39	0.35
Soluble anions (meq^{l-})				
$CO3^{2-}$	0	0	0	0
HCO_3^-	3.14	4	3.5	3.67
Cl^-	6.14	6.24	6.5	7.2
SO_4^{2-}	18.08	18.69	19.39	15.51
Available nutrients (mg/kg soil)				
N	13.18	12.35	14.1	13.77
P	4.94	7.06	5.41	7.23
K	208.68	298.9	277.4	220
Fe	5.12	4.25	4.89	4.32
Mn	3.43	3.52	6.06	3.96
Zn	0.68	0.62	0.66	0.75
Cu	2	2.31	2.26	2.01

Table (5): Some Chemical properties of the studied soils(Rahil samples).

Soil properties	Anhydrous ammonia		Urea	
	Depth , cm			
	0-15	15-30	0-15	15-30
Total $CaCO_3$(%)	11.4	11.4	8.25	11.4
Organic matter (%)	1.8	2.52	1.26	2.63
Soluble cations (meq^{l-})				
Ca^{2+}	5.3	5	4.3	4.1
Mg^{2+}	4.3	4.16	4.2	4.2
Na^{+}	17.75	17	18.1	17.3
K^{+}	0.34	0.29	0.28	0.27
Soluble anions (meq^{l-})				
CO_3^{2-}	0	0	0	0
HCO_3^{-}	6	6.7	6	5.7
Cl^{-}	7.7	7	7	6.8
SO_4^{2-}	13.99	12.75	13.88	13.17
Available nutrients (mg/kg soil)				
N	14.85	11.6	11.48	11.98
P	5.35	6.31	4.59	5.42
K	190.4	422	276.2	190.4
Fe	3.68	8.24	4.64	5.1
Mn	2.47	3	4.28	4.03
Zn	0.51	0.35	0.56	0.53
Cu	1.78	3.99	2.52	1.41

Table (6): Some Chemical properties of the studied soils (Hossam Nassar samples)

Soil properties	Anhydrous ammonia		Urea	
	Depth , cm			
	0-15	15-30	0-15	15-30
Total $CaCO_3$(%)	7.4	6.6	6.25	5.97
Organic matter (%)	1.85	2.55	2.39	2.3
Soluble cations (meq^{l-})				
Ca^{2+}	17	5.5	16	15
Mg^{2+}	8.6	8.22	7.4	7
Na^{+}	15.43	13.5	15	14.5
K^{+}	0.8	0.71	0.6	0.5
Soluble anions (meq^{l-})				
CO_3^{2-}	0	0	0	0
HCO_3^{-}	1.2	1.2	1.11	1.3
Cl^{-}	12.5	12.5	12.24	11.5
SO_4^{2-}	24.23	24.23	25.65	24.2
Available nutrients (mg/kg soil)				
N	11.35	12.18	11.35	11.6
P	7.1	6.76	4.24	8.05
K	439.9	293.3	448.4	399.73
Fe	7.12	6.24	8.13	8.3
Mn	7.6	11.98	3.75	5.81
Zn	0.85	0.99	3.26	0.65
Cu	2.16	3.52	3.26	3.45

Table (7): Microbial load of different groups of microorganisms in soil samples from HossamNassar farm as affected by soil treatments at different depths

Treatment	TMC *10>4	TF 10>4	ANF 10>4	TF %	ANF %	TF/ANF
A1	163.30	7.60	2.84	4.65	1.74	2.68
A2	185.60	17.00	2.02	9.16	1.09	8.42
U1	231.60	15.30	4.73	6.61	2.04	3.23
U2	168.30	36.00	3.25	21.39	1.93	11.08

R		-0.19	0.73
r (TF and ANF)			0.04
SD	31.10	12.06	1.14
SE ±	15.55	6.03	0.57
LSD (0.05)	49.46	19.18	1.80

A1 at 0 - 15 Cm , A2 at 15 - 30 Cm (ammonia treatment)

U1 at 0 - 15 Cm, U2 at 15 - 30 Cm (urea treatment)

TMC: Total microbial count, TF: Total fungi, ANF: Asymbiotic nitrogen fixers.

Table (8): Microbial load of different groups in soil samples from Rahil farm as affected by soil treatments at different depths

Treatment	TMC * 10>4	TF 10>4	ANF 10>4	TF %	ANF %	TF/ANF
A1	219.60	11.30	0.95	5.15	0.43	11.89
A2	219.60	11.40	0.95	5.19	0.43	12.00
U1	145.60	4.00	0.91	2.75	0.63	4.40
U2	145.60	4.00	0.91	2.75	0.63	4.40

R		1.00	1.00
r (TF and ANF)			1.00
SD	42.72	4.24	0.02
SE ±	21.36	2.12	0.01
LSD (0.05)	67.93	6.75	0.04

A1 at 0 - 15 Cm , A2 at 15 - 30 Cm (ammonia treatment)

U1 at 0 - 15 Cm, U2 at 15 - 30Cm (urea treatment)

TMC: Total microbial count, TF: Total fungi, ANF: Asymbiotic nitrogen fixers.

Table (9): Microbial load of different groups in soil samples from Tamia farm as affected by soil treatments at different depths.

Treatments	TMC * 10>4	TF 10>4	ANF 10>4	TF %	ANF %	ANF/TF
A1	156.30	1.40	2.20	0.90	1.41	1.57
A2	79.00	1.60	1.30	2.03	1.65	0.81
U1	180.00	0.60	3.13	0.33	1.74	5.22
U2	117.00	3.98	1.77	3.40	1.51	0.44

R		-0.46	0.96
r (TF and ANF)			-0.54
SD	44.44	1.46	0.78
SE ±	22.22	0.73	0.39
LSD (0.05)	70.65	2.31	1.24

A1 at 0 - 15 Cm , A2 at 15 - 30 Cm (ammonia treatment)

U1 at 0 - 15 Cm ,U2 at 15 - 30 Cm (urea treatment)

TMC: Total microbial count, TF: Total fungi, ANF: Asymbiotic nitrogen fixers

Table (10): Counts of different nematodes as affected by soil treatments at different depths in soil samples collected from Hossam farm.

Treatment	TN	PN	FN	DN	PN %	FN %	DN %
A1	180.00	20.00	20.00	140.00	11.11	11.11	77.78
A2	180.00	80.00	80.00	20.00	44.44	44.44	11.11
U1	240.00	120.00	0.00	120.00	50.00	0.00	50.00
U2	160.00	80.00	0.00	80.00	50.00	0.00	50.00

R		0.61	-0.25	0.36
SD	34.64	41.23	37.86	52.92
SE ±	17.32	20.62	18.93	26.46
LSD (0.05)	55.08	65.56	60.20	84.13

A1 at 0 - 15 Cm , A2 at 15 - 30 Cm (ammonia treatment)

U1 at 0 - 15 Cm ,U2 at 15 - 30 Cm (urea treatment)

TN=Total Nematodes, PN=Pathognic Nematodes, FN=Free Nematodes, DN=Died Nematodes.

Table (11): Counts of different nematodes as affected by soil treatments at different depths in soil samples collected from Rahel farm.

Treatment	TN	PN	FN	DN	PN %	FN %	DN %
A1	140.00	20.00	20.00	100.00	14.29	14.29	71.43
A2	140.00	20.00	20.00	100.00	14.29	14.29	71.43
U1	100.00	40.00	40.00	20.00	40.00	40.00	20.00
U2	100.00	40.00	40.00	20.00	40.00	40.00	20.00
R		-1.00	-1.00	1.00			
SD	23.09	11.55	11.55	46.19			
SE ±	11.55	5.77	5.77	23.09			
LSD (0.05)	36.72	18.36	18.36	73.44			

A1 at 0 - 15 Cm , A2 at 15 - 30 Cm (ammonia treatment)

U1 at 0 - 15 Cm ,U2 at 15 - 30 Cm (urea treatment)

TN=Total Nematodes, PN=Pathognic Nematodes, FN=Free Nematodes,

DN=Died Nematodes.

Treatment	TN	PN	FN	DN	PN %	FN %	DN %
A1	160.0	60.0	60.0	40.0	37.50	37.50	25.00
A2	120.0	40.0	40.0	40.0	33.33	33.33	33.33
U1	180.0	80.0	80.0	20.0	44.44	44.44	11.11
U2	260.0	120.0	120.0	20.0	46.15	46.15	7.69
R		0.99	-0.78	-0.78			
SD	58.88	34.16	34.16	11.55			
SE ±	29.44	17.08	17.08	5.77			
LSD (0.05)	93.62	54.31	54.31	18.36			

A1 at 0 - 15 Cm , A2 at 15 - 30 Cm (ammonia treatment)

U1 at 0 - 15 Cm ,U2 at 15 - 30 Cm (urea treatment)

TN=Total Nematodes, PN=Pathognic Nematodes, FN=Free Nematodes,

DN=Died Nematodes.

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تأثير الحقن بالامونيا الغازيه علي المدي الطويل علي الخواص الفيزوكميائيه والنيماتودا للتربة

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هشام إبراهيم القصاص(١)– الشحات محمد رمضان(٢)– درويش سام درويش(٣)
آمال عبد الجبار محمد عبد الوهاب(١)
١) معهد الدراسات والبحوث البيئية، جامعة عين شمس ٢) كلية الزراعة، جامعة عين شمس
٣) معهد بحوث الاراضي والمياه والبيئه

المستخلص

تناولت هذه الدراسه تأثير المدي الطويل للحقن بالامونيا الغازية للخواص الفيزوكميائية والكائنات الحيه الدقيقه للتربه والنيماتودا. جمعت عينات التربة من اماكن مختلفه من محافظة الفيوم. أوضحت النتائج نوعين من قوام التربة حيث سجلت اراضي رملية طينية من مزرعة حسام نصار– اراضي رملية طمييه من مزرعتي رحيل وطامية. اراضي رحيل وطامية اعطت اعلي قيمة للتوصيل الكهربي وجميع الاراضي المختبرة التي تم جمعها من المواقع المختلفة كانت قلوية خفيفة واعلي نسبة من الماده العضوية كانت علي عمق من ١٥–٣٠ سم لكلا المواقع التي تم معاملتها بالامونيا الغازيه. اعلي نسبه من الصوديوم لوحظت في موقع طامية أعلي كمية من النيتروجين والبوتاسيوم تم تسجيلها في الاراضي التي تم جمعها من مزرعة حسام نصار علي مدي عشر سنوات والعد الكلي للميكروبات سجلت أعلي من الموقع الثاني ١٥–٣٠ سم عن الذي لوحظ في العمق الاول والعد الكلي للفطريات سجلت أعلي قيمة في مزرعتي رحيل وطامية. من حيث المعاملة بالامونيا الغازية والبكتريا المثبته للنيتروجين اوضحت اعلي نسبه المعاملة باليوريا. وحدث تراجع كبير للنيماتودا الضارة في الاراضي المعاملةبالامونيا الغازية في مختلف المواقع وعلي كل الاعماق.