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EFFECT OF AQUEOUS PLANT EXTRACTS TO REDUCE AMMONIA VOLATILIZATION FROM FERTILIZERS SOIL

ASAAD A. SFOOK[1] & RAZZAQ GH. NEGHAMISH[2]

[1]Ministry of Education, Directorate General of Education in Dhi Qar, Iraq

[2]College of Agriculture, The Qar University, Iraq

ABSTRACT

There are many plants extract and many chemical compounds were decreasing volatile ammonia from the soil after adding Nitrogen fertilizer. In this study test many plants extract to know the ability this extracts on decreasing ammonia volatilization with many concentration (1.5 , 3 , 4.5) ml/100 g soil and *Hydroquinone* used to same aim .

The result explained all treatment of plant extracts and *Hydroquinone* compound with 1.5 ml/100 g soil and 2.5 mg/100 g soil respectively. Caused decreasing ammonia volatilization $p<0.05$ except plant extract of *Vigna radiata* , caused increasing a significantly different $p<0.05$ to ammonia volatilization compared with control treatment (soil and fertilizer only) in the second experiment used concentration 3 ml/100 g soil and 5 mg/100g soil of *Hydroquinone*. The result explained that the rate of ammonia volatilization were (10.8 , 4.1 , 5 , 13.5 , 4.2 , 4 , 2.8 , 2.7) mg NH_3/100 g soil to *Hydroquinone , Phaseolus vulgaris, Pennisetum americanum, Cinnamomum zeilanicum* Nees, *Eucalyptus camaldulensrs* Dehnl, *Vigna radiata, Matricaria chmomilla and Tribulus terrestis* L. respectively.

All this plant extracts caused a significantly decreasing ammonia volatilization $p<0.05$ except *Hydroquinone* treatment and *Cinnamomum zeilanicum* Nees caused increasing ammonia volatilization compared with control treatment in this concentration 3 ml/100g soil in other experiment used plant extract to the same plants with 4.5 ml/100 g soil and 7.5 mg/100 g soil of *Hydroquinone* in the experiment to know effecting increasing concentration of this plant and *Hydroquinone* an ammonia volatilization the result explained that all plant extracts recorded a significantly different decreasing ammonia volatilization except *Vigna vadiata* the rate of volatile ammonia were (5.6 , 5.5 , 4.8 , 5 , 3.6 , 3.7 , 2.7) mg NH_3/100 g soil to *Hydroquinone , Phaseolus vulgaris, Pennisetum americanum, Cinnamomum zeilanicum* Nees, *Eucalyptus camaldulensrs* Dehnl, *Matricaria chmomilla and Tribulus terrestis* L. respectively, compared with control treatment .

The interaction between treatment and concentration explained that the highest a volatile ammonia got with *Vigna radiata* in the concentration 1.5 ml/100 g soil and was 17.8 mg NH_3/100 g soil and the lowest volatile ammonia was 2.6 mg NH_3/100 g soil to *Hydroquinone* .

There are not any a significant difference at volatile ammonia among the concentration (1.5 , 3 , 4.5) ml/100 g soil and were 5.77 , 5.81 and 5.21 mg NH_3/100 g soil.

KEYWORDS: Reduce Ammonia, Fertilizers Soil

INTRODUCTION

Nitrogen element is very important and essentially to grow plant . The plant needs nitrogen to form protein and some enzyme and hormones. The nitrogen enters with formation process amino acid . The nitrogen moves in the soil profile. Some nitrogen in soil is taken by plant for growing and other of available nitrogen in the soil is leaching after transformation from organic matter to inorganic form as (NH_4^{+1} , NO_3^{-1} , NO_2^{-1}). The NO_3^{-1} leaches with irrigation water or with heavy raining , NH_4^{+1} volatiles after rising PH of soil as NH_3 and some microbes takes nitrogen by immobilization process and other nitrogen volatiles by denitrification process as gases to atmosphere like (N_2 , NO , N_2O) in the logged condition. Some of researcher showed that a lot of nitrogen was losing from nitrogen fertilizers by leaching , volatilization , immobilization and denitrification after addition nitrogen fertilizers (Bundick et al 2010 , Neilson 2006). The enviromental facters effects on nitrogen in soils , (Finck 1992) indicated (50- 70)% of addition nitrogen fertilizer absorption by plant , but (Peoples et al 1995) showed that 50% of addition nitrogen fertilizers are used by plants and the others lossed by erosion , volatilization , denitrification , leaching and immobilization , the yield of crop depends on amounts addition of fertilizer to soil and type of Nitrogen fertilizer and method of application and the time of addition. Urea is one of Nitrogen fertilizer and the most common in the world because it contains (46% N) , cheap , easy manufacturing and more useful to plants (Watson 2000) .

Urea fertilizer was analyzes to CO_2 and NH_3 after addition to soils by urease enzyme (Bremner 1995).

$$NH_2CONH_2 + H_2O \xrightarrow[\text{enzyme}]{\text{Urease}} NH_3 + HCO_3$$

Urea hydrolysis happen to soils by urease enzyme that formed by roots of plant and some microbiology. When the urea add to surface of land be more volatilization from the urea covered with soils . Some of researcher showed an amount of NH_3 volatilization reduce when the soil are tilling and irrigation water solve urea and take it to enter of soil profile, Amount of ammonia volatilization depends on soil properties like, PH , temperature , wind , soil moisture , pressure ,salts of soil (Fenn and Hossner 1995 , Murphy and Ferguson 1997).There are many strategies to reduce volatile ammonia from soil , The first technical is using chemical urease inhibitor (Cavanagh and Halloran 2003) use DCD and get reducing to ammonia.

Showed the nitrapyrin inhibitor caused reducing ammonia from nitrogen compounds but this chemical compounds caused volatilization to inhibitor and damage to plant , animal and human (Frye 2005) so this reason some of researcher is using plant extract to reduce ammonia volatilization from nitrogen fertilizers and gives more safety because all plant extract analyzes to other compounds analyzable and degradation by soil microbes . Some this plant extract used urease enzyme inhibitors (Al-Ansari and Abdul Kareem ; 2010 , Yasin ; 2010 and Neghamish ; 2013)

The aim of research is looking for plants extracts causing inhibitor to urease enzyme and reduce ammonia volatilization from soils.

MATERIALS AND METHODS

- It weighed 100 g from the soil sample and placed in the class.
- Added amount (1.5, 3 ,4.5) ml of plant extract to 100 g soil with field capacity .

- Hydroquinone compound (HQ) added amount (2.5 , 5 , 7.5) mg/100 g soil.
- Urea added to each treatment with amount 0.5 g to class container.
- The field capacity of the soil was (34) ml .
- Uric acid is prepared by the addition 20 g of uric acid to 700 ml of distilled water and the need for heat to dissolve, then add ml 20 mixture tinge 0.099 g Bromocresel green and 0.066 g Methyl Red in 100 ml of distilled water and then we take 20 ml of the mixture and add to the water dissolved in which uric acid then prove PH to 5 by adding NaOH (0.1) N until the solution up to PH = 5, then complete the acid to the liter with distilled water.
- A small plastic containers containing uric acid placed inside the soil and equal size for each plastic containers (10 ml) to each plastic containers.
- close to the provisions of these containers to prevent air to enter and leave period and are observed color of uric acid When is changing green, is titration with HCl (0.02) N change it to red until getting to end of finishing reaction , the size of HCl titration equal the amount of volatile ammonia.

  The acid is altered in plastic containers to constantly be output 0 without any volatile ammonia.

Preparation of Plant Extracts

Various plants were extracted , the ratio (1:10) (plant : water) and entered with sieve openings capacity (1mm) and put 10 gm of dry plant after to flask with size (500) ml The amounts of palm fiber and millet seeds extracts were added to flask amount 10 gm to each one and mixed with 100 ml distilled water and shake for six hours on Mechanical shaker with speed was 160 rpm after mixing and it was taken to filter paper for filtration(what man No.1) to obtain a solution , The solution was kept in the frozen until the test procedure. This solution was the original plant parts used.

Chemical and Physical Properties

- electrical conductivity was measured by conductivity meter to soil paste type (Hanna Ec2014) and by (Richard, 1954).
- Degree of soil reaction (PH),it has been assayed by using advice (PH-meter) of type. Hanna- PH 21 the Method described in (page *et al* 1982).
- Calcium and magnesium estimation was done by using a dough which was (0.01N Na-EDTA) according to Richard 1954) .
- Sodium and potassium were measured by using (flame photometric)(page *et al* 1982).
- Chloride was determined by using calibration method with solution of (0.05 N $AgNO_3$) by (black 1965).
- soil texture was estimated by using hydrometer (Black 1965).
- Organic matter :was estimated according to walkley and black according to (page *et al* 1982) by its oxidation with potassium dichromate and the presence of (H_2SO_4). Organic material was calculated by multiplying organic carbon factor with 1.724.

- Bulk density was measured by using (core – volume) according to (black 1965).
- Field Capacity was measured weighting Method .
- The data was analyzed by (Steel and Torrie) (1960) to the experiment with design factorial experiment with complete random design (C.R.D) .

RESULTS AND DISCUSSIONS

Figure 1 explains effect of addition aqueous plant extracts and *Hydroquinone* on decreasing a volatile ammonia from loam soils after addition Nitrogen fertilizers when the concentration of plant extract was 1.5 ml/100 g soil and 2.5 mg/100 g soil . The results explained that the rates of accumulation ammonia volatilization were (2.5 , 4.2 , 4.4 , 5.7 , 3.0 , 17.8 , 3.6 ,5.0) mg NH_3/100 g soil to *Hydroquinone* , *Phaseolus vulgaris, Pennisetum americanum, Cinnamomum zeilanicum* Nees, *Eucalyptus camaldulensrs* Dehnl, *Vigna radiata, Matricaria chmomilla and Tribulus terrestis* L. respectively. Compare with control treatment (6.2) mg NH_3/100 g soil (soil and urea dissolved with water).

All treatment of compound *Hydroquinone* and plant extracts caused a significantly decreasing $P<0.05$ to ammonia volatilization compare with control treatment except *Vigna radiata* caused a significantly increasing ammonia volatilization $p<0.05$ compare with all plant extract treatment , *Hydroquinone* and control treatment .

The treatment *Phaseolus vulgaris* and *Pennisetum americanum* extract have not any significant different t between them .

Some researchers showed that chemical compound caused inhibitor to volatile ammonia from Nitrogen fertilizers after addition to soil like (Al- Ansari and Abdul Kreem 2010 and Neghamish 2013) .

Some of researcher noted that plant extracts caused significantly different in decreasing ammonia volatilization in the soils after addition plant extracts with Nitrogen fertilizers (Ghosh 2002 , Cartarellalla *et al* 2009 , Yasin 2010 , Junejo *et al* 2010 , Neghamish 2013).

The reason of inhibition to ammonia from Nitrogen fertilizers, effecting chemical compounds of the plant extracts caused killing microbes that relationships with urease enzyme or destroy enzyme in the soil and prevent urease from doing on substrate (urea) and prevent Hydrolysis urea to NH_3 and CO_2 so that plant extracts contains many compounds , like phenols, glycoside and sabonins , terpenes and flavonoids all this compound do against microbes in the soil.

Figure 2 explained effect of addition aqueous plant extracts and *Hydroquinone* compound on decreasing a volatile ammonia from soil after 40 days from addition to soil and with concentration 3 ml/100 g soil to plant extracts and 5 mg/100 g soil to *Hydroquinone*.

The results showed that the rates of ammonia volatilization recorded (10.8 , 4.1 , 5.0 , 13.5 , 4.2 , 4.0 , 2.8 , 2.7) mg NH_3/100 g soil to *Hydroquinone* , *Phaseolus vulgaris, Pennisetum americanum, Cinnamomum zeilanicum* Nees, *Eucalyptus camaldulensrs* Dehnl, *Vigna radiata, Matricaria chmomilla and Tribulus terrestis* L. respectively. The rates of volatile ammonia reduced significantly $p<0.05$ To *Phaseolus vulgaris, Pennisetum americanum, Eucalyptus camaldulensrs* Dehnl, *Vigna radiata, Matricaria chmomilla and Tribulus terrestis* L. compared with control treatment (urea only) .

The *Hydroquinone* and *Cinnamomum zeilanicum* Nees recorded significantly increasing volatile ammonia

compared with control treatment when this the concentration 5 mg/100 g soil and 3 ml/100 g soil respectively .

The best treatments in this concentration caused a significantly reduction to volatile ammonia happen with *Matricaria chmomilla and Tribulus terrestis* L

The reason of causing reduction to ammonia volatilization to this extracts were containing them on some different compounds like (phenols, glycoside and sabonins , terpenes , alkalodesand flavonoids) all this compound destroy microbes or urease enzyme these results were similar with results of some researchers worked on effect of plants extracts on ammonia volatilization like (Ghosh 2002 , Junejo 2010 , Yasin 2010 , Rice and Pancholy 1973) all them worked on different plant extracts to prevent and reducing a volatile ammonia from Nitrogen fertilizer in soil .

Figure 3 explained effect of addition plant extracts with concentration 4.5 ml/100 g soil and *Hydroquinone* with concentration 7.5 mg/100 g soil on reduction a volatile ammonia , the results showed that all plant extracts reduced a volatile ammonia significantly $P<0.05$ compare with control treatment and extract of *Vigna radiata* did not cause any reduction to ammonia volatilization. Plant extract of *Phaseolus vulgaris* and *Hydroquinone* have not any significant different with them , and have not significant different between *Eucalyptus camaldulensrs* Dehnl and *Matricaria chmomilla*. The amount of volatile ammonia were (5.6 , 5.5 , 4.8 , 5.0 , 3.6 , 8.0 , 3.7 , 2.7) mg NH_3/100 g soil to *Hydroquinone , Phaseolus vulgaris, Pennisetum americanum, Cinnamomum zeilanicum* Nees, *Eucalyptus camaldulensrs* Dehnl, *Vigna radiata, Matricaria chmomilla and Tribulus terrestis* L. respectively.

Table 2 explained effect of concentrations of many aqueous treatments of plant extract and interaction them with type of plant treatment, *Eucalyptus camaldulensrs* Dehnl, *Matricaria chmomilla and Tribulus terrestis* L. recorded the lowest ammonia volatilization compared with other treatments, *Vigna radiata* recorded the high ammonia volatilization compared with other all types of plant extract reduced of volatile ammonia significantly $p<0.05$.

All treatment with extract and with HQ caused significantly reduction of ammonia volatilization $p<0.05$ compared with water treatment, but *Vigina radiata* and *Cinnamomum zeilanicum* Nees did not cause reduction ammonia volatilization. The intraction between concentractions and types of treatment ammonia volatilization, caused a significantly different $p<0.05$ to treatment *Vigna radiata* with the concentration (1.5) ml/100 g soil and was (17.8) mg NH_3/100 g soil. The lowest ammonia volatilization recorded to *Hydroquinone , Tribulus terrestis* L. and were 2.6 mg NH_3/100 g soil , to concentration 1.5 ml/100 g soil and 2.7 mg NH_3/100 g soil with concentrations (3 , 4.5) ml/100 g soil and because this plants have many compounds like phenol, glycoside, flavonoid, sabonins , terpenene … etc. and their compound caused inhibitor to bacteria that have the relationship with urease enzyme or this compounds destroy urease enzyme this information likes the information with many researchers like (Yacoubi 1988 , Abdul Kareem 2006 , Yasin 2010 , Neghamish 2013).

There are not signification difference among the concentrations (1.5 , 3 , 4.5) ml/100 g soil after addition to soil so this reason the economical cost of extraction made the concentration 1.5 ml/100 g soil, the best among other concentration at reduction ammonia volatilization .

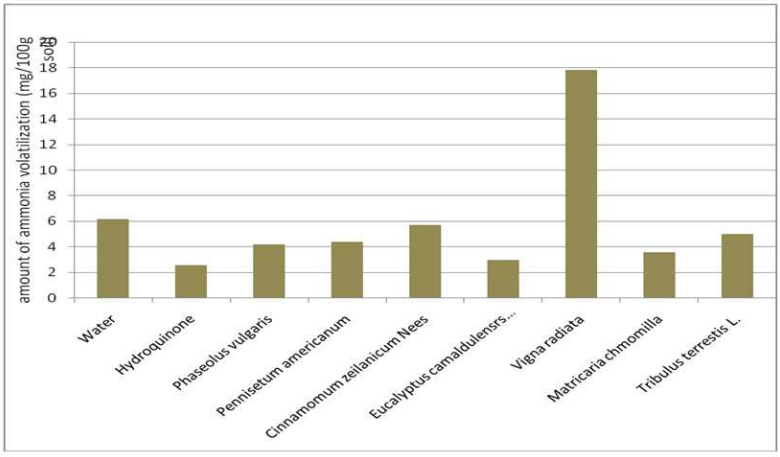

Figure 1: Illustrates the Effect of Plant Extracts and Chemical Compound at Decreasing Ammonia Volatilization with Concentrations 1.5 Ml / 100 G Soil

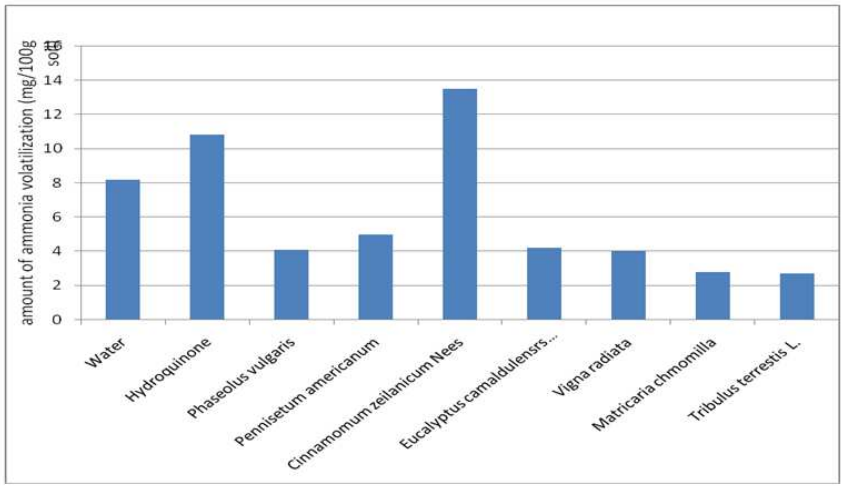

Figure 2: Illustrates the Effect of Plant Extracts and Chemical Compound at Decreasing of Ammonia Volatilization with Concentrations 3 Ml / 100 G Soil

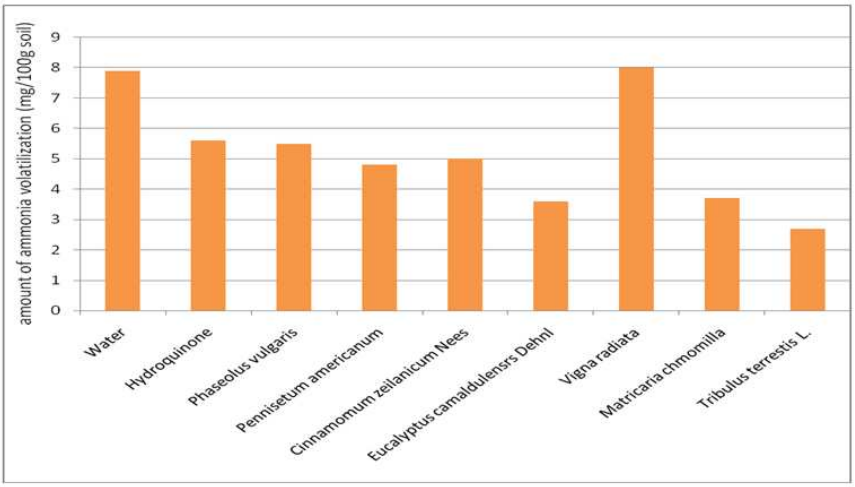

Figure 3: Illustrates the Effect of Plant Extracts and Chemical Compound at Decreasing Ammonia Volatilization with Concentrations 4.5 Ml / 100 G Soil

Table 1: Shows the Chemical and Physical Properties of the Studied Soil

Properties	Values	Units
PH	8.21	
EC	1	ds/m
Na^{+1}	27	mg/L
Ca^{+2}	64	mg/L
Mg^{+2}	21.5	mg/L
K^{+1}	97	mg/L
CO_3^{-2}	0	
HCO_3^{-1}	50.4	mg/L
Cl^{-1}	88	mg/L
Organic matter	1.23	%
Field Capacity	17.5	%
Clay	18.5	%
Silt	45.5	%
Sand	36	%
Soil texture	Loam	
Bulk density	1.34	gm/cm^3

Table 2: Shows the Effect of Aqueous Plant Extracts and Chemical Compound at Decreasing Ammonia Volatilization with Differents Concentrations

Concentration / Treatment	1.5	3	4.5	Mean
Water	6.2	8.2	7.9	7.43
Hydroquinone	2.6	10.8	5.6	6.33
Phaseolus vulgaris	4.2	4.1	5.5	4.62
Pennisetum americanum	4.4	5	4.8	4.66
Cinnamomum zeilanicum Nees	5.7	13.5	5	7.07
Eucalyptus camaldulensrs Dehnl	3	4.2	3.6	3.6
Vigna radiata	17.8	4	8	9.84
Matricaria chmomilla	3.6	2.8	3.7	3.36
Tribulus terrestis L.	5	2.7	2.7	3.46
Mean	5.77	5.81	5.21	

R.L.S.D (t) = 0.89 R.L.S.D (c) = 0.62 R.L.S.D (t*c) = 1.54

0.05 0.05 0.05

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