Available online at www.derpharmachemica.com

Scholars Research Library

Der Pharma Chemica, 2015, 7(10):521-532
(http://derpharmachemica.com/archive.html)

ISSN 0975-413X
CODEN (USA): PCHHAX

Evaluate the effect of three levels pH in leaching and volatilization of nitrogen fertilizers, in three soil types

Evelin Cevallos[1]*, Lorena Correa[1], Pablo Landázuri[1], Jaime Gía[2], Santiago Ulloa[1], Darwin Rueda[1], Bangeppagari Manjunatha[1] and Mariadoss Selvanayagam[3,4]

[1]Department of Life Sciences, Universidad de las Fuerzas Armadas-ESPE, Sangolquí, Quito, Ecuador, South America
[2]School of Medicine, Universidad de las Américas UDLA, Quito, Ecuador
[3]Department of Environmental Engineering, Universidad Estatal Amazonica, Puyo, Ecuador, South America
[4]Loyola - ICAM College of Engineering and Technology (LICET), Loyola Campus, Chennai, India

---

ABSTRACT

The present study was realized in order to determine the type of soil and the suitability of pH to avoid the losses of nitrogen from leaching and volatilization, using three different soils: organic, clayish and sandy, pH: 6, 7 and 8 and four nitrogenous fertilizers: Urea, Ammonium sulfate, Ammonium nitrate and Potassium nitrate. The ammonium and nitrates were estimated by using a probe and an spectrophotometer. The present research was conducted in Agricultural Sciences Faculty (IASA I), University of the Armed Forces (ESPE), Ecuador. The leached soil samples were estimated for ammonium and nitrates after 1, 3, 7, 14, and 21days, using the probe after volatilization. The evaluation was carried out by using a static camera for the measurement of NH_3, with10 ml of 2 % with H_3BO_3 and covered with a plastic cover. The data generated was analyzed by the Michaelis-Menten mathematical model for the measurement of the speeds and maximum concentrations. For comparison, two different solutions of Ammonium sulfate and Potassium nitrate were measured by the probe, and the spectrophotometer and the results were analyzed by the statistical Z-score test. The most reliable method is the probe. In clayish and sandy soils with pH 6, present less concentration of ammonium and nitrate, respectively. The greatest loss by volatilization is observed in sandy soil and the pH 8 with ammonium nitrate.

Key words: Leachening, Volatilización, Fertilizers.

INTRODUCTION

The intensive application of chemical fertilizers is one of the characteristics of modern agriculture. It is very clear that there is a need to produce more food for the growing world population and the consumption of fertilizer will be increased in coming years. But also it is necessary to be more respectful with the ambience and to be improving the efficiency of the fertilizers and the organic matters that one incorporates [1]. The demand of nutrients prepared by the FAO (United Nations Organization for the Fed and the Agriculture) and IFA (International Association of the Fertilizer Industry), reflects a global consumption of 150 million tons in 2001and 2002, of which 91 are of nitrogen continued of P_2O_5 (36 millions) and K_2O (23 million), what superposes a growth rate concerning 2.6% per year accumulative [1].

In the last few years, the use of the fertilizers has become indispensable due to the low fertility of the soil. In order to increase the yield and maximize the use of the fertilizer, it is required to know their characteristics, their effect on plants and soil, the application forms and how to derive and prepared for fertilization rates with base in the fertilizers available [2].

Since the use fertilizer is convenient, it is necessary to consider, the characteristics of the soil, the reactions and transformations of the products. Some of the nitrogenous fertilizers which are ammoniated generate a residual that create acidification of the soil. This is known as acidating effect of Ammonium sulfate with regard to the Ammonium nitrate and the urea. Nevertheless, it is not possible to generalize on this effect in all the soils, normally the capacity buffer of the clayish soils does that the acidity induced by these three sources is less, particularly in case of the ammonium sulfate [3].

With the nitrogenous fertilizers, the farmers sublimate the necessary nitrogen so that the plants can have an ideal growth and development and result in an economically profitable and sustainable agricultural production [4]. The nitrogenous fertilizers contain nitrogen of high quality mineral and must be used properly. These nitrogenous fertilizers must be used as per the recommendations of the Codes of Good Agrarian practices and under proper guidelines recommended by the National and International organisations. To determine the amount of fertilizer needed for the cultivation, is depends upon the amount of nitrogen available in the soil (analysis of mineral nitrogen) [4]. In order to add the essential nutrient to the soil for effective growth and development of plants, it is necessary to estimate the different components of fertilizer available in the soil so that we may be able to sublimate the specific nutrient based on the quality of the soil. This addition of nutrient could be done at the right time either single or multiple application depending up on the climatic conditions. At all times should be considered the weather conditions and the level of development of the cultivation [4].

According to Lenntech [5], the sources of nitrogen as nitrates are imported (ammonium nitrate, calcium nitrate and potassium nitrate) and the Ammonium sulfate. The contamination of ground water is mainly, because of the cultivation, in areas where the soil layer is relatively thin, or has little nutrients capacity or when changes exist in the uses of the grounds; fertilization excess for intensive agricultural activities; extension of cultivation that need high fertilization doses because the soil is used during long periods (example: corn, tobacco and vegetables); drainage systems that provoke the fertilizers sewer pipe; cycles of intensive farming of rotation characterized by frequent plows and extensive areas of naked soils during the winters; organic fertilizers for development of cultivation [5].

In the present study, we have analyzed and evaluated the effect leaching and volatilization of nitrogen fertilizers, on three soil type at three different pH. We have also determined the appropriate pH at which it reduces the loss by leaching and volatilization of nitrogen fertilizers in different soil at three different pH by using probe and a spectrophotometer.

MATERIALS AND METHODS

Development

The evaluation of the effect at three levels of pH in leaching and volatilization of nitrogen fertilizers, in three different type of soil, were carried out in the laboratory of the Facultad de Ciencias Agropecuarias IASA I, located in the parish of San Fernando, in Ecuador.

The samples were collected in Tumbaco for sandy soil, in the IASA-I for organic soil and in Quinindé for clayish soil. The sampling area was decided by dividing the area in homogeneous spaces in accordance with its topography. The following parameters were taken into consideration: relief, erosion, color, the vegetation and the differences of handling as the type of farming, fertilizations, rotations and types of cultivation. For the extraction of the sample the vegetable coverage was eliminated. With a spade courts will be carried out, in the shape of V, up to approximately 15-20cm deep. Then the samples were mixed in a bag or bucket for the securing of the sample representative of 500 g approximately [6].

The samples were packed in bags of thick plastic or in special bags of role for soils (raincoats inside). They were labeled with the corresponding information of every sample and were sent to the laboratory, for the essay and its analysis [7].

pH establishment

For the establishment of pH, we diluted the soil to obtain the initial pH and pH after the (modification) treatment in the study for the modification of pH, the doses of lime as carbonate of lime suggested for [8]. Then the pH was calculated by using the formula:

$$\text{Dose (ton of cal.ha}^{-1}\text{)} = \text{(pH to reach – pH current) / to be able tampon of the soil}$$

The buffer capacity (CT) of pH of the soil is the quantity of acid or necessary base to modify a unit of pH (Rowell, 1994), and it is estimated like the reciprocal one of the slope of the curve of qualifications with acid or base [9]. While major the (CT) of a major soil is the need for a base or acid to change the value of its pH.

Preparation and distribution of the experimental units: 250g of soil sample was mixed with different types of fertilizers. The doses of nitrogenous fertilizers were of 1g.kg^{-1} soil [10]. The mixed soil samples were placed in 1.35 liter plastic packing's. A glass cup kept in the entire experimental unit, and took to prolificacy to all the samples.

Leach tests: leaching data were taken with the following time interval in days.

Table 1: Symbol, intervals of time (days), and description of the leaching

Symbol	Time Interval in days	Description
t0	0	Baseline, takes all samples at field capacity
t1	0-1	Taking the first sample, day 1, elapsed time between day 0 and day 1
t2	2-3	Taking the second sample, day 3, leachate between day 2 and 3
t3	4-7	Taking the third sample, day 7, leachate between 4, 5, 6 and 7.
t4	8-14	Taking the fourth sample, day 14, leachate between days 8, 9, 10, 11, 12, 13 and 14.
t5	15-21	Taking the fifth sample, day 21, leachate from 15, 16, 17, 18, 19, 20 and 21.

The readings were taken by using the probe which indicated the NH4 and NO3 in ppm level.

Experimental design

The experiment was designed the following the procedure of Paramasivam and Alva [11]. The design was realized completely to the Hazard with an arrangement trifactorial in the type of soil, pH and nitrogenous sources, with thirty six treatments and 4 repetitions, every experimental unit was represented by a plastic packing of 1.35 Lt., which contained 250g. of the miscellany of soil and fertilizer.

The factors to be proved for this investigation were: type of soil, levels of pH and type of fertilizer the treatments to be verified are the result of the combination of the factors I occur rarely + pH + type of nitrogenous fertilizer (Table 2).

After completing the experiment, the data generated was compiled, a variance analysis is, used and then the Michaelis-Menten [12] test was done to 5 % for treatments, between groups and inside every group to determine the significant difference.

The Michaelis equation and Menten describes as it changes the speed of leached with the concentration of ammonium and nitrate:

$$v0= Vmax[S] / Km + [S]$$

Leaching of nitrate and ammonium

The quantity of nitrate and leached ammonium one came up in mg. l^{-1} in a period of 21 days, with an interval of time that corresponds to five measurements with the probe (YSI 550 DO).

Maximum concentration of ammonium and nitrate

It was calculated in mg.l^{-1}, with the entire leaching information, so much of ammonium and nitrate, by means of the equation of Michaelis Menten [12].

Maximum speed of ammonium and nitrate
It was calculated in ppm.day^{-1}, with the entire information of leaching of ammonium and nitrate, by means of the equation Michaelis and Menten [12]

Table 2: Evaluated treatments of the combination of soil + pH + type of source fertilizer

Treatment	Code	Description
1	S1P1N1	Organic Soil + pH 6 + Urea
2	S1P1N2	Organic Soil + pH 6 + Ammonium sulfate
3	S1P1N3	Organic Soil + pH 6 + Ammonium nitrate
4	S1P1N4	Organic Soil + pH 6 + Potassium nitrate
5	S1P2N1	Organic Soil + pH 7 + Urea
6	S1P2N2	Organic Soil + pH 7 + Ammonium sulfate
7	S1P2N3	Organic Soil + pH 7 + Ammonium nitrate
8	S1P2N4	Organic Soil + pH 7 + Potassium nitrate
9	S1P3N1	Organic Soil + pH 8 + Urea
10	S1P3N2	Organic Soil + pH 8 + Ammonium sulfate
11	S1P3N3	Organic Soil + pH 8 + Ammonium nitrate
12	S1P3N4	Organic Soil + pH 8 + Potassium nitrate
13	S2P1N1	Clayish Soil + pH 6 + Urea
14	S2P1N2	Clayish Soil + pH 6 + Ammonium sulfate
15	S2P1N3	Clayish Soil + pH 6 + Ammonium nitrate
16	S2P1N4	Clayish Soil + pH 6 + Potassium nitrate
17	S2P2N1	Clayish Soil + pH 7 + Urea
18	S2P2N2	Clayish Soil + pH 7 + Ammonium sulfate
19	S2P2N3	Clayish Soil + pH 7 + Ammonium nitrate
20	S2P2N4	Clayish Soil + pH 7 + Potassium nitrate
21	S2P3N1	Clayish Soil + pH 8 + Urea
22	S2P3N2	Clayish Soil + pH 8 + Ammonium sulfate
23	S2P3N3	Clayish Soil + pH 8 + Ammonium nitrate
24	S2P3N4	Clayish Soil + pH 8 + Potassium nitrate
25	S3P1N1	Sandy Soil + pH 6 + Urea
26	S3P1N2	Sandy Soil + pH 6 + Ammonium sulfate
27	S3P1N3	Sandy Soil + pH 6 + Ammonium nitrate
28	S3P1N4	Sandy Soil + pH 6 + Potassium nitrate
28	S3P2N1	Sandy Soil + pH 7 + Urea
30	S3P2N2	Sandy Soil + pH 7 + Ammonium sulfate
31	S3P2N3	Sandy Soil + pH 7 + Ammonium nitrate
32	S3P2N4	Sandy Soil + pH 7 + Potassium nitrate
33	S3P3N1	Sandy Soil + pH 8 + Urea
34	S3P3N2	Sandy Soil + pH 8 + Ammonium sulfate
35	S3P3N3	Sandy Soil + pH 8 + Ammonium nitrate
36	S3P3N4	Sandy Soil + pH 8 + Potassium nitrate

Volatilization analysis
A static camera was used for the measurement of NH3. In every experimental unit a plastic packing of 8 was placed one. The same one that contained 10 ml of 2 % with H3BO3 and was covered by a plastic cover. The covers of the cameras remained closed during 24hrs every two days for the ammonia apprehension, for later the capture of information [13]. The static camera placed one for every treatment, with the target to compare 2 methods to be used for the losses measurement for volatilization of nitrogenous fertilizers.

Volatilization of nitrate and ammonium
The quantity of nitrate and ammonium volatilized measured itself in mg to 21 days. By means of qualifications using the static camera to catch NH3.

RESULTS

Losses of Ammonium and Nitrate for leaching

Table 3: Speed of leached and maximum ammonium concentration in organic soil, in accordance with the type of nitrogenous fertilizer (EquationMichaelis-Menten, 1912)

Organic soil (N-NH4)			
	pH	**Vmáx (SE) ppm/days**	**Cmáx (SE) ppm**
Without Fertilizer	6	2.35 (1.10)	33.5 (3.81)
	7	2.35 (1.15)	31.9 (3.81)
	8	2.35 (1.70)	21.7 (3.81)
Urea	6	6.65 (1.24)	67.8 (4.75)
	7	11.71 (2.12)	95.2 (8.15)
	8	3.79 (0.85)	42.8 (2.95)
Ammonium sulfate (NH4)(SO4)2			
	6	5.16 (1.16)	74.2 (5.74)
	7	5.85 (1.86)	58.1 (6.64)
	8	3.08 (0.71)	59.6 (3.96)
Ammonium nitrate (NH4)NO3			
	6	7.71 (1.08)	65.4 (3.65)
	7	6.21 (0.74)	66.3 (2.92)
	8	3.91 (0.68)	39.3 (2.10)
Potassium nitrate KNO3			
	6	11.23 (1.68)	72.6 (5.05)
	7	6.17 (0.82)	57.6 (2.83)
	8	4.72 (0.82)	39.6 (2.27)

In organic soil without fertilizer, the maximum ammonium concentration presented to itself to pH 6 and 7 (31.9 ppm) and (33.5 ppm), respectively; in contrast to pH 8 that reached a maximum concentration of ammonium (21.7 ppm). There it did not show any significant differences in the maximum leaching speeds to pH 6, 7 and 8 (2.35 ppm.day^{-1}).

After having applied urea in organic soil, the maximum ammonium concentration presented to itself to pH 7 (95.2 ppm) at a maximum speed of leaching of 11.71 ppm. day^{-1} in contrast to pH8 that reached a maximum concentration of ammonium of 42.8 ppm and a maximum speed of leaching of 3.79 ppm.day^{-1}.

After 6 to modify the organic soil to pH and on having applied ammonium sulfate, the maximum ammonium concentration was 74.2 ppm at a maximum speed of leaching of 5.16ppm.day^{-1}; in comparison to pH 8 that showed a maximum concentration of ammonium of 59.6 ppm at a maximum speed of leaching of 3.08 ppm. day^{-1}.

Applying ammonium nitrate in organic soil with pH 6 and 7, the maximum ammonium concentrations were 65.4 ppm and 66.3 ppm, respectively, with maximum speeds of leaching of 7.71ppm.day^{-1} and 6.21 ppm. day^{-1}, respectively; in contrast to pH 8, the ammonium concentration was 39.3 ppm and the maximum leaching speed was 3.91 ppm.day^{1}.

The leaching with potassium nitrate reached a maximum concentration of ammonium of 72.6ppm and maximum speed of leaching of 11.23 ppm. day^{-1} to pH 6; in comparison to pH 8 the maximum ammonium concentration was 39.6 ppm and the maximum speed of leaching of 4.72 ppm.day^{-1}.

Table 4: Speed of leached and maximum nitrate concentration in organic soil, in accordance with the type of nitrogenous fertilizer (Equation Michaelis-Mention, 1912).

Organicsoil(N-NO3)			
	pH	**Vmáx (SE) pm/days**	**Cmáx (SE) ppm**
Without Fertilizer	6	2.29 (0.44)	50.4 (2.47)
	7	3.05 (0.62)	49.0 (2.85)
	8	3.39 (0.49)	77.2 (3.21)
Urea	6	3.21 (0.46)	59.3 (2.47)
	7	1.55 (0.16)	77.6 (1.81)
	8	3.07 (0.32)	84.3 (2.49)
Ammonium sulfate (NH4)(SO4)2	6	1.62 (0.14)	61.8 (1.20)
	7	1.49 (0.11)	73.4 (1.17)
	8	3.74 (0.32)	73.2 (1.89)
Ammonium nitrate (NH4)NO3	6	2.78 (0.41)	58.6 (2.39)
	7	2.33 (0.29)	69.0 (2.22)
	8	2.94 (0.33)	81.9 (2.52)
Potassium nitrate KNO3	6	2.68 (0.50)	58.2 (2.95)
	7	2.88 (0.53)	60.1 (3.08)
	8	3.16 (0.45)	83.3 (3.37)

In organic soil without fertilizer, the maximum nitrate concentration found to be pH 8 (77.2 ppm); in contrast to pH 6 and 7 and that reached maximum concentration of nitrates of 50.4 ppm and 49.0 ppm, respectively. The 6, 7 and 8 did not show any significant difference in the maximum leaching speeds to pH.

Afterhaving applied urea in organic soil, the maximum nitrate concentration found to be pH 8 (84.3 ppm) at a maximum speed of leaching of 3.07ppm. day^{-1}; in contrast to p H 6 that reached the maximum concentration of nitrate of 59.3 ppm; and a maximum speed of leaching of is1.55 ppm.day^{-1} to pH 7.

After 7 and 8 to modify the organic soil to pH and on having applied ammonium sulfate, the maximum nitrates concentrations were 73.4 ppm and 73.2 ppm, respectively, at a maximum speed of leaching of 3.74 ppm.day^{-1} to pH 8; in comparison to pH 6 that showed a maximum concentration of nitrate of 61.8 ppm at maximum speeds of leaching of 1.62 ppm.day^{-1} and 1.49 ppm.day^{-1} with pH 6 and 7, respectively.

Applying ammonium nitrate in organic soil with pH 8, the maximum nitrate concentration was 81.9 ppm; in contrast to pH 6, the nitrate concentration was 58.6 ppm. They did not present significant differences for the maximum leaching speeds.

The leaching with potassium nitrate reached a maximum concentration of nitrate of 83.3 ppm to pH 8; in comparison to pH 6 and 7 that the maximum nitrates concentrations were 58.2 ppm and 60.1 ppm, respectively. The maximum leaching speeds did not show any significant differences.

Table 5: Speed of leached and maximum ammonium concentration in clayish soil, in accordance with the type of nitrogenous fertilizer (Equation Michaelis-Menten, 1912)

Clayishsoil (N-NH4)			
	pH	**Vmáx (SE) ppm/days**	**Cmáx (SE) ppm**
Without Fertilizer	6	6.33 (1.77)	20.3 (2.10)
	7	9.28 (0.99)	64.8 (2.99)
	8	8.75 (1.21)	46.4 (2.71)
Urea	6	6.07 (3.01)	20.8 (3.77)
	7	4.94 (0.74)	67.3 (3.37)
	8	6.85 (2.37)	33.4 (4.41)
Ammonium sulfate (NH4)(SO4)2	6	3.82 (2.10)	37.3 (6.23)
	7	8.75 (1.62)	142.1 (11.22)
	8	5.78 (2.87)	47.5 (8.42)
Ammonium nitrate (NH4)NO3	6	3.14 (0.56)	36.3 (1.87)
	7	4.52 (0.45)	77.9 (2.50)
	8	5.35 (0.87)	49.0 (2.76)
Potassium nitrate KNO3	6	4.13 (1,.10)	37.5 (3.18)
	7	8.04 (1.39)	77.4 (5.48)
	8	3.35 (0.72)	46.7 (2.90)

In clayey soil without fertilizer, the maximum ammonium concentration (64.8 ppm) and the maximum leaching speed (9.8 ppm/days) presented to pH 7 to itself; in contrast to pH 6 that reached a maximum concentration of ammonium of 20.3 ppm with a maximum speed of leaching of 6.33 ppm/days.

On having applied urea in clayey soil, the maximum ammonium concentration is pH 7 (67.3 ppm); in contrast to pH 6 that reached a maximum concentration of ammonium of 20.8 ppm. The maximum leaching speeds did not show any significant differences.

After 7 to modify the clayey soil to pH and on having applied ammonium sulfate, the maximum concentration of ammonium and the maximum speed of leaching they were 142.1 ppm and 8.75 ppm/days respectively; in comparison to pH 6 that showed a maximum concentration of ammonium of 37.3 ppm with a maximum speed of leaching of 3.82 ppm/days.

Applying ammonium nitrate in clayish soil with pH 7, the maximum concentration of ammonium and the maximum speed of leachingthey were 77.9 ppm and 4.52 ppm/days; in comparison to pH 6 that showed a maximum concentration of ammonium of 36.3 ppm with a maximum speed of leachingof 3.14 ppm/days.

The leaching with potassium nitrate to pH 7 reached a maximum concentration of ammonium and a maximum speed of leaching of 77.4 ppm and 8.04 ppm/days, respectively; in comparison to pH 6 that showed a maximum concentration of ammonium of 37.5 ppm with a maximum speed of leaching of 4.13 ppm/days.

In clayey soil without fertilizer, the maximum nitrate concentration presented to itself to pH 8 (9.9 ppm); in contrast to pH 6 and 7 that reached maximum concentrations of nitrates of 8.0 ppm and 7.6 ppm, respectively. They did not present significant differences in the maximum leaching speeds to pH6, 7 and 8.

On having applied urea in clayey soil, the maximum nitrate concentration presented to itself to pH 6 (39.2 ppm); in comparison to pH 7 that reached a maximum concentration of nitrate of 21.5 ppm. 6, 7 and 8 did not present significant differences in the maximum leaching speeds to pH.

Table 6: Speed of leached and maximum nitrate concentration in clayish soil, in accordance with the type of nitrogenous fertilizer (Equation Michaelis – Mention, 1912)

ClayishSoil (N-NO3)	**pH**	**Vmáx (SE) ppm/days**	**Cmáx (SE) ppm**
Without Fertilizer	6	2.46 (0.74)	8.0 (0.61)
	7	1.88 (0.58)	7.6 (0.54)
	8	2.25 (0.56)	9.9 (0.60)
Urea	6	3.75 (0.56)	39.2 (1.75)
	7	3.85 (0.96)	21.5 (1.65)
	8	4.79 (0.95)	31.8 (2.07)
Ammonium sulfate (NH4)(SO4)2	6	2.18 (0.40)	11.7 (0.52)
	7	1.33 (0.28)	9.8 (0.43)
	8	2.12 (0.36)	13.1 (0.53)
Ammonium nitrate (NH4)NO3	6	1.48 (0.12)	24.7 (0.42)
	7	0.99 (0.09)	22.8 (0.37)
	8	1.64 (0.13)	24.4 (0.44)
Potassium nitrate KNO3	6	0.73 (0.07)	26.5 (0.42)
	7	0.66 (0.07)	24.9 (0.41)
	8	1.93 (0.19)	24.7 (0.56)

After 8 to modify the clayish soil to pH and on having applied ammonium sulfate, the maximum nitrate concentration was 13.1 ppm and the maximum leaching speed was 2.12 ppm/days; in comparison to pH 7 that showed a maximum concentration of nitrate of 9.8 ppm at a maximum speed of leaching of 1.33 ppm/days.

Applying ammonium nitrate in clayey soil with pH 6 and 8, the maximum nitrates concentrations were 24.7 ppm and 24.4 ppm, respectively, and the maximum speeds of leaching is1.48 ppm/days and 1.64 ppm/days, in contrast to pH 7, the nitrate concentration was 22.8 ppm with a maximum speed of leaching is 0.99 ppm/days.

Table 7: Speed of leached and maximum ammonium concentration in sandy soil, in accordance with the type of nitrogenous fertilizer (EquationMichaelis– theymention 1912)

Sandy Soil(N-NH4)	**pH**	**Vmáx (SE) ppm/days**	**Cmáx (SE) ppm**
Without Fertilizer	6	6.30 (0.95)	82.8 (4.57)
	7	13.00 (3.69)	63.2 (8.85)
	8	11.01 (4.86)	38.4 (7.80)
Urea	6	13.76 (5.32)	103.6 (20.17)
	7	14.44 (6.73)	83.5 (20.01)
	8	9.60 (3.13)	82.1 (11.87)
Ammonium Sulfate (NH4)(SO4)2	6	5.69 (0.95)	89.9 (5.31)
	7	4.54 (0.93)	62.5 (4.17)
	8	1.40 (0.40)	39.6 (2.35)
Ammonium nitrate (NH4)NO3	6	6.58 (0.63)	93.6 (3.39)
	7	4.56 (0.54)	66.4 (2.55)
	8	2.31 (0.42)	37.5 (1.72)
Potassium nitrate KNO3	6	6.32 (1.12)	71.5 (4.66)
	7	8.32 (1.68)	65.6 (5.51)
	8	2.82 (1.05)	25.6 (2.57)

The leaching with potassium nitrate reached a maximum concentration of nitrate of 26.5 ppm to pH 6; in comparison to pH 7 and 8 that the maximum nitrates concentrations were 24.7 ppm and 24.9 ppm, respectively. The maximum leaching speed with pH 8 was 1.93 ppm/days; to difference with pH 6 and 7 that were 0.73 ppm/days and 0.66 ppm/days, respectively.

In sandy soil without fertilizer, the maximum concentration of ammonium of 82.8 ppm presented to pH 6 to itself; in contrast to pH 8 that reached a maximum concentration of ammonium of 38.4 ppm. The leaching speeds with pH 7 and 8 were 13.0 ppm. day^{-1} and 11.0 $ppm.day^{-1}$, respectively; compared to pH 6 that shows a maximum speed of leaching of 6.30 $ppm.day^{-1}$. On having applied urea in sandy soil, they show significant differences both for the maximum ammonium concentration as well as for the maximum speed of leaching.

After 6 to modify the sandy soil to pH and on having applied ammonium sulfate, the maximum concentration of ammonium and the maximum speed of leaching were 89.9 ppm and 5.69 $ppm.day^{-1}$, respectively; in comparison to pH 8 that showed a maximum concentration of ammonium of 39.6 ppm with a maximum speed of leaching of 1.40 $ppm.day^{-1}$.

Applying ammonium nitrate in sandy soil with pH 6, the maximum concentration of ammonium and the maximum speed of leaching were 93.6 ppm and 6.58 $ppm.day^{-1}$, respectively; in comparison to pH 8 that showed a maximum concentration of ammonium of 37.5 ppm with a maximum speed of leaching of 2.31 $ppm.day^{-1}$.

The leaching with potassium nitrate to pH 6 and 7 reached maximum concentrations of ammonium and maximum speeds of leaching of 71.5 ppm, 6.32 $ppm.day^{-1}$ and 65.6 ppm, 8.32 ppm/days, respectively; in comparison to pH 8 that showed a maximum concentration of ammonium of 25.6 ppm with a maximum speed of leaching of 2.82 $ppm.day^{-1}$.

Table 8: Speed of leached and maximum nitrate concentration in sandy soil, in accordance with the type of nitrogenous fertilizer (Equation Michaelis-Menten, 1912)

Sandy Soil(N-NO3)	**pH**	**Vmáx (SE) ppm/days**	**Cmáx (SE) ppm**
Without Fertilizer	6	6.39 (1.76)	8.9 (0.91)
	7	5.44 (1.30)	9.7 (0.80)
	8	5.23 (0.81)	14.2 (0.76)
Urea	6	7.87 (2.94)	9.1 (1.37)
	7	4.01 (0.63)	15.4 (0.75)
	8	7.10 (1.21)	18.8 (1.23)
Ammonium Sulfate (NH4)(SO4)2	6	4.18 (0.86)	9.9 (0.63)
	7	7.28 (1.19)	14.6 (0.94)
	8	9.20 (1.03)	24.5 (1.18)
Ammonium nitrate (NH4)NO3	6	0.64 (0.12)	22.6 (0.65)
	7	1.32 (0.18)	28.8 (0.78)
	8	1.29 (0.16)	31.0 (0.79)
Potassium nitrate KNO3	6	0.54 (0.13)	23.4 (0.76)
	7	1.32 (0.27)	23.0 (0.96)
	8	2.19 (0.41)	25.8 (1.19)

In sandy soil without fertilizer, the maximum nitrate concentration presented to itself to pH 8 (14.2 ppm); in contrast to pH 6 that reached a maximum concentration of nitrate of 8.9 ppm. 6, 7 and 8 did not present significant differences in the maximum leaching speeds to pH.

On having applied urea in sandy soil, the maximum nitrate concentration presented to itself to pH 8 (18.8 ppm); in comparison to pH 6 that reached a maximum concentration of nitrate of 9.1 ppm. The maximum leaching speeds to pH 6 and 8 were 7.87 $ppm.day^{-1}$y 7.10 ppm/days, respectively; to difference to pH 7 that its maximum leaching speed was 4.01 $ppm.day^{-1}$.

After 8 to modify the sandy soil to pH and on having applied ammonium sulfate, the maximum nitrate concentration was 24.5 ppm and the maximum leaching speed was 9.20 $ppm.day^{-1}$; in comparison to pH 6 that showed a maximum concentration of nitrate of 9.9 ppm at a maximum speed of leaching of 4.18 $ppm.day^{-1}$.

Applying ammonium nitrate in sandy soil with pH 8, the maximum nitrate concentration was 31.0 ppm and the maximum leaching speed was 1.29 $ppm.day^{-1}$; in comparison to pH 6 that showed a maximum concentration of nitrate of 22.6 ppm at a maximum speed of leaching of 0.64 $ppm.day^{-1}$.

The leaching with potassium nitrate reached a maximum concentration of nitrate of 25.8 ppm to pH 8 and the maximum leaching speed was 2.19 $ppm.day^{-1}$; in comparison to pH 6 quemostró a maximum concentration of nitrate of 23.4 ppm at a maximum speed of leaching of 0.54 $ppm.day^{-1}$.

The types of soil used for the investigation were organic, clayey and sandy with pH at initial stage of 7.7, 5.67 and 8.22, respectively. These differences are related to the characteristics of the soils and the climatic factors like the rain, the wind and the temperature, which control the intensity of leaching and the wear of minerals in the soil, having a major influence in the chemical properties of the soils, particularly acidity, alkalinity and salinity. The acidity is associated with leached soils, with high precipitations, while the alkalinity happens principally in drier regions [14].

On having modified the pH of (6, 7 and 8), the three types of soil in study, the least concentrations and the speed of leaching of ammonium and nitrate appear to be pH 6 and 7, and it is necessary to highlight that the type of nitrogenous fertilizer did not influence the quantity of leached. In accordance with the works of [9, 15, 16] on the control of the acidity, alkalinity and increase of the soil fertility, but mention that there does not matter the source of nitrogenous fertilizer that is used but the level of acidity or alkalinity I occur rarely to which the nitrogen is applied.

In the organic soils of this investigation, the least losses of nitrogen give themselves with pH 8, since the bacteria proliferation nitrificantes diminishes. The microorganisms need ideal values of pH between 5.5 and 7.5. If the pH is bigger than 7 the step of NO2 falls ill more - to NO3 - while when the pH is superior to 8 the step of NH4 falls ill + to NO2- [17, 18].

In general terms of handling, in an established cultivation it is necessary to mention that, the irrigation of the soil in arid regions, they limit the tendency to the alkalinity, nevertheless; the bad use of the water (irrigation - drainage) increases the alkalinity [15, 19, 20]. The deforestation of the natural vegetation causes the intensive decomposition of the organic matter, leaching of nitrate and production of acidity [21].

Volatilization of Ammonium and Nitrates

Table 9: Volatilization quantity in milligrams, in three types of soil with three types of pH and four types of nitrogenous fertilizer

Soil	pH	Fertilizar	Volatilization mg. N. First repeat 21 days	Volatilization mg. N. Second repeat 21 days
Organic	8	Ammonium sulphate	0	0.014
Sandy	7	Potassium nitrate	0.98	0.28
Clayey	7	Ammonium sulphate	4.48	0.14
Sandy	8	Potassium nitrate	1.40	0.84
Organic	7	Urea	2.8	0.14
Clayey	8	Potassium nitrate	0	0.294
Organic	6	Potassium nitrate	0	0
Clayey	6	Ammonium sulphate	0	0
Sandy	6	Urea	70	2.52

In table 10. Indicates that the biggest volatilization quantity gives itself with Ammonium nitrate in sandy soil with pH 8, which volatiliza 140 mg. of nitrogen in 21 days during the first repetition and 0.84 mg. of nitrogen in the second repetition.

The biggest loss for volatilization appears to be pH major to 7 and with ammoniated fertilizers as it indicates [22], the loss of Nitrogen for volatilization of the ammonias gas (NH3) can be the main cause of the low efficiency of some ammoniated fertilizers in very particular situations as there can be lime soils when they are applied superficially and of the anhydrous ammonia when it is injected in a defective way. The above mentioned losses are the result of numerous chemical, physical and biological processes in which such numerous factors like the pH intervene, the cation exchange capacity, the organic matter, the presence of remains in the surface, the temperature, the wind, the water evaporation of the surface of the soil and the quantity and the method of application of the fertilizer.

The volatilization of the ammonia is a mechanism that happens naturally in all the soils, for mineralization of organic nitrogen. But the losses originated from chemical fertilizers are greatly major than the originated ones from the Nitrogen of the soil [23].
Differences exist in the volatilization of the first and second repetition in the same time owed principally at the rate of temperature, the same one that accelerates the volatilization, what fits to the mention of the authors [24] that the temperature also found the volatilization. To major temperature, more rapid will be the passage of Ammonia dissolved in the solution of the soil to Ammonia in the air. The soil moisture and the valuation of evaporation play an important role. The loss of moisture is a pre-requisite for the loss of Ammonia. If the urea penetrates in the profile due to a rain, hydrolyzed quickly to Ammonium and is retained by the exchange complex and by less capable it to the volatilization.

CONCLUSION

In organic soil, lower concentrations of ammonia and leaching rates were at pH 8 (40.6 ppm) (ppm 3.57 day^{-1}.), respectively; lower concentrations of nitrates and leaching rates were at pH 6 (57.66 ppm) and (2.52 ppm.day^{-1}) respectively. The type of nitrogen fertilizer does not affect the amount of leaching. In clayey soil, lower concentrations of ammonium and leaching rates were at pH 6 (30.44 ppm) and (4.7 ppm.day^{-1}), respectively; lower concentrations of nitrates and leaching rates were at pH 7 (17.32 ppm) and (1.74 ppm.day^{-1}) respectively. The type of nitrogen fertilizer does not affect the amount of leaching. In sandy soil, lower concentrations of ammonium and leaching rates were at pH 8 (44.64 ppm) and (5.43 ppm.day^{-1}), respectively; lower concentrations of nitrates and leaching rates were at pH 6 (14.78 ppm) and (3.92 ppm.day^{-1}) respectively. No significant differences in the type of nitrogen fertilizar. The greater loss by volatilization shown in sandy soil pH 8 (70.41 mg. N) with ammonium nítrate at 21 days of experimentation.

REFERENCES

[1]S Ruano, Handbook of rational crop fertyilización Spain, **1997**, 14-22.
[2]Gavi Reyes, Especialidad de Edafologia. Mexico:Irenat, **2001.**
[3]S Chien, Fertideg.com, **2001**.
[4]S Fertiberia, Fertiberia, **2012.**
[5]Lenntech, **2002**. Lenntech. Retrieved from http://www.lenntech.es/
[6]J Havlin, J Beaton, S Tisdale, W Nelson, Soil fertility evaluation. New Jersey, **1999**.
[7]ICA, Fertilization in various crops, **1992**.
[8]D Suárez, M Márquez, Buffer enables variation in soils derived from volcanic ash. *Scielo*, **1992**, 388-393.
[9]D Rowell, Buffer enables variation in soils derived from volcanic ash. *Scielo*, **1994**, 350.
[10]Soil Science Society of China, *Journal of Environmental Sciences*, **1999**, 17(2), 181-184.
[11]S Paramasivam, A Alva, *Journal of Environmental Sciences*, **1997**, 17(2), 181-184.
[12]L Michaelis, M.L. Menten, *Biochem. Zeitung*, **1912**, 49, 333–369.
[13]S Zhang, C Zhang, Z Sun, Heibei Plain. China, **2002**.
[14]G Howells, T Dalziel, T. Restoring Acid Waters. London, **1992**.
[15]T Roberts, Causes of type 1 Sprude decline in Erope. **1989**.
[16]R Humbert, The cultivation of sugar cane. Mexico, **1980**.
[17]C Perdomo, R Dodera, Main processes of nitrogen loss, **1992**.
[18]S Uhart, H Echeverría, Fertilize INTA, **1997**.
[19] Potash and Phosphate Institute, Soil Fertility Handbook, **1987**.
[20]H Teuscher, R Adler, Soil and Fertilidad. New York, **1981**.
[21]J Díez, P Hernaiz, I Carrasco, In N Management in agroecosystems in relation to the Water Frame work Directive. Maastrich, **2005**.
[22]J Havlin, J Beaton, S Tisdale, W Nelson, Soil fertility evaluation. New Jersey, **1999**.
[23]Enzo Cástino, Fertilizar, Civil Association and ICASA Mora & Araujo, **2005**.

[24]H Fontanetto, H Vivas, O Keller, F Llambías, Volatilization of ammonia from nitrogen sources applied different wheat with tillage, **2001**.