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Efficiency of Prepared Chelate Fertilizer from Humic Acid in Reducing Ammonia Volatilization from Urea Fertilizer

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Abstract: Composted cow manure sample was collected from filed of college of Agriculture, University of Basrah. Its properties were identified. Humic acid was extracted from cow manure and diagnosed according to elemental analysis (CHN), spectral study (E_4/E_6), infra-red spectrum (IR), in addition to chemical composition of functional groups. Two types of humic acid were prepared, one of them humic acid with fermented plant residue (HA1-N) and other humic acid with zeolite (HA2-N). A laboratory experiment was carried out to study the amount of ammonia volatile from two prepared chelate fertilizers (HA1-N and HA2-N) and urea fertilizer by incubation two types of soils (sandy soil and clay loam soil) at 35°*C* with four rates of nitrogen (0, 125, 250 and 500 $mg\ N\ kg^{-1}$ soil) and with five incubation time (3, 6, 12, 24 and 48 days). The study found that increasing rate of nitrogen and incubation time increased ammonia volatilization, and the highest value was at the rate 500 $mg\ N\ kg^{-1}$ soil and at 48 days of incubation to reach a 21.427 and 9.736 $mg\ N\text{-}NH3\ Kg^{-1}$ soil for sandy soil and clay loam soil, respectively. Application of two prepared chelate fertilizers (HA1-N and HA2-N) at rate 500 $mg\ N\ Kg^{-1}$ reduced ammonia volatilization to 99.30 % and 98.62 % for sandy soil and 98.96 % and 97.77 % for clay loam soil comparing with urea fertilizer . Fertilizers were took the following order in reducing ammonia volatilization : HA1-N > HA2-N > Urea.

Keywords: Humic acid , Ammonia volatilization , Urea fertilizer , Chelate fertilizer

Introduction

Nitrogen is one of the most important nutrient in the fertilization programs, because it is important for chlorophyll molecules synthesis, proteins, enzymes, cellular membranes, cell division and plant tolerance for extreme environmental conditions (Barker & Bryson, 2007). Nitrogen fertilizers lead to loss when added to soils by many process like volatilization, leaching, denitrification and immobilization, which lead to low efficiency of fertilizers (Bundick *et al*., 2009). In order to provide continuous nitrogen for plant and increase efficiency of nitrogen fertilizers, several methods were used such as urease inhibitors, nitrification inhibitors, methods of application, slow release fertilizers and others (Prasad & Power, 1997).

All studies had shown the important role of organic matter including humic acid in increasing nitrogen availability in soils, because its role in improving physical, chemical and biological properties of soils and their buffering capacity (Stevenson, 1982). Ahmed *et al*. (2006); Fan & Mackenzie (1993) found that using of acidic substances such as humic acid reduce nitrogen losses as ammonia from fertilizers. Al-Tameemi *et al*. (2014) found decrease in ammonia volatilization from urea fertilizer by application of humic acid to some calcareous soils from southern Iraqi soils. Due to the lack of studies related to the effect of humic acid in nitrogen availability, the study suggested to achieve the following objectives by preparing of environmental safe chelated organic fertilizer loaded with certain proportions of nitrogen to increase its availability in soils.

Materials & Methods

Collection of composted cow manure and determine its characteristics. A sample of composted cow manure was collected from field of College of Agriculture, University of Basrah on 19th October, 2017, which was fermented for six months. It's initial characteristics had been identified as shown in table (1).

pH and electrical conductivity were measured in suspended leachate (1:5) (cow manure: distilled water) according to the methods described in Page *et al*. (1982). Organic matter of cow manure was determined by determination of organic carbon (Black, 1965).

Cow manure was digested according to method mentioned by Cresser & Parsons (1979). Total nitrogen, total phosphate and total potassium were determined in digestion solution. C/N and C/P ratios were calculated by dividing of total carbon on total nitrogen and total carbon on total phosphate, respectively.

Table (1): Some chemical properties of cow manure.

Property	Unit	Value
pH (1:5)	-	7.18
Electrical Conductivity (EC) (1:5)	dS m^{-1}	21.50
Organic Matter	g kg^{-1}	380.50
Total nitrogen		17.98
Total phosphate		9.50
Total potassium		9.70
C/N ratio	-	12.28
C/P ratio	-	23.23

Preparation of humic acid

Cow manure was collected from animal filed of the Agricultural Research Station / College of Agriculture, University of Basrah which was fermented for six months at date 19th October, 2017. Cow manure sample was air dried and impurities were removed. It was sieved at 1 mm and stored in plastic containers for use in subsequent experiment.

Extraction of humic acids

Humic acids (humic acid and fulvic acid) were extracted from composted cow manure by using alkaline solution of 0.5 *M* NaOH according to the method mentioned in Page *et al*. (1982). Separation of humic acid from fulvic acid was used by concentrated acid of HCl (6 *N* HCl), and pH value of the extraction solution was adjusted to pH 1, and it left for next day for coagulation. The humic acid (precipitate) was separated from fulvic acid by centrifugation at 4000 rpm, and kept each of them in plastic containers in refrigerator until is used.

Purification of humic Acid

According to the method described in Page *et al*. (1982) in removing clays and impurities from humic acid by using 0.1 M KOH and centrifugation and pH adjusted to 6 by using dilute solution of hydrochloric acid. In order to increase the efficiency of humic acid in cations sorption, humic acid treated with H-resin and separated from it by 50 mesh sieve, and then it was adjusted to pH = 6 and kept in clean plastic containers in refrigerator.

Diagnoses of humic Acid

Humic acid was diagnosed by using elemental analysis (Carbon, hydrogen and nitrogen) by using Italian Euro EA3000. Spectrophotometry in visible region was used according to the ratio of E_4/E_6 (Page *et al*., 1982).

Infra-red spectrum (IR) of humic acid was measured in laboratory of College of Pharmacy, University of Basrah, by using humic acid with potassium bromide (KBr) and recording IR spectrum by using infra-red spectrum (IR) type IR Affinity-1 instrument.

Chemical Composition of Humic Acid

Total acidity, carboxylic groups, total hydroxyl, phenolic and alcoholic groups were estimated according to the methods described in Page *et al*. (1982). Phenolic OH groups were calculated from the following relationship (meq phenolic OH groups.gm^{-1} of Humic acid = *meq* total acidity.gm^{-1} Humic acid – *meq* carboxylic groups.gm^{-1} Humic acid).

Preparation of Chelate Fertilizer HA-N

Chelate fertilizer HA-N was prepared with two types HA1-N and HA2-N, by taking a certain amount of pure humic acid at pH = 6 and treated with a known concentration of ammonium chloride to reach nitrogen concentration 15 to 20 % and adjusting pH value to 6. Humic acid was treated with natural materials, peat moss and fermented sawdust for HA1-N, and peat moss, fermented sawdust and zeolite for HA2-N. Nitrogen concentration of chelate fertilizers was determined by digestion fertilizers according to the method of Cresser & Parsons (1979).

Sampling and Preparation of Soils

Two agricultural land sites were selected for experiment, one of them from Zubair site and other from Medayna site on 20th October, 2017 at depth of 0-30 cm. Physical and chemical properties of soils were determined according to the methods mentioned in Richards (1954), Black (1965), Jackson (1973), Papanicolaou (1976), Bremner (1982), and Page *et al*. (1982) (Table 2).

Testing the Efficiency of Chelate Fertilizers (HA1-N and HA2-N) in Loss of Nitrogen by Volatilization

A laboratory experiment was carried out to study the efficiency of prepared chelate fertilizers (HA1-N and HA2-N) in loss of ammonia by volatilization in two calcareous soils and comparing them with urea fertilizer, nitrogen was added at four rates (0, 125, 250 and 500 mg N. Kg^{-1} soil) and at five periods of incubation (3, 6, 12, 24 and 48 days). After each incubation period volatile ammonia was calculated according to the relationship :

$$mg\ (NH_3\text{-}N)/\ 500\ gm\ \text{soil} = (\text{Volume of hydrochloric acid X Normality of acid X 14) X 2}$$

Table (2): Some properties of both studied soils.

Properties	Unit	Value	
		Zubair (Sandy soil)	Medayna (Clay loam soil)
pH (1:1)	-	7.75	7.45
Electrical conductivity (EC) (1:1)	dS m^{-1}	7.00	3.99
Cation exchange capacity (CEC)	Cmol kg^{-1}	5.85	20.50
Organic matter	gm kg^{-1}	1.65	11.50
Carbonate minerals	gm kg^{-1}	200.00	287.50
Total nitrogen	gm kg^{-1}	0.10	1.10
C/N	-	6.09	7.33
Available nitrogen	mg kg^{-1}	4.20	20.00
Soluble cations	mmol L^{-1}		
Ca^{+2}		8.50	9.00
Mg^{+2}		16.00	6.23
Na^{+}		15.31	6.00
K^{+}		0.865	1.64
Soluble anions	mmol L^{-1}		
Cl^{-}		30.50	17.50
SO_4^{-2}		11.50	5.00
CO_3^{-2}		0.00	0.00
HCO_3^{-}		15.00	11.50
Soil particles	gm kg^{-1} soil		
clay		39.00	318.00
silt		41.00	368.00
sand		902.00	312.00
Soil texture		Sandy	Loam clay

Results & Discussion

Diagnosing of humic acid by:-

Elemental analysis

The results in table (3) showed the elemental analysis of humic acid extracted from fermented cow and its content of carbon, hydrogen, nitrogen, sulfur, oxygen and carbon to nitrogen ratio which were reached to 35.87%, 4.36%, 2.66%, 0,65%, 56.46% and 13.48 %, respectively. Tan (2003) pointed out that humic acid content is differed according to source of organic material (soil, water, plant, animal or plant residues, etc.), soil characteristics and conditions, and extraction solution. Al-Tameemi (1997) found that C, H, N, S and O of humic acid were 57.80 %, 5.63 %, 2.75%, 0.68% and 33.14%, respectively. The results of this study were consistent with the results finding by several researchers such as Madhavi (2014) and Ferrara & Brunetti (2008).

Table 3 shows the ratio of carbon to nitrogen (C/N ratio) of humic acid which reached 13.48. Kumada (1987) pointed out that reaching of C/N ratio value between 10 to 15 means that organic matter reaches the degree of humification.

Table (3) explained the ratio of carbon to nitrogen (C/N ratio) of humic acid which

Table (3): Elemental analysis and E_4/ E_6 ratio of humic acid.

Humic acid	% for elemental						E4 / E6
	C	H	N	S	O	C/N	
	35.87	4.36	2.66	0.65	56.46	13.48	3.38

reached 13.48. Kumada (1987) pointed out that reaching of C/N ratio value between 10 to 15 means that organic matter reaches the degree of humification.

E_4/E_6 ratio which represents the optical density or absorption ratio of humic acid at wave length of 465 and 665 *nm* which was 3.38 (table 3). This ratio had been used by many researchers in the identification and diagnosis of humic substances. The value of E_4/E_6 differs with the different source of humic acid and type and concentration of extraction solution (Schnitzer & Khan, 1972), and the value of E_4/E_6 reflects the degree of condensation of ring of humic acid. The low values indicate the high degree of condensation of humic acid, while the high value of E_4/E_6 show the low degree of condensation and high concentration of aliphatic structures (Schnitzer, 1977).

Infra-red Spectroscopy (IR)

Infra-red spectra of humic acid (fig. 1) shows frequencies ranging from 524.64 cm^{-1} to 3417.86 cm^{-1}, indicating that there were different groups with different structures of functional groups.

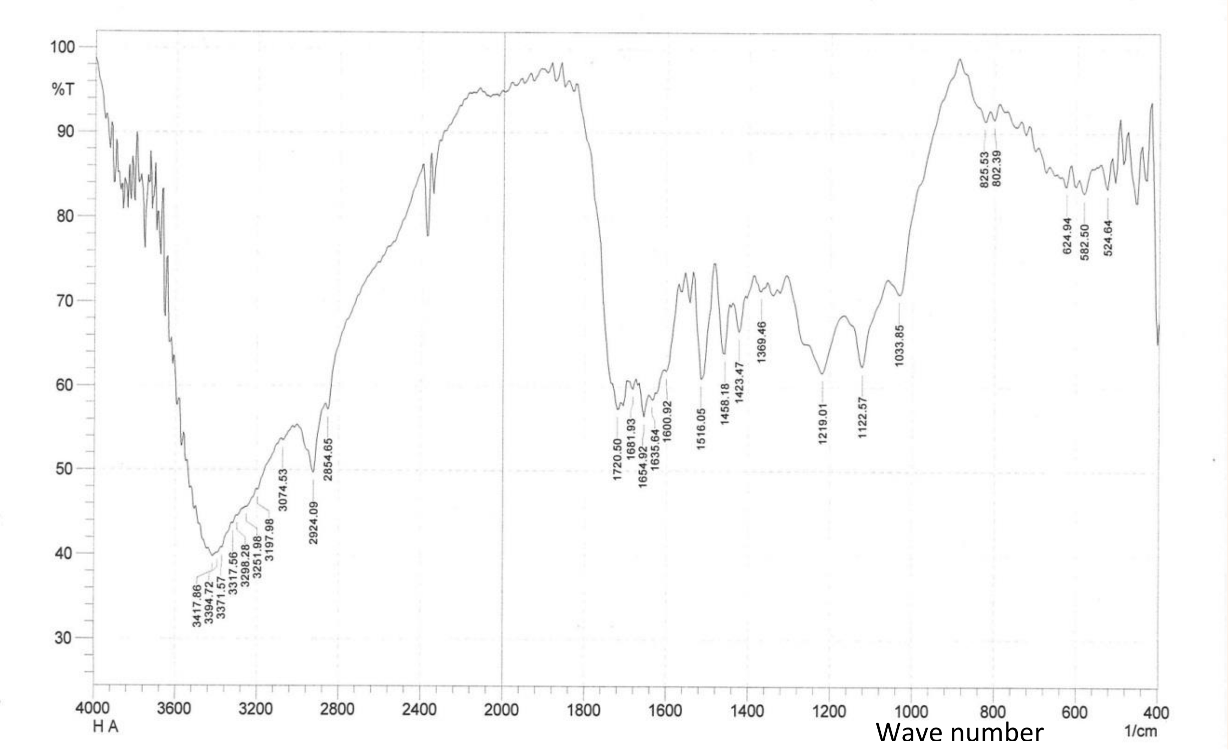

Fig. (1): Infra-red spectra of humic acid extracted from cow manure.

According to Peters *et al.* (1973) O-H groups predominate between 2800 to 3500 cm^{-1} with the dominance of amides, amines and alcoholic groups. The spectra intensity of spectrum at 2000 cm^{-1} indicates the presence of ring type structures (C=C). The emergence of beams at the spectrum 1720.50 cm^{-1} indicates the presence of compounds with C=O and aliphatic compounds, while at 1681.93 to 1516.05 cm^{-1} are structures of type C=C. The spectral bands ranging from 1458.18 to 802.39 cm^{-1} are compounds, containing C-H, usually methyl, methylene and isopropyl.

The spectra of infrared radiation does not give the chemical composition of organic compounds but gives an idea of the nature and properties of the materials and the structure of the compounds (Stevenson, 1982). The results of IR showed the predominance of cyclic compounds (C=C groups).

Functional Groups of Humic Acid

Table (4) revealed the results of analysis of oxygen- containing functional groups of humic acid (total acidity, carboxylic, phenolic , alcoholic and total hydroxyl groups), which reached 7.20, 4.30, 2.90, 4.30 and 7.20 meq gm^{-1}, respectively. This results in agreement with the results of Al-Tameemi (1997), Ahmed *et al*. (2006), Ferrara & Brunetti (2008), Madhavi (2014) and Eshwar *et al*. (2017). The difference in the total acidity values of humic acid is due to the differences in the concentration of functional groups of carboxylic and phenolic groups. The high values of total acidity are evidence of ability of humic acid to adsorb nutrients, heavy metals, high cation exchange capacity and retention of water (Tan, 2003).

Table (4): Functional groups of humic acid extracted from cow manure.

Functional groups	Value ($meq\ gm^{-1}$)
Total acidity	7.20
Carboxylic groups COOH	4.30
Phenolic OH	2.90
Alcoholic OH	4.30
Total OH	7.20

Results of humic acid analysis showed that concentration of phenolic groups (2.90 $meq\ gm^{-1}$) was less than carboxylic groups (4.30 $meq\ gm^{-1}$), this explains that carbohydrate and phenolic compounds had been transformed to carboxylic groups through oxiclation process (Eshwar *et al*., 2017). The role of phenolic groups in the nutrients chelation is less important than carboxylic groups because of its ionization at pH>9 (Schnitzer, 1986). Both carboxylic and phenolic groups accounted for 59.72 % and 40.28 % of total acidity of humic acid, respectively .

The concentration of alcoholic groups and hydroxyl groups of humic acid were 4.30 and 7.20 $meq\ gm^{-1}$, respectively. Al-Tameemi (1997) found that their concentration in humic acid were 4.90 and 7.35 $meq\ gm^{-1}$, respectively. Alcoholic and hydroxyl groups are less important than carboxylic and phenolic groups in their reactions with colloids and nutrients because they are usually associated with side chains of humic acid (Gamble, 1988).

Effect of Rate and Type of Nitrogen Fertilizer, and Time of Incubation on Ammonia Volatilization

Results in fig. 2 and 3 indicate that there were a significant differences in the amount of volatile ammonia with different nitrogen rates applied to sandy and clay loam soils. The amounts of volatile ammonia at rate 0, 125, 250 and 500 mg N kg^{-1} soil were 0, 2.603, 3.776 and 8.183 mg NH$_3$-N kg^{-1} for sandy soil and 0.247, 1.923, 2.406 and 3.696 mg NH$_3$-N kg^{-1} for clay loam soil, respectively. These results were agreed with the results finding **by Abdul-Kareem (2006), Alberto *et al*. (2010), Ma *et al*. (2010).**

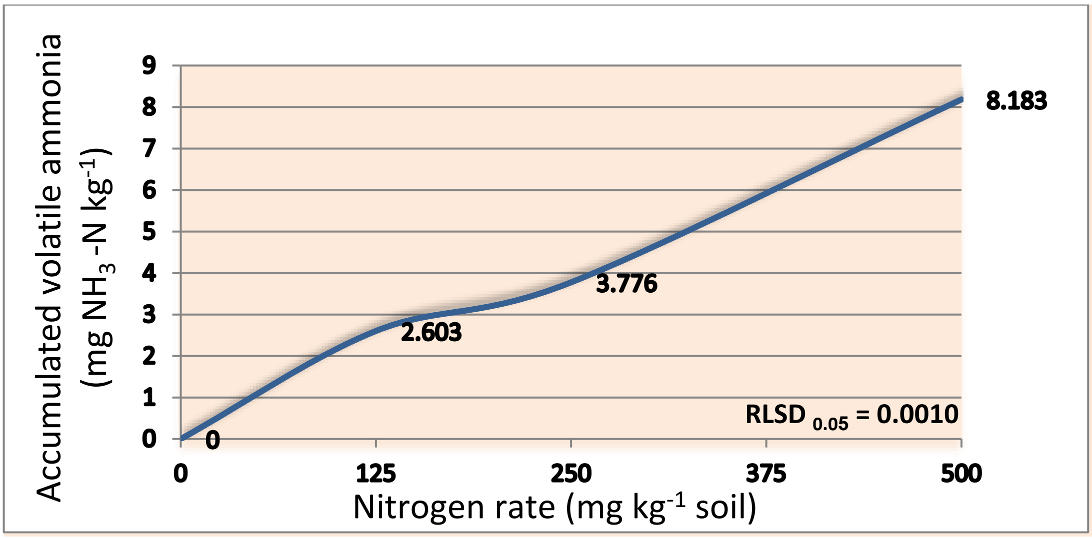

Fig. (2): Effect of nitrogen rate on accumulated ammonia volatilization in sandy soil.

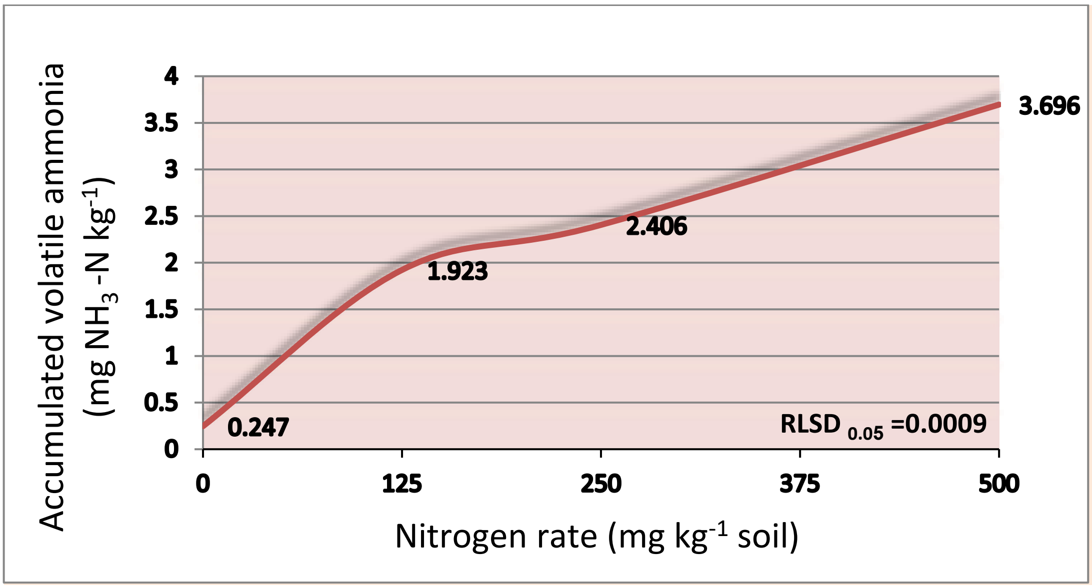

Fig. (3): Effect of nitrogen rate on accumulated ammonia volatilization in clay loam soil.

Figs. (4 and 5) revealed effect of incubation periods on ammonia volatilization in sandy and clay loam soils, respectively. The results showed a significant differences between incubation periods (3, 6, 12, 24 and 48 days) to reached 0.109, 1.278, 3.263, 4.001 and

9.550 *mg* NH_3- *N* kg^{-1} for sandy soil and 0.019, 0.071, 1.185, 3.269 and 5.797 *mg* NH_3-*N* kg^{-1} for clay loam soil, respectively. This is due to the increase in fertilizer hydrolysis by urease enzyme and release of nitrogen then losing a part of it by volatilization. The lowest value of volatilization was after 3 days, while the highest value was after 48 days, and ammonia volatilization was higher in sandy soil than clay loam soil.

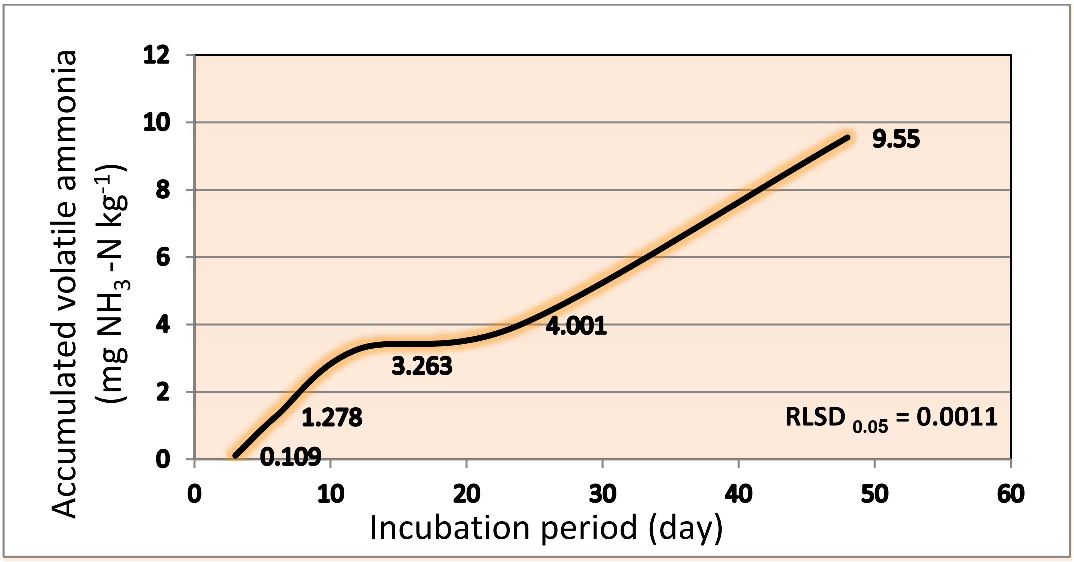

Fig. (4): Effect of incubation period on accumulated ammonia volatilization in sandy soil.

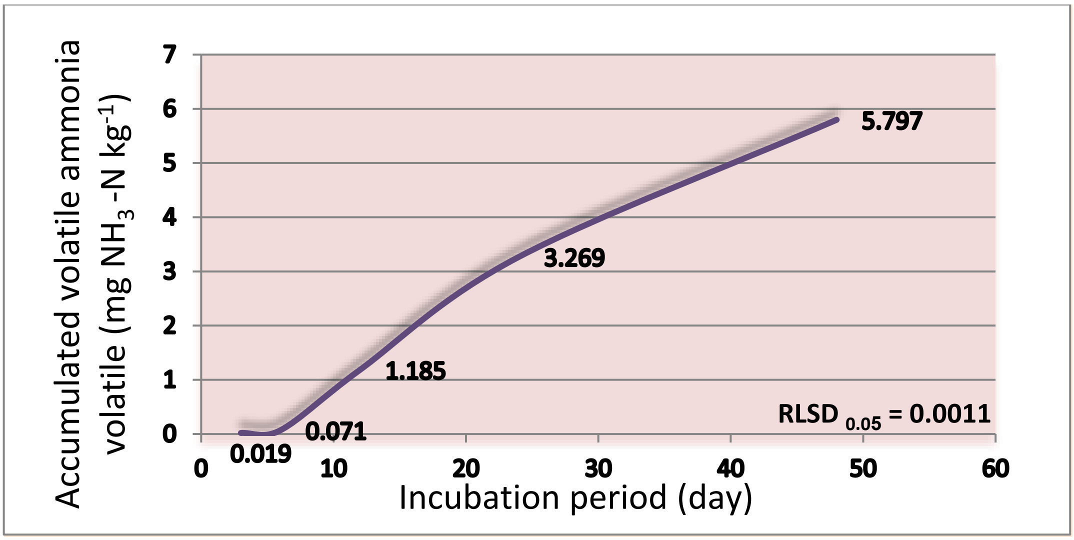

Fig. (5): Effect of incubation period on accumulated ammonia volatilization in clay loam soil.

Fig. (6 and 7) showed high significant effect of type of nitrogen fertilizer on amount of volatile ammonia for sandy and clay loam soils. It was reached 10.673, 0,062 and 0.187 mg NH_3- N kg^{-1} soil for urea and chelate fertilizers HA1-N and HA2-N respectively for sandy soil and 6.027, 0.041 and 0.137 mg NH_3- N kg^{-1} soil for clay loam soil respectively. The decrease in the amount of volatile ammonia for two chelate humic acid fertilizers were 99.42 % and 98.25 % for sandy soil and 99.32 % and 97.73 % for clay loam soil, respectively.

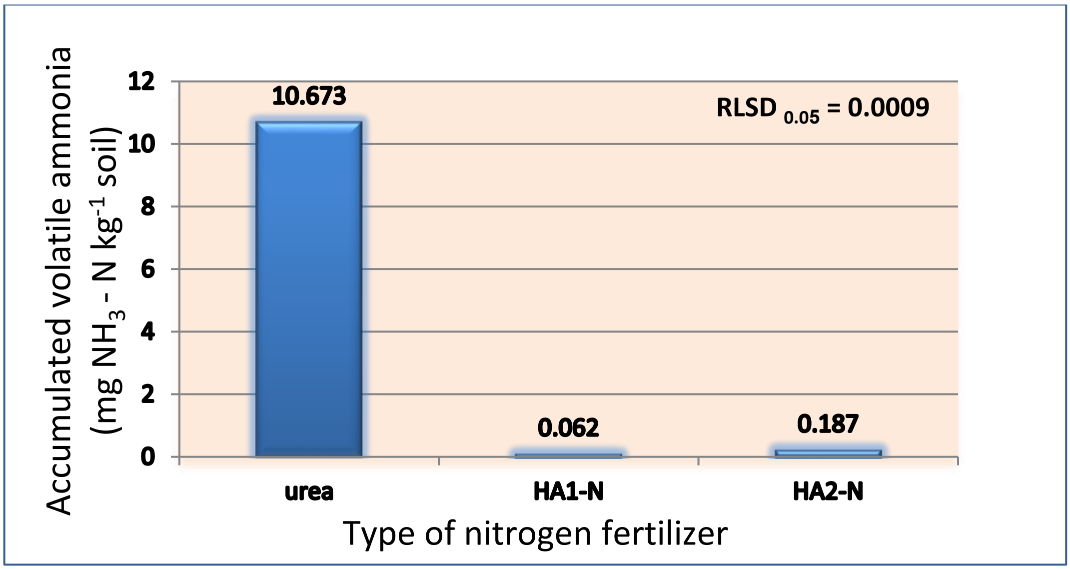

Fig. (6): Effect of type of nitrogen fertilizer on accumulated ammonia volatilization in sandy soil.

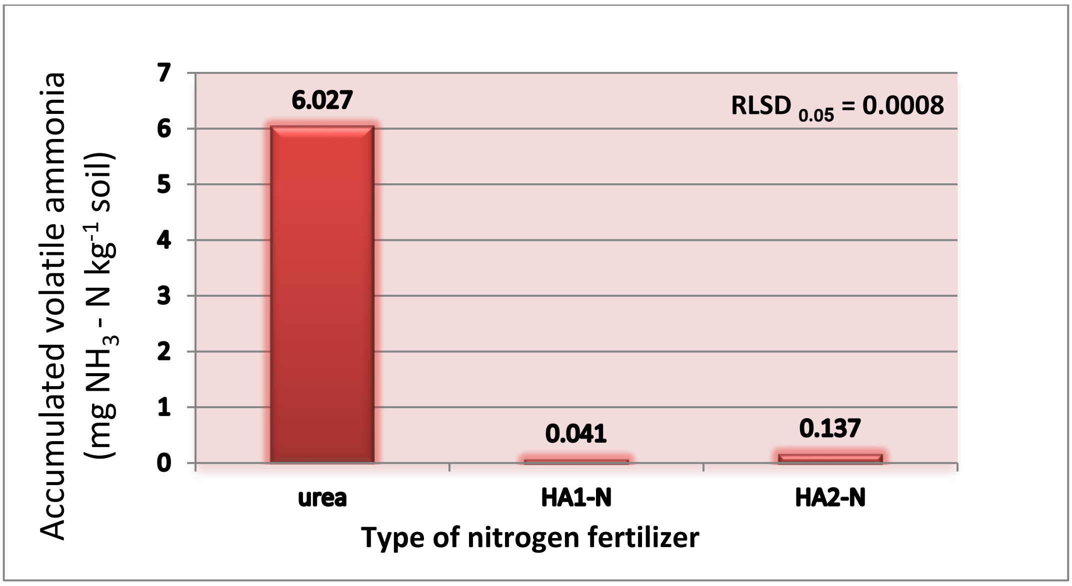

Fig. (7): Effect of type of nitrogen fertilizer on accumulated ammonia volatilization in clay loam soil.

This is due to the nature and composition of materials used in preparation of two chelate fertilizers, which are rich with functional groups which have ability to chelate and adsorb ammonium ions and reduce its loss by volatilization. These results agree with the results finding by Al-Tameemi *et al*. (2014). Results in tables (5 and 6) displayed the effect of interaction between rate of nitrogen fertilizer and incubation period on the amount of volatile ammonia. The highest amount of volatile ammonia was in sandy and clay loam soils after 48 days and at rate 500 mg N kg^{-1} soil to reached 21.427 and 9.736 mg NH3- N kg^{-1} soil, respectively with a significant differences between rates of nitrogen fertilizer. The results also showed (table 5 and 6) that ammonia volatilization started after 24

Table (5): Effect of interaction between nitrogen fertilizer rates and incubation periods on amount of volatile ammonia (mg NH3- N kg^{-1} soil) from sandy soil.

Rate of nitrogen (mg kg^{-1}) Incubation periods (day)	Amount of volatile ammonia (mg NH3- N kg^{-1} soil)				RLSD 0.05 (Rate of nitrogen X Incubation periods)
	0	125	250	500	
3	0	0.112	0.137	0.187	
6	0	0.663	1.605	2.843	
12	0	1.725	3.533	7.794	
24	0	3.423	3.920	8.663	
48	0	7.090	9.682	21.427	
RLSD 0.05 (Rate of nitrogen X Incubation periods)					0.0023

Table (6): Effect of interaction between nitrogen fertilizer rates and incubation periods on amount of volatile ammonia (mg NH3- N kg^{-1} soil) from clay loam soil.

Rate of nitrogen (mg kg^{-1}) Incubation periods (day)	Amount of volatile ammonia (mg NH3- N kg^{-1} soil)				RLSD 0.05 (Rate of nitrogen X Incubation periods)
	0	125	250	500	
3	0	0	0	0.075	
6	0	0	0.071	0.214	
12	0	1.287	1.344	2.108	
24	0.500	2.935	3.292	6.349	
48	0.733	5.395	7.322	9.736	
RLSD 0.05 (Rate of nitrogen X Incubation periods)					0.0021

days in clay loam soil for control treatment, while no volatilization occurred until 48 days in sandy soil. This is due to the properties of both studied soils (Table 2). Application of nitrogen fertilizer encouraged ammonia volatilization in sandy soil at higher rate than clay loam soil, especially at the rate of 500 mg N kg^{-1} soil due to ability of clay loam soil to adsorb and held of ammonium and reduce its loss by volatilization. Tables (7 and 8) showed a significant effect of interaction between type of nitrogen fertilizer and its rate on ammonia volatilization from both studied soils. The highest amount of volatile ammonia from urea fertilizer at 500 mg N kg^{-1} soil reached in sandy soil 24.050 mg NH3- N kg^{-1} soil and clay loam soil 10.738 mg NH3- N kg^{-1} soil, while the lowest values were achieved with HA1-N at rate 500 mg N kg^{-1} soil to reached 0.168 mg NH3- N kg^{-1} soil for sandy soil and 0.112 mg NH3- N kg^{-1} soil for clay loam. The per cents of decrease in the amount of ammonia volatile at rate 500 mg N kg^{-1} soil for HA1-N and HA2-N fertilizers as compared with urea fertilizer in sandy soil were 99.30 % and 98.62 % , respectively and 98.96 % and 97.77 % for clay loam soil, respectively. Fertilizers were taken the

Table (7) : Effect of interaction between type of nitrogen fertilizer and its rate on the amount of volatile ammonia in sandy soil.

Type of nitrogen fertilizer Rate of nitrogen (mg kg^{-1})	Amount of volatile ammonia (mg NH3- N kg^{-1} soil)			RLSD $_{0.05}$ (Type of nitrogen fertilizer X Rate of nitrogen)
	Urea	HA1-N	HA2-N	
0	0	0	0	
125	7.627	0	0.180	
250	11.014	0.078	0.235	
500	24.050	0.168	0.331	
RLSD $_{0.05}$ (Type of nitrogen fertilizer X Rate of nitrogen)				0.0018

Table (8): Effect of interaction between type of nitrogen fertilizer and its rate on the amount of volatile ammonia in clay loam soil.

Type of nitrogen fertilizer Rate of nitrogen (mg kg^{-1})	Amount of volatile ammonia (mg NH3- N kg^{-1} soil)			RLSD $_{0.05}$ (Type of nitrogen fertilizer X Rate of nitrogen)
	Urea	HA1-N	HA2-N	
0	0.740	0	0	
125	5.645	0	0.125	
250	6.983	0.052	0.183	
500	10.738	0.112	0.239	
RLSD $_{0.05}$ (Type of nitrogen fertilizer X Rate of nitrogen)				0.0016

following order in reducing the amount of volatile ammonia: HA1-N > HA2-N > Urea. Results in tables (9 and 10) indicated the significant effect of interaction between type of nitrogen fertilizer and incubation periods

Table (9): Effect of interaction between type of nitrogen fertilizer and incubation periods on the amount of volatile ammonia in sandy soil.

Type of nitrogen fertilizer Incubation periods (day)	Amount of volatile ammonia (mg NH3- N kg^{-1} soil)			RLSD $_{0.05}$ (Type of nitrogen fertilizer X Incubation periods)
	Urea	HA1-N	HA2-N	
3	0.327	0	0	
6	3.815	0	0.019	
12	9.567	0.036	0.187	
24	11.588	0.072	0.345	
48	28.067	0.201	0.382	
RLSD $_{0.05}$ (Type of nitrogen fertilizer X Incubation periods)				0.0020

Table (10): The effect of interaction between type of nitrogen fertilizer and incubation periods on the amount of volatile ammonia for clay loam soil.

Type of nitrogen fertilizer / Incubation periods (day)	Amount of volatile ammonia (mg NH3- N kg^{-1} soil)			RLSD$_{0.05}$ (Type of nitrogen fertilizer X Incubation periods)
	Urea	HA1-N	HA2-N	
3	0.056	0	0	
6	0.208	0	0.006	
12	3.419	0	0.135	
24	9.561	0	0.247	
48	16.890	0.206	0.294	
RLSD$_{0.05}$ (Type of nitrogen fertilizer X Incubation periods)				0.0018

Table (11): Effect of interaction between type of nitrogen fertilizer, its rate and incubation period on ammonia volatilization in sandy soil.

Type of nitrogen fertilizer	Incubation periods (day)	Amount of volatile ammonia				RLSD$_{0.05}$ (Type of nitrogen fertilizer X Incubation periods X Rate of nitrogen)
		Rate of nitrogen (mg kg^{-1})				
		0	125	250	500	
Urea	3	0	0.336	0.412	0.560	
	6	0	1.990	4.816	8.456	
	12	0	4.947	10.360	22.960	
	24	0	9.953	11.312	25.088	
	48	0	20.911	28.170	63.186	
HA1-N	3	0	0	0	0	
	6	0	0	0	0	
	12	0	0	0	0.143	
	24	0	0	0	0.286	
	48	0	0	0.392	0.411	
HA2-N	3	0	0	0	0	
	6	0	0	0	0.075	
	12	0	0.229	0.240	0.280	
	24	0	0.315	0.448	0.616	
	48	0	0.358	0.485	0.685	
RLSD$_{0.05}$ (Type of nitrogen fertilizer X Incubation periods X Rate of nitrogen)						0.0039

on the amount of volatile ammonia in two studied soils. The results show that increasing the incubation periods increase the amount of volatile ammonia due to increase in fertilizers hydrolysis. Ammonia volatilization from urea fertilizer was started after three days in both soils, but it was started after six days for sandy soil and after 24 days for clay loam soil for HA1-N. The highest values of ammonia volatilization was started after 48 days for urea to reached 28.067 mg NH3- N kg^{-1} soil in sandy soil and 16.890 mg NH3- N kg^{-1} soil for clay loam soil.

Results in tables (11 and 12) demonstrated the significant effect between type of nitrogen fertilizer and its rate and incubation periods on the amount of volatile ammonia in two studied soils. Ammonia volatilization was begun after three days of incubation from urea in sandy soil, and ammonia volatilization increased with increasing of nitrogen rate, while ammonia volatilization was started after 12 days of incubation for HA1-N and after 6 and 3 days at rates 250 and 500 *mg N kg^{-1}* soil from urea for clay loam soil, respectively. HA1-N didn't volatile ammonia at 125 *mg N kg^{-1}* soil till 48 days of incubation in both studied soils. Ammonia volatilization was higher in sandy soil than clay loam soil at all rates of nitrogen and all types of fertilizers and incubation periods (table 11 and 12).

Table (12): Effect of interaction between type of nitrogen fertilizer, its rate and incubation period on ammonia volatilization in clay loam soil.

Type of nitrogen fertilizer	Incubation periods (day)	Amount of volatile ammonia (mg NH3- N kg^{-1} soil)				RLSD 0.05 (Type of nitrogen fertilizer X Incubation periods X Rate of nitrogen)
		Rate of nitrogen (mg kg^{-1})				
		0	125	250	500	
Urea	3	0	0	0	0.224	
	6	0	0	0.212	0.618	
	12	0	3.725	3.850	6.100	
	24	1.500	8.580	9.542	18.620	
	48	2.200	15.920	21.310	28.130	
HA1-N	3	0	0	0	0	
	6	0	0	0	0	
	12	0	0	0	0	
	24	0	0	0	0	
	48	0	0	0.261	0.561	
HA2-N	3	0	0	0	0	
	6	0	0	0	0.025	
	12	0	0.135	0.182	0.224	
	24	0	0.225	0.335	0.428	
	48	0	0.265	0.396	0.516	
RLSD 0.05 (Type of nitrogen fertilizer X Incubation periods X Rate of nitrogen)						0.0036

Conclusions

The improvement of two kinds of chelated fertilizer from humic acid derived from cattle manure, one of them was humic acid with composted plant residues (HA1-N) and the other was humic acid with zeolite mineral (HA2-N) with different N ratios can significantly reduce nitrogen volatilization as compared with urea fertilizer.

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References

Abdulkareem, M.A. (2006). Role of some plant extracts on urease activity, urea transformations in soils, and barley growth. Ph. D. Thesis, Coll. Agric., Univ. Basrah: 211pp.

Ahmed, O.H.; Aminuddin, H. & Husni, M.H.A. (2006). Effects of urea, humic acid and phosphate interactions in fertilizer microsites on ammonia volatilization and soil ammonium and nitrate contents. Int. J. Agric. Res., 1(1): 25-31.

Alberto, C.C.B.; Mota, E.P.; Souza, S.C.H.; Cardoso, R.D. & Oliviera, P.P.A. (2010). Ammonia volatilization, dry matter yield and nitrogen levels of Italian ryegrass fertilized with urea and zeolite. 19th World Congress of Soil Sci., Soil Solutions for a Changing World. 1-6 August, Brisbane, Australia.

Al-Tameemi, H.J. (1997). The chemical behavior of artificial trace elements chelate producing from humic acids and common fertilizers and their efficiency in some calcareous soils. M. Sc. Thesis, Coll. Agric., Univ. Basrah: 203pp.

Al-Tameemi, H.J.; Ashoor, N.I. & Al-Auqbi, S.J. (2014). Effect of humic acid on ammonia volatilization from some calcareous soils. Int. J. Bioflux Soc., 6(3): 163-168.

Barker, A.V. & Bryson, G.M. (2007). Nitrogen. 21-50. In: Barker, A.V. & Pilbeam, D.J. (Eds.). Handbook of Plant Nutrition. CRC Press. 773pp.

Black, C.A. (1965). Methods of soil analysis. American Society of Agronomy, Inc. Pub. Madison, Wisconsin: 1572pp.

Bremner, J.M. (1982). Regular Kjeldahl Methods. 11-33. In: Page, A.L.; Miller, R.H. & Keeney, D.R. (Eds.). Methods of soil analysis Part (2). 2nd ed. ASA. Inc. Madison, Wisconsin: 1158pp.

Bundick, H.; Bruulsema, T.; Hunter, M.; Lawrence, J.; Czymmek, K. & Ketterings, Q. (2009). Enhanced efficiency nitrogen sources. Agronomy Fact Sheet Series (Fact Sheet 45). 2pp. http://nmsp.cals.cornell.edu/publications/factsheets/factsheet45.pdf.

Cresser, M.S. & Parsons, J.W. (1979). Sulfuric -perchloric acid digestion of plant material for the determination of nitrogen, phosphorus, potassium, calcium and magnesium. Anal. Chim. Acta, 109(2): 431-436.

Eshwar, M.; Srilatha, M.; Rekha, K.B. & Sharma, H.K. (2017). Characterization of humic substances by functional groups and spectroscopic methods. Int. J. Curr. Microbiol. App. Sci., 6(10): 1768-1774.

Fan, M.X. & Mackenzie, A.F. (1993). Urea and phosphate interactions in fertilizer microsites: Ammonia volatilization and pH changes. Soil Sci. Soc. Am. J., 57: 839-845.

Ferrara, G. & Brunetti, G. (2008). Influence of foliar applications of humic acids on yield and fruit quality of table grape cv. Italia. J. Int. des Sciences de la Vigne et du Vin, 42(2): 79-87.

Gamble, S.D. (1988). Atrazine hydrolysis in aqueous suspensions of humic acid at 25.0 C. Can. J. Chem., 66(10): 2605 - 2617.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice. Hall of Indian Private limited, New Delhi: 214pp.

Kumada K. (1987). Chemistry of Soil Organic Matter. Elsevier, 17: 240pp.

Ma, B.L.; Wu, T.Y.; Tremblay, N.; Deen, W.; McLaughlin, N.B.; Morrison, M.J. & Stewart, G. (2010). On-farm assessment of the amount and timing of nitrogen fertilizer on ammonia volatilization. Agronomy J., 102(1): 134-144.

Madhavi, P. (2014). Effect of biochar and humic acid of fertilizer use and yield of maize (*Zea mays* L.) in alfisols of southern Telangana region of andhrapradesh. M. Sc. Thesis, Coll. Agric. Univ. Rajendranagar, Hyderabad: 366pp.

Page, A.L.; Miller, R.H. & Keeney, D.R. (1982). Methods of Soil Analysis. Part 2, 2nd edn. Agron. 9, Pub. Madison Wisconsin: 1158pp.

Papanicolaou, E.P. (1976). Determination of cation exchange capacity of calcareous soils and their percent base saturation. Soil Sci., 121: 65 -71.

Peters, C.D.; Zion, M.S. & Wood, E.F. (1973). A soil vegetation atmosphere transfer scheme for modeling spatially variable water and energy balance processes. J. Geophys. Res., 102: 4303-4324.

Prasad, R. & Power, J.F. (1997). Soil Fertility Management for Sustainable Agriculture. Boca Raton. New York: 384pp.

Richards, L.A. (1954). Diagnosis and Improvement of Saline and Alkali Soils. Agric. Handbook No. 60. U. S. Dept. Agric. Washington D. C.: 160pp.

Schnitzer, M. (1977). Recent findings on the characterization of humic substances extracted from soils from widely differing climatic zones. In Soil Org. Matter Stud.. Int. Atomic Energy Agency, Vienna, II: 117-132.

Schnitzer, M. (1986). Organic Matter Characterization. 581- 594. In: Page A.L.; Miller, R.H. & Keeney, D.R. (Eds.). Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. 2nd edn. Soil Sci. Soc. Am., Madison: 1158pp.

Schnitzer, M. & Khan, S.U. (1972). Humic substances in the environment. Marcel Dekker, New York.: 327pp.

Stevenson, F.J. (1982). Humus Chemistry. Genesis. John Wiley & Sons, New York: 512/ 443pp.

Tan, K.H. (2003). Humic Matter in Soil and Environment. Principles and Controversies, Marcel Dekker, Inc., New York: 495pp.