

EFFECT OF IRRIGATION WATER SALINITY AND TEMPERATURE ON AMMONIA VOLATILIZATION FROM CALCAREOUS SOIL

HANAA ISHO SHAMON and MOHAMMAD SEDQI SALIH MOHAMMED DOHUKI
Dept. of Soil and Water Science, College of Agricultural Engineering Sciences,
University of Duhok, Kurdistan Region-Iraq-Iraq

(Received: June 3, 2021; Accepted for Publication: June 24, 2021)

ABSTRACT

This investigation was done during (January 2020 to July 2020) in the laboratories of the College of Agricultural Engineering Sciences/ University of Duhok/Kurdistan Region-Iraq, to study the influence of five differ irrigation water in their salinity ($EC = dS m^{-1}$) and two temperature degrees (25 and 45) $^{\circ}C$ on nitrogen volatilization from calcareous soil, using closed chamber techniques. The irrigated water (W1= 0.70 $dS m^{-1}$) was natural water from the College well considered as control treatment. While the others were synthesized from W1 which were W2, W3, W4, and W5, with EC values (1.5, 3.0, 4.5 and 6.0) $dS m^{-1}$ respectively, using $MgCl_2$ salt. The soil fertilized with urea 46%N at rate 320KgN ha^{-1} . The soil characterized with [clayey texture, high pH-value, high $CaCO_3$, low organic matter content, low available nitrogen, with CEC (28.6 $Cmol_c Kg^{-1}$ soil)]. The experiment implemented in randomized complete block design (RCBD), with three replicate. The averages were compared using adjusted L.S.D. ($P \leq 0.05$). The results show an increasing in the temperature degrees of incubation significantly increased the nitrogen volatilization as ammonia both accumulated and total amount. Increasing in the water salinity levels increased the soil salinity positively, when negatively affected the amount of nitrogen losses through volatilization. As well as the combined effects of temperature and salinity of the waters found to have significant negative effects on accumulated volatilized ammonia from the soil. The highest amount of total and accumulated losses of ammonia from the soil obtained from the interaction effect between the highest level of water salinity and the highest incubated temperature degree. Also the results shows that the amount of accumulated volatilized ammonia from the soil with the time under the effect of studied factors increased at the beginning and after a period reached to fixed level, and after that there was no nitrogen volatilization from the soil.

KEYWORDS: water salinity, temperature, nitrogen volatilization

1. INTRODUCTION

Nitrogen considered as an essential nutrient for plant growth and development, because it is an important constituents of many cell components. Nitrogen considered as the most lacking nutrient in most cultivated lands over the entire world, due to the requirement of most plants to N is high, as well as it expose to losses from lands by different methods under specific environmental states.

Generally, nitrogen is a plentiful element in the atmosphere, it found in the soil in different forms, as nitrogen gas in the air organic nitrogen e.g. amine, amide and protein, (Frame, 2012 and Huang et al., 2012). The stable form of the nitrogen in the nature is nitrogen gas (N_2) which compost 79% of the air (Weathers et al., 2013). Although the nitrogen exists in the atmosphere in huge quantities but it is found in non-useable form by most organisms and plants,

due i it exist in inert form (N_2). So, it is necessary converted to available form for plant, through biological fixation process from the air (symbiotically and non-symbiotically), lightning from air (Huang et al., 2012), and fixing artificially from atmosphere by Haber-Bosch method (Mosier et al., 2004 and Huang et al., 2012).

The amount of total nitrogen in soils is fluctuated from less than (0.02%) in sub-soils to more than (2.5%) in organic soils, (Havlin et al., (2005). Sabiene et al., (2010), mentioned that about 90% to 98% of the total nitrogen of the soil is related to organic nitrogen source, while the remains 2% is linked to inorganic nitrogen forms in the soil. While Roy et al., (2007), reported that < 5% of the total nitrogen in the soil is exist in form of nitrate and ammonium ions that are accessible to organisms.

Nowadays is urea [$CO (NH_2)_2$] is one of the most common fertilizers used by growers overall

the entire world, due to its high value of nitrogen content (46%N), it is inexpensive compared with other types of nitrogen fertilizers. Roy et al., (2007) and Cameron, et al., (2013), mentioned that it uses widely by the farmers attributed to its inert molecules, high, rapid solubility in the water, and hydrolyze enzymatically to ammonium ions and CO₂ by urease enzyme that acts as a catalyst which exists in plant litters (organic matter) in the soils. The released NH₄⁺ from hydrolyzed urea can transform to NH₃ under specific soil conditions, and lost to the atmosphere when applied to the surface of the land through broadcasting, (Yeomans, 1991).

Bouwman et al., (2002), reported that the amount nitrogen losses from the total added worldwide 78 million tons N per year of inorganic nitrogen fertilizers and total applied of animal manure 33 million tons N per year is [14%N (10–19) %N and 23%N (19–29) % N], respectively. The amount of nitrogen volatilization in developing and industrialized countries as ammonia from applied inorganic fertilizers is expected to be around (18 and 7) % N of the total added N, respectively. The estimated amount of nitrogen losses as ammonia from total animal manure is about (21 and 26) %N in industrialized and developing countries, respectively. This is due to high temperatures and the intense use of urea, ammonium sulfate, and ammonium bicarbonate in that area.

As it is known that soil salinity is one of the most problems in irrigated lands of most countries in arid and semiarid areas, due to climatic changes, that negatively influences plant growth, development, and production, (Zhu, 2001). Because the irrigation water content dissolved salts, when the land irrigation the water evaporates lift the salts behind to accumulate in the soil resulting (building) soil salinity, causes stress to plants due to the effects of (salinity, osmotic, toxicity, and specific) of the salts, in addition to its impact on the soil properties and soil microorganisms activity, urease activity, (Volkmar et al., 1997, Chowdhury, et al., 2011, Morrissey et al., 2014, and Zhang, et al., 2019).

As a result of continuous growth in the human population, their food demands increases, which needed to cultivate the land intensively, continuously, with using high rates of nitrogen fertilizers and irrigating the land with saline water to overcome their requirements from food,

all these affect on the soil productivity, through changes in the soil properties, microbial activity that affect on nitrogen losses from the soil as ammonia.

Therefore, it is necessary to analyze water, identify its quality and its suitability for a given purpose depending on the ionic composition of water before using, (Dohuki, 1997, Dohuki and Esmail, 2000, Esmail, et al., 2007, Ashraf, 2011, Dohuki, et al., 2013, and Rekani, (2013). While Muthanna, (2011), Alexander and Mahalingam, (2011), and Mirza et al., (2012), reported that the water quality has a direct negative impact on soil properties, and soil management, and finally influences plant production. Shirazi et al., (2011) and Dohuki, 1997, Ackah et al., (2011), state that differences in climate factors lead to changes in water quality. Since there is no studies in Iraqi Kurdistan Region about the influence of irrigation water quality or salinity on nitrogen volatilization, for this reason this study was selected to focus on the role of irrigation water salinity in nitrogen volatilization.

2. MATERIAL AND METHODS

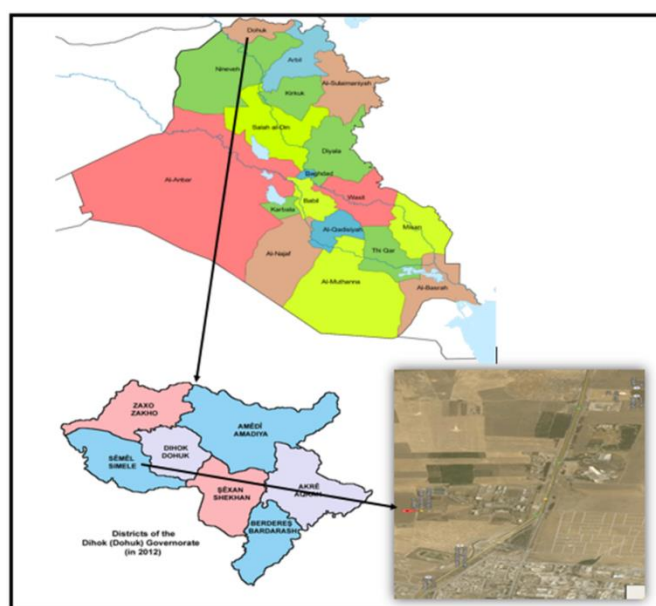
2.1. Collecting and preparation of the soil samples for experimental and analysis

Soil sampling was done randomly, when the sub-samples were collected homogeneously from the depth (0-30) cm from the research field of the College of Agricultural Engineering Sciences/ University of Duhok/ Kurdistan Region-Iraq, Figure (1). The collected soil samples were air-dried, well mixed, divided according to a regular (standards method) process to obtain a representative composite soil sample for the soil in the field. The compound soil sample was sifted through a sieve having (4 mm) slot to represent the soil state in the field.

A given quantity of the compound soil sample ground using a wooden hammer, sieved through a sieve (2 mm) in capacity, then placed in plastic bags and stored in a refrigerator adjusted at (4°C) in the lab. for physiochemical analysis. Some selected physical and chemical properties were analyzed according to (Motsara, and Roy, 2008, Karim, 1999 , Ryan, et al., 2001, and Hesse, 1972) table (1).

Table (1):- Some selected physical and chemical Properties of the soil used in the laboratory Experiment before implementing the experiment.

Soil properties	Units	Value
Sand	$g\ kg^{-1}$	97.60
Silt		361.00
Clay		541.40
Soil Texture	-	Clay
CEC	$Cmol_c\ kg^{-1}$	28.60
Organic matter	$(g\ kg^{-1})$	8.50
Field Capacity	%	34.95
P.W.P.	%	28.68
Calcium Carbonate	$g\ kg^{-1}$	14.14
pH in Soil extract (1:2) at 25°C	-	7.74
EC Soil extract (1:2) at 25°C	$dS\ m^{-1}$	0.302
Available N before experimentation	$mg\ Kg^{-1}$	280.00
Available N after experimentation		500.00

**Fig. (1):-** Site of soil sampling on the map

2.2. The Laboratory Experiment

An experiment was done in the laboratory of the department of the soil and water Sciences / College of Agricultural Engineering Sciences/ University of Duhok/ KRG-Iraq, to study the effect of five irrigated waters differing in their salinity, and under the effect of two different incubation temperature degrees on ammonia volatilization from the fertilized soil with $(320\ kg\ N\ ha^{-1})$ urea fertilizer (46% N), by broadcasting then mixing the added urea with the surface soil.

The Five saline irrigated water used in the experiment were different in their salinity levels which were [(W1= 0.707 which was natural water from the College well-considered as control treatment), the others were (W2= 1.5. W3=3.0, W4=4.5 and W5= 6) $dS\ m^{-1}$

,which prepared artificially from (W1), using $MgCl_2$ depending on the following equation, (welch, 1952).

$$TDS = EC \times F$$

Where: EC = Electrical conductivity in ($dS\ m^{-1}$).

F = Factor equal to 640 this factor is not stable,

Following formula used in saline water preparation:

$$TDS\ mg\ l^{-1} = 0.64 \times EC\ dS\ m^{-1}$$

2.2.1. The soil treatments preparation

For this purpose, transparent plastic containers with dimensions (length 18 width 18 and height 17) cm were used. One kg of the prepared air-dried composite soil sample, which prepared before, soil sieved by a sieve

(4mm) in capacity), was placed in each plastic container (pots). Soil treatment (pots) were fertilized at recommended rate of nitrogen (320 kg N ha^{-1}), (for *corn in the studied region*), (Sebahi, et al., 1991). Urea fertilizer 46%N was used in fertilizing the soil treatments (pots) in one dose, through broadcasting method.

The pots were irrigated to 50% of the filed capacity, in first irrigation, with synthesized irrigation waters different in electrical conductivity (EC) or salinity ($W1=0.70$, $W2=1.5$, $W3=3.0$, $W4=4.5$, and $W5= 6.0$)

d.Sm^{-1} . The pots were incubated in an incubators cabinet, on controlled temperature (25 ± 0.2) °C. The same experiment was repeated as mentioned previously but with changing incubation temperature to (45 ± 0.2) °C). Whenever the soil moisture in the pots lost 75% of its field capacity. The soils were irrigated with the same saline water prepared before. This process was controlled gravimetrically by weighting the pots daily, then irrigate to the required percentage of the 75% field capacity figure (2).

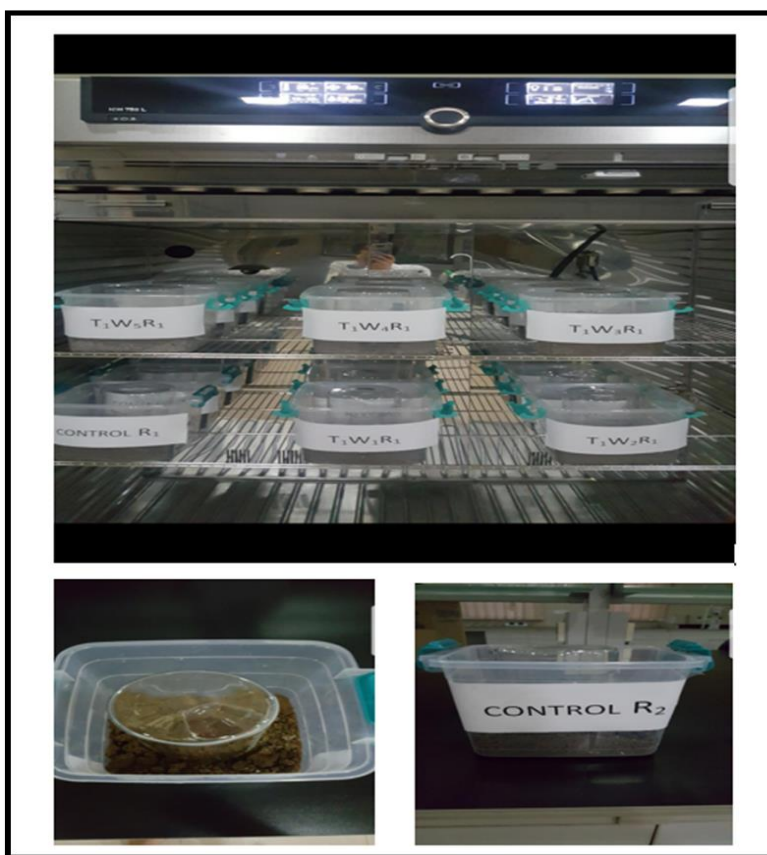


Fig. (2):- A sides of conducted laboratory experiment

2.3. Measurement the Volatilize Nitrogen (NH_3)

A closed chamber technique was used for assessing the volatilized ammonia from the soil in the pots. After packing the soil in transparent plastic pots, the pots were irrigated with five irrigation water different in their salinity levels from prepared saline waters. A beaker with 50ml capacity was placed, containing 20ml Boric acid (4%) and few drops of mixture indicator (Bromocrysol green blue + Methyl red), which changed the color of the solution to pink color in all treated pots.

The treated soil pots and beaker containing boric acid and mixture indicator were covered with transparent plastic containers with covered area (19.625cm^2). The edges of covered plastic containers are closed tightly with the soil in order, to prevent loss out volatilized ammonia from the enclosed area, to trap the volatilized ammonia in the covered plastic containers in order to react with the boric acid in the placed beakers in the pots. After that, the treated pots were incubated in a cabinet calibrated at (25 ± 0.2) °C Figure (3). The same experiment was repeated but this

time incubation at (45 ± 0.2) °C. The experiment was monitored with time whenever the color of the solution in the beakers changed from pink color to blue-greenish color, the beakers were removed and titrated with (0.0143 N) HCl, for measuring the amount of volatilized N, as ammonia. At the same time of removing the first beaker,

another beaker containing boric acid with a mixture indicator was placed in the container and incubation continued for the same treatment and monitored with time. This process continued till reached a state no change event in color of the solution in the beaker, which indicates to that there no more enough nitrogen to be volatilized from the soil.

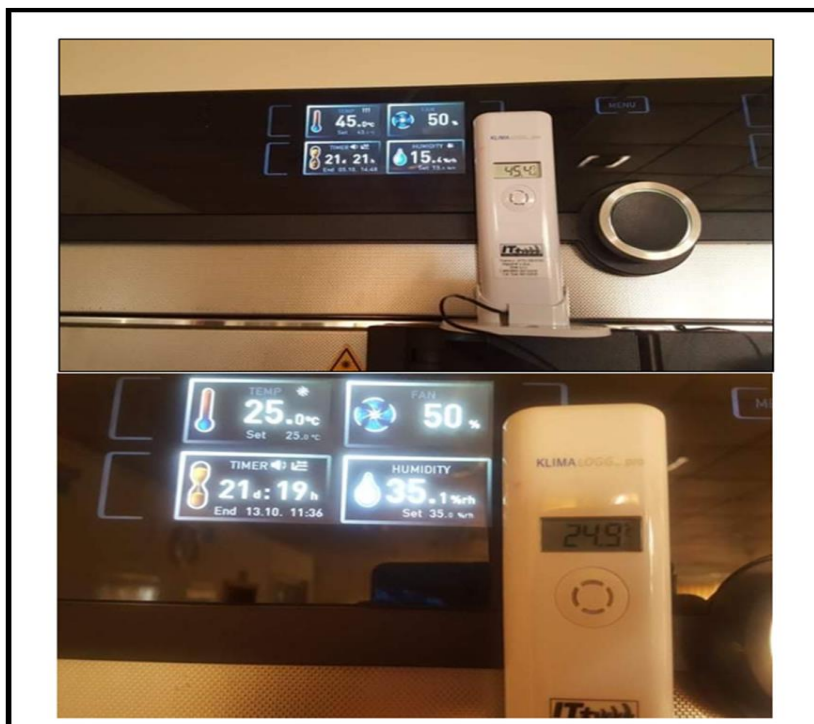


Fig. (3):- Show aside of the process of calibrating the incubator cabinet used in the experiment.

2.4. The Statistical analysis

The obtained data analyzed statistically using Randomized complete block Design (RCBD), three times replicated, and differences between treatments means will calculated using adjusted L.S.D, (0.05), Total No. of treatments = $5 \times 2 \times 3 = 30$ experimental units

The data was analyzed using analysis of variance (Two-way ANOVA) following general linear model (GLM) procedure at $(p < 0.05)$ to identify the significant differences for the selected parameters among studied treatments. Significant differences between treatment means were tested using Fisher's LDS method. The statistical analysis was performed using the Minitab software package 17.

3. RESULTS AND DISCUSSION

3.1. Effect of the saline water and incubated temperature on soli salinity

Table (2) show that the irrigated water salinity, incubated temperature degrees (25 and 45) °C and their interaction, were significantly influenced on studied soil parameters after the experiment at $(p \leq 0.05)$.

Concerning the interaction effect of water salinity and temperature degree 25°C on soil salinity after experiment, table (2) show that the salinity of irrigated water significantly increased the soil salinity, significant differences were found in the value of the soil salinity between soil treatments. Increasing in the salinity of irrigated water caused an increase the soil salinity in all soil treatments in comparing with control treatment (W1). The minimum value of soil salinity was 0.387 dS m^{-1} , recorded in

control treatment with EC value $W1=0.7 \text{ dS m}^{-1}$, while the maximum value of soil salinity was 1.279 dS m^{-1} treatment (W5) when irrigated with irrigation water 6.0 dS m^{-1} .

From the results in the table (2) appear that the interaction effect between temperature degree 45°C and salinity of irrigation water on soil salinity after the experiment, it took the same trend of that incubation under 25°C . Significant differences were recorded between all soil treatments. The lowest value of the soil salinity registered at the interaction treatment of (temperature 45°C and $W1= 0.70 \text{ dS m}^{-1}$) which was 0.358 dS m^{-1} , and the highest value obtained at the interaction treatment (incubation temperature 45°C and $W5= 6.0 \text{ dS m}^{-1}$) which was 1.483 dS m^{-1} .

By comparing the interaction effects of both incubated temperature degrees (25 and 45) $^\circ\text{C}$ and the salinity of irrigated water on the salinity of soil after experimenting. The results indicated

that incubation at temperature 45°C was superior significantly of that at 25°C . The higher soil salinity were 1.483 dS m^{-1} , recorded at treatment when irrigated with saline water $W5=6.0 \text{ dS m}^{-1}$ at temperature degree 45°C , but when treated with the same saline water level but incubated at 25°C the salinity of the soil was 1.279 dS m^{-1} comparing of that incubated at 45°C .

Rely on the effect of the salinity of the irrigated water on the means of the soil salinity after experimenting under incubation temperature degrees 25°C and 45°C . The results demonstrate that the water salinity at both incubated temperatures degrees, affected significantly the soil salinity, which were (0.780 and 0.805) dS m^{-1} respectively. The salinity of the soil increased after the experiment in comparing with the salinity of the soil before the experiment which was (0.302 dS.m^{-1}) table (1).

Table (2):- Effect of the EC values of irrigation water, incubated temperature degrees and their interaction on EC value of the soil

Treatments		Soil parameter
Temperature ($^\circ\text{C}$)	EC values of Irrigation water(dS m^{-1})	EC (dS m^{-1})
25 $^\circ\text{C}$	W1(0.7)	0.387 ^{fg}
	W2(1.5)	0.510 ^e
	W3(3.0)	0.725 ^d
	W4(4.5)	1.000 ^c
	W5(6.0)	1.279 ^b
Mean effect of temp. 25 $^\circ\text{C}$		0.780 ^a
45 $^\circ\text{C}$	W1(0.7)	0.358 ^g
	W1(1.5)	0.460 ^{ef}
	W3(3.0)	0.693 ^d
	W4(4.5)	1.031 ^c
	W5(6.0)	1.483 ^a
Mean effect of temp. 45 $^\circ\text{C}$		0.805 ^a

The treatment in columns with same letters means that there is no significant different between them, at p - value ≤ 0.05

An increasing in the soil salinity after the experiment under the interaction effect of incubation temperature degrees and salinity of the irrigated water attributed to that an increase in incubation temperature degrees will increase the amount of evaporated water and soil dehydration then leading to precipitating more soluble salts from irrigation water, and accumulation in the soil, finally leading to soil salinization. Generally, the soil salinity increased in comparing with its value before experimentation which was (0.302) dS m^{-1} table (1). These results are going with those found by

(Dohuki, 1997, Esmail, 1986, 1992, Baba, 2010, Hashim, 2011, Rekani, 2013, and Dohuki, et al., 2013).

3.2. Effect of the EC values of irrigated water and incubated temperature degrees on ammonia volatilization from the soil

From table (3) appear significant variation in the amount of cumulative volatilized ammonia and total volatilized ammonia from studied soil when treated with irrigation water different in their salinity and incubation under temperature degrees (25 and 45) $^\circ\text{C}$, at ($p \leq 0.05$).

Depending on the interaction effects of the salinity of irrigated water and incubation degrees of temperature (25°C) on the cumulative volatilized ammonia from the soil, significant differences exhibited between most treatments and control treatment (W1=0.70 dS m⁻¹), an increasing the salinity of irrigated water from 0.70 dS m⁻¹ to 6.00 dS m⁻¹ caused decreases in the amount of accumulated volatilized ammonia from both actual (19.625 cm²) area and per hectare. The maximum value of the accumulated volatilized ammonia was recorded at treatment (W1= 0.70 dS m⁻¹) when irrigated with the lowest water salinity level, which was (1.685 mg N 19.625 cm⁻²) and (8.584 Kg N ha⁻¹). While the minimum amount of accumulated volatilized ammonia was obtained when the soil irrigated with irrigation water (W5= 6.0 dS m⁻¹) which was (0.789 mg N 19.625 cm⁻²) and (4.019 Kg N ha⁻¹).

Concerning the effect of studied parameters (waters salinity and temperature degrees of incubation) on the total amount of volatilized nitrogen as ammonia, significant differences were found between studied treatments. The results took the same trend of the accumulated volatilized nitrogen. With increasing the salinity of irrigated waters and incubated degrees of temperature, the total amount of nitrogen losses

from the actual area and per hectare decreased. The highest values of the total amounts of nitrogen losses as ammonia were obtained from treatment (W1) which was (1.283 mg N 19.625 cm⁻²) and (6.539 kg N ha⁻¹), while the lowest value was recorded at treatment W5 when incubated under temperature degree (45°C), which was (0.681 mg N 19.625 cm⁻²) and (3.471 kg N ha⁻¹). The results also indicated that increasing in the temperature degree of the incubation to (45°C) caused increases in the losses of total and accumulated volatilized nitrogen, in comparison of that incubation under temperature degree (25°C).

These decreases in the losses of nitrogen from the soil as ammonia under the effect of irrigation waters having different levels of the EC values and incubation under the different degrees of temperature may be attributed to the effect of the soil salinity which increased with increasing the EC values of the irrigated waters from (W1=0.70 to W5=6.00) dS m⁻¹, that reduces the soil microbial and urease activities, due to increase in the osmotic potential of soil solution with increasing the levels of soil salinity that causes stress to the soil organisms.

Table (3):- Effect of the EC values of irrigation water, incubated temperature degrees and their interaction on nitrogen volatilization

Treatments		Soil parameters			
Temperature (°C)	EC values of Irrigation water (d S m-1)	Cumulative Volatilized N (mg 19.625cm ²)	Cumulative Volatilized (N Kg ha ⁻¹)	Total Volatilized N (mg 19.625cm ⁻²)	Total Volatilized N (Kg ha ⁻¹)
25 °C	W1(0.7)	1.685 ^f	8.584 ^f	0.476 ^e	2.425 ^e
	W2(1.5)	1.358 ^g	6.920 ^g	0.411 ^{ef}	2.092 ^{ef}
	W3(3.0)	1.297 ^g	6.611 ^g	0.397 ^{fg}	2.021 ^{fg}
	W4(4.5)	1.087 ^{gh}	5.541 ^{gh}	0.331 ^g	1.688 ^g
	W5(6.0)	0.789 ^h	4.019 ^h	0.229 ^h	1.165 ^h
Mean effect of temp. 25 °C		1.243 ^b	6.335 ^b	0.369 ^b	1.879 ^b
45°C	W1(0.7)	6.664 ^a	33.957 ^a	1.283 ^a	6.539 ^a
	W2(1.5)	5.628 ^b	28.678 ^b	1.064 ^b	5.421 ^b
	W3(3.0)	4.611 ^c	23.494 ^c	0.863 ^c	4.399 ^c
	W4(4.5)	3.878 ^d	19.761 ^d	0.756 ^d	3.852 ^d
	W5(6.0)	3.411 ^e	17.383 ^e	0.681 ^d	3.471 ^d
Mean effect of temp. 45 °C		4.838 ^a	24.654 ^a	0.930 ^a	4.737 ^a

The treatment in columns with same letters means that there is no significant different between them, at p- value ≤ 0.05

As well the higher amount of nitrogen losses from the soil under the effect of irrigated water salinity at a low degree of incubation (25°C), may be correlated with the degree of temperature (25°C) which may enhances the soil microbial activity and urease activity, that are responsible for organic matter decomposition, and hydrolyzing urea from both added urea and organic matter degradation to ammonium. Soil organisms under these condition suffer from only the stress of soil salinity while when incubated at a higher degree of temperature (45°C) the soil conditions were changed and under these new conditions the soil microorganisms growth and urease activity reduced, due to the stress which resulted from both increasing in the soil salinity and increasing in the temperature degree of the soil, that decreases the rate N transformation and urease activity in hydrolyzing urea to ammonia and its losses from the soil. Perhaps the properties of the studied soil and method of urea application also may enhances N losses as ammonia, (e.g. soil pH value and soil CaCO₃ content, low soil organic matter content at low-temperature degree) table (1). These results are agreed with those found by many researchers, who indicated that the soil factors influence on the microorganisms and urease activity. Therefore, N losses decreased from soil, (Al Rashidi, et al., 1997, Havlin et al., 2005, Ghollarata and Raiesi, 2007, Freire, 2009, Zhenghu and Honglang, 2000, Rousk et al., 2011, Kujur, et al., 2012, Akmal, et al., 2012, Setia et al., 2012, Wen-wen et al., 2019, and Wang, et al., 2020).

Many researchers as well found that increasing in the temperature influences on nitrogen volatilization through enhancement N transformation and hydrolysis of the urea in the soil by urease. This can demonstrate that the soil microbial activity and urease activity influenced by temperature within a given degree of the temperature. When temperature increased to a high level caused stress to soil microorganism and urease activity. Perhaps the losing water from the soil which found to be insufficient for their growth and activities, (Hargrove et al., 1977, Bremmer and Mulvaney, 1978, Titko, et al., 1987 Lai and Tabatabai, 1992, Olesen and Sommer, 1993, Maulood, 1997, Darwesh, 1998, Sander, 1999, Staudinger and Roberts, 2001, Al-Hamdany, 2005, Akmal, et al., 2012, Sharifnia, et al., 2016, and Wahid, 2017).

3.3. Effect of EC value of irrigated water and incubated temperature degrees on ammonia volatilization from soil with time

Figure (4) shows the effect of the accumulated volatilized nitrogen from the studied soil when fertilized with urea fertilizers 46%N under inter action effect of salinity of irrigated waters (W1=0.70, W2=1.50, W3=3.00, W4=4.50, and W5=6.00) dS.m⁻¹, and under incubation temperature degree (25 °C) with time. Generally, the results indicated that with increasing salinity of the irrigated water, the cumulative amount of volatilized ammonia from the soil decreased with the time. A higher amount of accumulated volatilized nitrogen as ammonia measured with the higher level of the irrigation water salinity (W6=6.0 dS m⁻¹) with time, and the lowest value obtained when treated with (W1=0.70 dS m⁻¹). The treatment can be ranked as follows depending on the effect of the salinity of irrigated waters on accumulated N volatilization as ammonia from the soil with time, (W5 > W4 > W3 > W2 > W1). Also the figure (4) show that volatilized ammonia from the soil took place within 9 days of incubation [From date (22-Jan.) to (1- Mar.)/ 2020] under the effect of studied parameters (salinity of irrigated waters and temperature degree (25°C), then decreased with time of incubation after 18 days of incubation [From date (22-Jan.) to (10Mar.)/2020] and a more time within 32 days of incubation [From date(22-Jan.) to (26-Mar./2020] and after 59 days of incubation the amount of volatilized ammonia fixed and there was no or very low amount of volatilized ammonia found, in all treatments. This demonstrate that the salinity of the studied water caused soil salinity and affected on the microorganisms growth and urease activity which are responsible of N transformation and urea hydrolyses as mentioned before. This results are similar with those found by, many researches with small differences may be due to the differences in the effect of studied parameters on ammonia volatilization, (Hargrove et al., 1977, Bremmer and Mulvaney, 1978, Titko, et al., 1987 Lai and Tabatabai, 1992, Olesen and Sommer, 1993, Maulood, 1997, Darwesh, 1998, Sander, 1999, Staudinger and Roberts, 2001, Al-Hamdany, 2005, Akmal, et al., 2012, Sharifnia, et al., 2016, and Wahid, 2017).

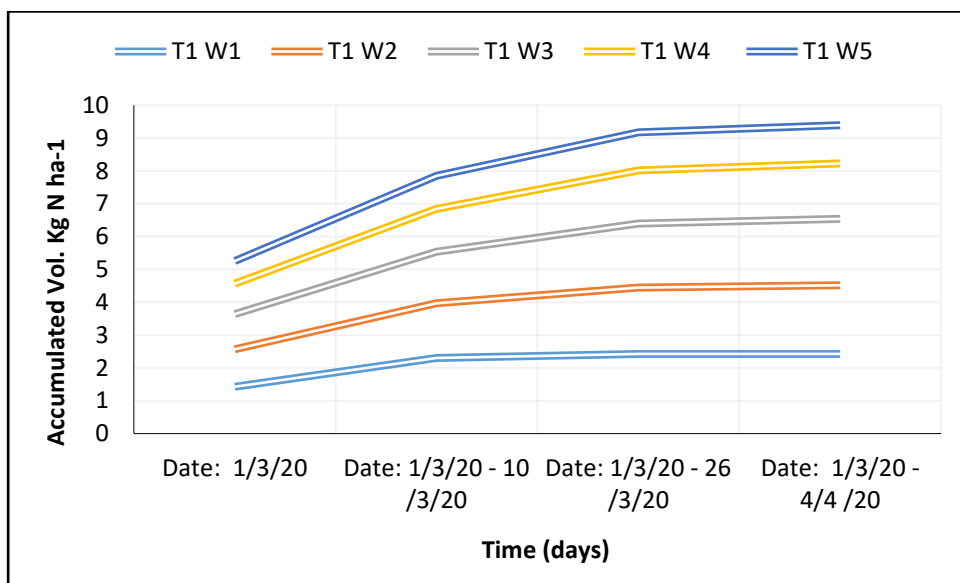


Fig.(4):- Interaction effect of EC value of water and Temperature at 25°C on accumulated Vol. N Kg/1ha with time.

From figure (5) appear the effect of the salinity of the irrigation water when incubated under the temperature degree (45°C) on accumulated volatilized ammonia with time. The results were took the same trend of that incubation under (45°C) with variation in the amount of volatilized ammonia from the soil, and with time of volatilization. The effect of the

salinity of the irrigation water on accumulated volatilized ammonia from the soil can be ranked as follows (W1> W2> W3> W4 > W5), with variation in the time and amount of ammonia volatilization. The results indicated that the incubated temperature degree (45°C), enhanced the ammonia volatilization from added urea to the soil.

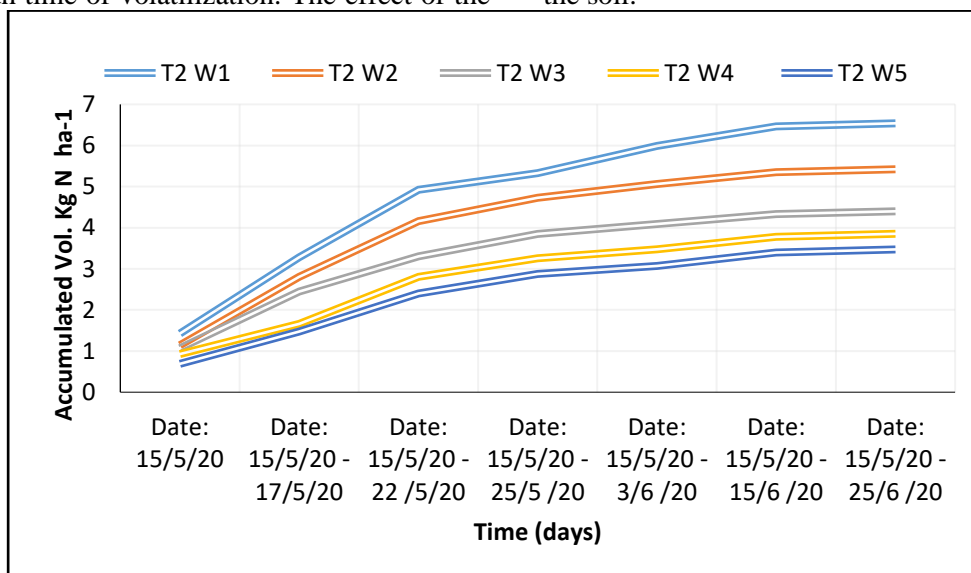


Fig .(5):- Interaction effect of salinity of irrigated water and temperature at 45°C on accumulated Volatilized ammonia with time.

Ammonia volatilization were took place after 3 days of incubation [from date(13-May) to (15-May) /2020], and increased the amount of accumulated volatilized ammonia 5 days of incubation [from date (13-May) to 17-May)/2020] and increased with time of

incubation after 10 days [from (13-May) to(22-May)/2020] and increased after 13 days of incubation [from (13-May) to (25-May)/2020] and continued in increasing after 21 days, after 33 days of incubation fixed, after that no volatilized ammonia found in all treatments,

these attributed to the same reasons mentioned before.

4- CONCLUSION

From this study it can be concluded that ammonia volatilization is a complex process that cannot be expressed simply through study the effect of one factor on nitrogen losses alone, due to interaction between soil, environment and management factors, and nitrogen losses through different processes and forms. The higher temperature degrees (45°C) are more effective on nitrogen losses as ammonia in comparison with low degree of temperature 25°C. The results indicated that irrigating soil with saline water increases soil salinity after implementing the experimental. Increasing in water salinity decreases nitrogen volatilized. The interaction effect of both studied temperature and water salinity levels also decreased nitrogen volatilization from soil.

REFERENCES

- Ackah, M., Agyemang, O. Anim, A. Osei, K. J., Bentil, N.O., Kpattah, L. Gyamfi, E.T. and Hanson, J.E.K. (2011). Assessment of groundwater quality for drinking and irrigation: the case study of Teiman-Oyarifa Community, Ga East Municipality, Ghana. IAEES, 2011, 1(3-4):186-194.
- Akmal, M.; Altaf, M.S.; R.; Hassan, F.U. and Islam, M. (2012). Temporal Changes in Soil Urease, Alkaline Phosphatase and Dehydrogenase Activity in Rain Feb Wheat Field of Pakistan. The Journal of Animal and Plant Sciences. 22(2): 457=462.
- Al- Hamdany, R. I. A. M., (2005). Effect of Sulphur on Ammonia Volatilization from Urea and Sheep Manure Fertilizers in Calcareous Soil. Ph. D. thesis in Soil Fertility and Plant Nutrition. University of Mosul, College of Agricultural and Forestry, Dept. of Soil Sciences. Iraq.
- Alexander, J. J. and Mahalingam, B. (2011). Sustainable tank irrigation: An irrigation water quality perspective. Vol. 4 No. 1 (Jan 2011) ISSN: 0974- 6846.
- Al-Rashid, R.K; A.H. Theiab., and A.H. Al-Ansari. (1997). Urease activity and ammonia volatilization from urea applied to Trickle irrigated Tomatoes. Iraqi. Jor. Agr. Sci. 28:1-8.
- Ashraf, S. (2011). Groundwater Suitability for Irrigation in the Damghan Region, Semnan Province, Iran. Advances in Environmental Biology, 5(10): 3072-3078
- Baba, A. B. A. (2010). The role of chemical composition of some water resources in limiting its suitability for irrigation purpose in sulaimani governorate Kurdistan region. MSc. Thesis. College of Agri. Salahaddin Erbil Univ. Iraq.
- Bouwman, A. F.; Boumans, L. J. M. and Batjes, N. H. (2002). Estimating of global NH₃ volatilization loss from synthetic fertilizers and animal manure applied to arable lands and grasslands. Global Biochemical cycles, Vol.16:NO.2. 1024.
- Bremmer, J.M; and R.L Mulvaney. (1978). Urease activity in soil. Soil Sci. Soc. Am.J. 16:149-196.
- Cameron, K. C.; Di, H. J. and Moir, J. L. (2013). Nitrogen losses from the soil/ Plant system: A review. Annals of Applied Biology, 162(2), Pp.145-173.
- Chowdhury, N., Marschner, P. and Burns, R.G. (2011). Soil microbial activity and community composition: impact of changes in matric and osmotic potential. Soil Biology and Biochemistry, Vol. 43, No 6, (June, 2011), pp. 1229-1236, ISSN: 0038-0717
- Darwesh, D. A. (1998). Effect of some soil properties, Nitrogen Source and Complementary, Irrigation on Ammonia Volatilization and Growth of Wheat. MSc. Thesis, Dept. of Biology, College of science, University of salahaddin-Erbil / KRG/Iraq.
- Dohuki, M. S. S. M. and Esmail, A. O. (2000). Classification of some underground water in Duhok Governorate for Irrigation and drinking Purpose. Journal of Duhok University, Vol.3 No. 2.
- Dohuki, M. S. S. M., Esmail, A. O. and Al-Obaidi, M. A. J. (2013). Effect of water quality on growth and yield of (*Zea mays L.*) in calcareous soil from Erbil provenance in Kurdistan Region- Iraq. J. of university of Kirkuk for Agric. Scie. Vol.4 No. 2- 2013. (in Arabic).
- Dohuki, M-S. S. M. (1997). Evaluation of some wells and springs water in Dohuk Governorate for irrigation and drinking purpose. M.Sc. Thesis. Coll. of Science. Univ. of Salahadin Iraq. (In Arabic).
- Esmail, A. O. (1986). Limitation of some ground water suitability in Erbil plain for different uses. MSc. Thesis. College of Agri. Salahaddin Univ. Iraq. (In Arabic).
- Esmail, A. O. (1992). Effect of composition and ion pair in irrigation water on soil and plant. Ph. D. Thesis, College of Agri. Baghdad Univ. Iraq. (In Arabic).
- Esmail, A. O., Maulood, P. M. and Shekha.(2007). Evaluate Kasnazan impoundment water for irrigation purposes. College of Education. First

- Conference of Biology. Education and Sci. J. Mosul Univ. Vol. (20). No. (2).
- Frame, W.H. (2012). Ammonia Volatilization, Urea Hydrolysis, and Urease Inhibition with the Application of Granular Urea in Agroecosystems. Phd. Dissertation, of Philosophy, Institute and State University of the Virginia Polytechnic.
- Freire, E. de A.; Laime, E.M.M.; Navilta, V. do N.; Lima, V. L. de & Santos, J.S. dos. (2009). Análise dos riscos de salinidade do solo do perímetro irrigado de Forquilha, Ceará. *Revista Educação Agrícola Superior*, Vol. 24, No 2, (December, 2009), pp.62-66, ISSN: 0101-756 X.
- Ghollarata, M. and Raiesi, F. (2007). The adverse effects of soil salinization on the growth of *Trifolium alexandrinum* L. and associated microbial and biochemical properties in a soil from Iran. *Soil Biology and Biochemistry* 39(7):1699-1702.
- Hargrove, W.L.; D.E.Kissel and L.B. Fenn.(1977). Field Measurements of ammonia available soil moisture on crop yield. *Can.J. of plant. Sci.* 43:441-446(C.F. Al-Hadethi 1982).
- Hashim, F.A. (2011). The effect of irrigation water quality on solid- Liquid Phase Behavior of Vertisols in Duhok Governorate. M.Sc.Thesis. Coll. of agri. Univ. of Dohuk. Iraq.
- Havlin, John L; Beaton, James D ;Tisdale, Samauel L and Nelson,Werner L.(2005).*Soil Fertility and Fertilizers, An Introduction to Nutrient Management*. North Caroline State University .Upper Saddle River, New Jersey.
- Hesse, P. R. (1972). A textbook of soil chemical analysis. Chemical publishing Co. INC. New York.
- Huang, P.M, Li, Y and Summer, M. E. (2012). *Handbook of soil science Properties and processes*. 2nd ed. CRC Press, Boca Raton.
- Karim, T. H. (1999). Models to predict water retention of Iraqi soil. *Journal of the Indian Soc. of soil Sci.* 1:16-19.
- Kujur, M., Gartia S. K., and Patel, A. K. (2012). Quantifying the Contribution of Different Soil Properties on Enzyme Activities in Dry Tropical Ecosystem. *Asian Research Publishing Network Journal of Agricultural and Biological Science*.7 (9): 1-10.
- Lai, C.M., and M.A. Tabatabai. (1992). Kinetics parameters of immobilized urease. *Soil Biol. Biochem.*:225-228.
- Maulood, P.M. (1997). Effect of dosage and time of urea application and percentage of available water depleted on ammonia volatilization and corn growth. M Sc. Thesis, Collage of Sciences, University of Salahaddin/ Erbil/ Iraq. (in Arabic).
- Mirza, A.T. M. T. Rahman1, S. H. Rahman1 and R. K. Majumder. (2012). Groundwater quality for irrigation of deep aquifer in southwestern zone of Bangladesh. *Songklanakarin J. Sci. Technol.* 34 (3): 345-352.
- Morrissey E M, Gillespie J L, Morina, J C, Franklin R B. (2014). Salinity affects microbial activity and soil organic matter content in tidal wetlands. *Global Change Biology*, 20, 1351–1362.
- Mosier, A. R.; Syers, J.K.; J.R. and Frency. (2004). Nitrogen Fertilizer: An essential component of increased food, feed, and fiber production, In: A. Mosier, et al. (Eds.), *Agriculture and the nitrogen cycle: assessing the impacts of fertilizer use on food production and the environmental*, Island Press, Washington D.C.pp. 3-15.
- Motsara, M. R., and Roy R. N. (2008). Guide to laboratory establishment for plant nutrient analysis. Food and Agriculture Organization of the United Nations (FAO) fertilizer and plant nutrition bulletin -19. New Delhi India Rome Italy. P: 21.
- Muthanna, M. N. (2011).Quality Assessment of Tigris River by using Water Quality Index for Irrigation Purpose. *ISSN 1450-216X Vol.57 No (1):15- 28.*
- Olesen, J. E., and S.G. Sommer. (1993). Modeling effects of wind speed and surface cover on ammonia volatilization from stored pig slurry. *J. Agri. Sci.* 27:2567-2574.
- Rekani, O. A. O. (2013). Effect of irrigation water quality on some soil chemical properties, phosphorous and maize (*zea mays* L.) Growth. M SC. Thesis in soil fertility, Department of Soil and Water Sciences, Faculty of Agriculture and Forestry, University of Duhok/ Iraq.
- Rekani, O. A. O. (2013). Effect of irrigation water quality on some soil chemical properties, phosphorous and maize (*zea mays* L.) Growth. M SC. Thesis in soil fertility, Department of Soil and Water Sciences, Faculty of Agriculture and Forestry, University of Duhok/ Iraq.
- Rousk, J., Elyaagubi, F. K., Jones, D.L., and Godbold, D. L. (2011). Bacterial salt tolerance is unrelated to soil salinity across an arid agroecosystem salinity gradient. *Soil Biology and Biochemistry*, Vol.(43): 9: Pps. 1881-1887.
- Roy, R.N; Finck, A. ; Blair, G.J. and Tandon, H.L.S.(2007). *Plant nutrition for food security .A guide for integrated nutrient management* ,FAO. Discovery Publishing House , New Delhi-110002.
- Ryan, J., G. Estefan and A. A. Rashid (2001). *Soil and plant analysis Laboratory Manual*. ICARDA, Alippo, Syria, and NARC, Islamabad, Pakistan. (2nd Ed.): 139- 140.
- Sabienè, N.; Kušlienè G. and Zaleckas, E. (2010). The influence of land use on soil organic

- carbon and nitrogen content and redox potential. *Žemdirbystė= Agriculture*, 97(3), pp.15-24.
- Sander, R. (1999). Modeling atmospheric chemistry: interactions between gas-phase species and liquid cloud/aerosol particles. *Surv. Geophys.*:1-31.
- Sebahi, J. H. S. and F. Mowafaq (1991). Uses Chemical fertilizer indicator. Ministry of Agric. and Irrigation. Public Authority for Agricultural Services. Press the General Authority of Survey. (In Arabic).
- Setia, R.M. Smith, P., Marschner, P., Gottschalk, P., Baldock, J., Verma, V., Setia, D., Smith, J. (2012). Simulation of Salinity Effects on Past, Present, and Future Soil Organic Carbon Stocks. *Environ. Sci. Technol.* 2012, 46, 3, 1624– 1631.
- Sharifnia, S., Khadivi, M.A., Shojaemehr, T. and Shavisi, Y. (2016). Characterization, isotherm and kinetic studies for ammonium ion adsorption by light expanded clay aggregate (LECA). *Journal of Saudi Chemical Society*, 20, pp.S342-S351.
- Shirazi, S.M., Z. Ismail, S. Akib, M. Sholichin and M.N. Islam. (2011). Climatic parameters and net irrigation requirement of crops. *International Journal of Physical Sciences*. 6: 15-26.
- Staudinger, J. and Roberts, P.V. (2001). A critical compilation of Henry's law constant temperature dependence relations for organic compounds in dilute aqueous solutions. *Science Direct*. Vol.44. Pp.561- 561-576.
- Titko, Steve.III, John R. Street and Terry J. Logan (1987). Volatilization of Ammonia from Granular and Dissolved urea Applied to Turf grass. *Agron. J.*79: 535-540.
- Volkmar, K. M., Y. Hu. and H. Steppuh. (1997). Physiological responses of plants to salinity. A review. *Can. J. Plant Sci.* 78:19-27.
- Wahid, O. M. (2017). Thermodynamic and kinetics of Ammonia Volatilization from some Nitrogen Fertilizers in Calcareous Soil- Erbil. M. Sc. Thesis, Dept. of Soil Chemistry, College of Science, University of Salahaddin-Erbil / KRG/ Iraq.
- Wang, S., Tang, J., Li, Z., Liu, Y., Zhou, Z., Wang, J., Qu, Y., and Dai, Z. (2020). Carbon Mineralization under Different Saline—Alkali Stress Conditions in Paddy Fields of Northeast China. *Sustainability*, an open Access J. MDPI, 12, 292.
- Weathers, K. C., Strayer, D.L. Likens, G. E. Groffman , P.M. and Rose-Marashall ,E.J. (2013). *Fundamentals of ecosystem science*. Elsevier, NewYork.
- Welch, P. S. (1952). *Limnological methods*. McGraw-Hall, Book company Inc.
- Wen-wen, Z., Chong, W. Rui, X. and Li-jie, W. (2019). Effects of salinity on the soil microbial community and soil fertility. *College of Resources and Environmental Sciences, China Agricultural University, Beijing. J. of Integrative Agric.* 18(6): 1360–1368.
- Yeomans, J. C. (1991). Inhibition of nitrogen transformations in soil: Potentials and limitations for agriculture. *Trends in Soil Science*.1:127-158.
- Zhang, W., Chong, W., Rui, X. and Li-jie, W. (2019). Effects of salinity on the soil microbial community and soil fertility. *J. of Integrative Agriculture* . 18(6): 1360–1368.)
- Zhenghu, D., and Honglang, X. (2000). Effects of Soil Properties on Ammonia Volatilization. *Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Soil Sciences. Plant Nutrition.*, 46 (4), 845-852.
- Zhu, J-K., (2001). Plant salt tolerance. *Trends in Plant Science*. Vol. 6, 2: 66-71.

کارتیکرنا سویراتی یا ئاقیت ئافدانی و پلئیت گهرمیی ل سهرهه لچوونا گازا ئه مونیای ژ ئاخا کسلی

پوخته

تاقیکرناهه لآبووری هاته ئه نجامدان ل (شواتا 2020 هه تا تیرمه ها 2020) ل لآبووریت پشکا زانستیت ئاخ و ئاقی / کولیژا زانستیت ئه ندازیاریت چاندنی / زانکویا دهوک- ههریما کوردستانا عیراقی ، ب مه ره ما قه کولیئی ل سهرهه لچوونا پینچ ئاقیت د جودا د سویراتی یا ئاقیت ئافدانی دا ودوو پلئیت گهرمیی (25 و 45) س^ه ل سهرهه لچوونا گازا ئه مونیای ژ ئاخ، ب ریکا بکارئینانا ته کنیکا سیسته می ژووریت گرتی. ئافا ئیکئی هاتیه بکارئینان ئافا سروشتی یا سیبا (well) کولیژا زانستیت چاندنی بوو ($w1 = 0.70$ دیسیسیمینز م⁻ ¹) و هاته دهستنیسانکرن وه کو مامه لآ کونترولی، وه هر چوار ئاقیت دی ($w2 = 1.5$ ، $w3 = 3.0$ ، $w4 = 4.5$ و $w5 = 6.0$) دیسیسیمینز م⁻¹ ، هاتنه ئاماده کرن ژ ئافا ئیکئی (W1) بکارئینانا خوئی یا $MgCl_2$. مامه لئیت ئاخ هاتنه زبلکرن ب زبلی کیمیکی یوریا (46% نیتروجین) ب تیکراییی یا (320 کگم نایروجین هکتار⁻¹). تاقیکرن هاته ئه نجامدان ب کارئینانا نه خشه سازی یا کهرتکیت هه ره مه کییت ته مام (RCBD)، وب دووباره کرنا سیجارکی، وه مبرکرن هاته کرن دناقهره تیکراییی یا ئافنجییت مامه لآدا ب کارئینانا بجویکترین جوداهییته ئه ریئی (Adj. LSD) ل ئاستی ($P \leq 0.05$).

ئاخا هاتیه بکارئینان د تاقیکرنی دا ئه ف سالۆخه ته بخوو گرتن، ئاخژ جوئی کسلی بوو، راجنی (texture) وئ گله یی (clay) بوو، پلا ترش و تفتاتی یا (pH) وئ یا بلند بوو، ریژاسه دی یا کسلی ($CaCO_3$) تیدا یا بلند بوو، ریژاسه دی یا ماددیت ئه ندامی (Organic matter) تیدا یا کیم بوو، چه ندی یا نایتروجینی بهر دهست بوو رووه کی تیدا یا کیم بوو، ههروه سا شیانا بخووه گرتنا که ته یونا (CEC) تیدا 28.6 میلی مۆل بارگه / کگم ئاخ⁻¹. د ئه نجامادا دیار بوو بلند بوونا پلا گهرمیی کارتیکرناهه ئه ریئی یا پوزتیف هه بوو ل سهرهه زیده بوونا هه لچوونا نایتروجینی که له که بووی کشتی ب شیوی گازا ئه مونیای ژ ئاخ، هه ره سا زیده بوونا سویراتی یا ئاقیت ئافدانی بو ئه گهری زیده بوونا سویراتی یا ئاخ ب شیوه کی ئه ریئی یی پوزه تیف ، د هه مان ده مدا بو ئه گهری کیبوونا هه لچوونا نایتروجینی که له که بووی و کشتی ب شیوی گازا ئه مونیای ژ ئاخ بشیوه کی نه ریئی یی نیطه تیظ. هه ره سا کارتیکرنا ب هه قرا یا هه ردوو هوکاریت سویراتی یا ئاقی و پلئیت گه رمیی ل سهرهه لچوونا نایتروجینی که له که بووی و کشتی ب شیوی گازا ئه مونیای ژ ئاخ، کارتیکرناهه نه ریئی یا نیطه تیظ هه بوو، تیکراییی یا هه لچوونا گازا ئه مونیای ژ ئاخ کیم بوو ب بلند بوونا سویراتی یا ئاقی و پلا گهرمیی. بلندترین جه ندی یا هه لچوونا گازا ئه مونیای که له که بووی و یا کشتی ژ ئاخ دیار بوو ل بن کارتیکرنا مامه لآ ئافدانی ب بلندترین ئاستی سویراتی یا ئافی و ل بن کارتیکرنا بلندترین بلاکه رمیی، هه روه سا ببوویرنا ده می جه ندی یا هه لچوونا گازا ئه مونیای که له که بووی و یا کشتی ژ ئاخ ل دهست پیکن بلند بوو یاش جیگیر بوو ل ئاسته کی دیارکی و کارتیکرنا هه ردوو ثلیت طه رمیی هه مان ئاراسته هه بوو، زیده باری ئه نجامان دیارکر کو کارتیکرنا پلئیت گهرمیی د جودا بوون ل سهرهه ندی یا هه لچوونا نایتروجینی که له که بووی و کشتی ب شیوی گازا ئه مونیای ژ ئاخ.

تأثير ملوحة مياه الري و درجات الحرارة على تطاير الامونيا من تربة كلسية

الخلاصة

نفذت تجربة مختبرية (من شباط 2020 الى تموز 2020) في مختبرات قسم علوم التربة والمياه / كلية علوم الهندسة الزراعية / جامعة دهوك / اقليم كوردستان - العراق، لدراسة تأثير خمسة أنواع من مياه الري مختلفة في الملوحة و بالحضانة تحت درجتين مختلفتين من درجات الحرارة (25 و 45) م°، في تطاير النتروجين على شكل غاز الامونيا من التربة، باستخدام تقنية النظام المغلق. المياه الاولى كانت مياه طبيعية ممثلة ببئر كلية علوم الهندسة الزراعية $W1 = 0.70$ ديسيسيمينز م⁻¹ و اعتبرت كعامل السيطرة، و بقية المياه كانت ($W2 = 1.5$ ، $W3 = 3.0$ ، $W4 = 4.5$ و $W5 = 6.0$) ديسيسيمينز م⁻¹ حيث تم تصنيعها من مياه الأولى ($W1$) باستخدام ملح $MgCl_2$. سمدت معاملات التربة بسماد اليوريا (46% نيتروجين) بمعدل (320 كغم نيتروجين هكتار⁻¹). تم تنفيذ التجربة باستخدام تصميم القطاعات العشوائية الكاملة (RCBD) و بثلاث مكررات، و تم المقارنة بين المتوسطات باقل الفروقات المعنوية المعدلة (Adj. LSD) عند مستوى احتمالي ($P \leq 0.05$). تميزت التربة المدروسة بصفات الكلسية ذات قوام طيني، و ارتفاع درجة تفاعل التربة، محتواها العالي من كربونات الكالسيوم، ذات محتواها المنخفض من المواد العضوية و النتروجين الجاهز و ذات سعة تبادلية كاتيونية (28.6) مليمول شحنة / كغم تربة⁻¹. اظهرت النتائج انه بزيادة درجة حرارة الحضانة أدى إلى زيادة معنوية في تطاير النيتروجين المتراكم. كما وجد انه بزيادة مستويات ملوحة المياه زادت قيمة ملوحة التربة بشكل معنوي موجب، و انخفاض في كمية النيتروجين المتراكم المفقود من خلال التطاير بشكل معنوي سالب. كما وجد ان التأثير التداخل لدرجة الحرارة و قيمة ملوحة المياه على تطاير النيتروجين المتراكم كانت ذا معنوية سالبة اي خفضت من معدل تطاير النتروجين التراكمي على شكل غاز الامونيا. ظهرت أعلى فقد لغاز الامونيا من التربة عند معاملة التربة بالقيم الأعلى لكل من قيمة ملوحة للمياه المدروسة و عند الحضانة تحت درجة الحرارة الأعلى. اظهرت النتائج ان تأثير درجات الحرارة كانت اكثر بكثير على كمية التراكمية للنيتروجين المتطاير على هيئة غاز الامونيا من التربة مع الزمن، اذ زادت في البداية و من ثم مع مرور الزمن استقرت و بعد ذلك لم يحدث تطاير.