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Research article

Effect of ammonium and phosphorus, under controlled conditions, on functional properties in two contrasting soils

Manel Allani [a,*], Hatem Ibrahim [b], Abdessatar Hatira [a], Iuliana Gabriela Breaban [c]

[a] *University of Tunis El Manar, Faculty of Sciences of Tunis, 2092, Tunis, Tunisia.*
[b] *University of Carthage, Faculty of Sciences of Bizerte, 7021, Jarzouna, Tunisia.*
[c] *Laboratory of current environment and sustainable development, Department of Geology, Faculty of Geography and Geology, Alexandru Ioan Cuza University of Iasi, 700505, Romania.*
**Corresponding author. Tel. : +216 20 380 163 (manel_allani@hotmail.fr).*

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Abstract

Over-supply of nitrogen and phosphorus as a mineral fertilizer can lead to disruption of the biochemical properties of soils. The aim of this research is to study the temporal evolution of the quantities of nitrogen and phosphorus mineralized in two agricultural soils to demonstrate the impact of changes in the physicochemical properties related to ammonium (NH_4^+) and phosphorus (PO_4^{3-}) applied to their availability in a vertic soils. A short-term incubation experiment of 6 weeks was carried out under controlled conditions of the laboratory, on two soils, one of Tunisian origin (Vertic Xerofluvents) and the second of Romanian origin (Vertisol). The two soils were subjected to two inorganic inputs, ammonium (NH_4^+) and phosphorus (PO_4^{3-}). Two different normality (0.5 N and 1N) of nitrogen and phosphorus were added in each soil and incubated at 25 °C and 30 ± 1 °C. These treatments were compared to samples from both control soils without input.

The main results indicate that during the incubation period, the addition (NH_4^+) and (PO_4^{3-}), on both soils, resulted to an increase in ammonium availability at the beginning of the experiment and in phosphorus, at the same time pH decreases and salinity (electrical conductivity, CE) increases. This study shows the impact of nitrogen and phosphate amendments on the evolution of the physicochemical properties of soils from different pedoclimatic conditions.

Key words: Incubation, Nitrogen, Phosphorus, Physico-chemical properties, Soil amendment, Vertisol.

1. Introduction

Worldwide, soil quality obviously affects its agricultural value (Annabi et al., 2009; Cherifa et al., 2009; Nietupski et al., 2010; Gu et al., 2011; Keith et al., 2012; Boukhalfa-Deraoui et al., 2015). The application of mineral fertilizers in soil has several effects on soil properties, for example salinity values and soil pH (Rajput et al., 2014, Boukhalfa-Deraoui et al., 2015, Hirzel et al., 2018). The adequate use of fertilizers has beneficial effects on soil properties and the environment beyond the evidence of improved food production (Cherifa, 2009).

Nitrogen (N) and soil phosphorus (P) are the most important nutrients for increasing yield (Annabi et al., 2013, Blanchart and Plassard, 2014), and they are often considered the two most limiting nutrients for plant productivity. Maintaining an adequate level of nitrogen (N) and phosphorus (P) in crops to produce a high quality is very important, and the systematic application of nitrogen and phosphorus fertilizers on agricultural soil has become a part of agriculture in developed countries (Withers et al., 2001). Monitoring the chemical environment of soils and their mineral content is very important for crop nutrition and the maintenance of water quality near agricultural areas (Blanchart and Plassard, 2014).

Mineral amendments are important, and they are known to improve soil quality, but their effect are not simultaneous, it takes several weeks and even months to see this effect as reported by FAO, but they do not always have a positive effect on the properties of the soil after a long term application of fertilizers (Sui et al., 1999).

However, continued long-term fertilizer application can lead to the accumulation of N and P on surface horizons to those required for optimal plant growth, thus increasing the potential for loss of N and P to surface waters and eutrophication (McDowell et al., 2001).

Therefore, it is important to know the impact of chemical fertilizers on soil properties to determine their potential benefits or adverse effects on soil quality (Pinochet et al., 2000; Cayuela et al., 2009; Hirzel et al., 2018) For example, soil pH may be affected, as well as the availability of exchangeable bases, such as Ca, Mg, K, and Na (Castro and Crusciol, 2013; Fageria and Nascente, 2014; Moreira et al., 2015). And above all, the chemical properties of the soil that can be affected by the addition of different nutritional sources are essential nutrients, such as N and P and certain micronutrients (Hirzel et al., 2010; Castro and Crusciol, 2013).

The aim of this study was to evaluate the effect of adding the concentrations of the two most important mineral fertilizers, under controlled conditions, to the soil and their impacts on the selected physicochemical properties, of two agricultural soils of vertic character, from two different origins, the first from Tunisia and the second from Romania, which can help the recommendation of N and P fertilizers and the protection of the quality of soil.

2. Material and methods

2.1. Soil sampling

The experiment focuses on surface horizons of two agricultural soils. The first soil is from northwestern Tunisia one of the main cereal production sites of the city of Siliana (Ouechtati, 2009). The second one is from a plot in southwestern Romania, also one of the main cereal production sites in the province of Oltenia (Iagaru et al., 2001), for comparative purposes as part of an exchange project. Soil samples were taken from the superficial layer (0-30 cm) following the method described by Pauwels et al. (1992). These soil samples were then thoroughly blended to form a composite sample and then air-dried in the laboratory before being sieved through a 2 mm diameter mesh to obtain the fine soil.

Physico-chemical analysis of soil samples was determined according to the standard method published by Richards (1954) and Jackson (1958). The granulometry (Robinson, 1922), soil pH (AFNOR, 2005), and the electrical conductivity EC (AFNOR, 1995c), total organic carbon in the soil was quantified by the modified Walkley-Black method (Yeomans and Bremner, 1998) and total nitrogen was determined by digestion with sulfuric acid and Kjeldahl distillation (Bremner, 1996), Phosphorus was determined colorimetrically in all extracts using ammonium molybdate ascorbic (Olsen et al., 1954, Bowman and Cole, 1978).

2.2. Incubation experiment

Under controlled laboratory conditions, soil samples were incubated at room temperature, with different normalities of NH_4 and PO_4 (0.5 N / 1N – 50 ml), these are chosen from the study of Allani, (2014). During the experimental period in the laboratory, in plastic bottles of 250 ml served as pot, without plant, each flask included a homogeneous mixture of 100 g of soil and 10 ml of distilled water. Daily, the flasks were aerated for 10 minutes and each day, the weight of each flask was checked and kept constant by adding distilled water if necessary. The soil moisture content has been kept constant. The experiment was conducted in in vitro condition following completely randomized design with three replications were treated after the specified time (0.1,3,6,12,18,24,30,36j) for pH, EC, P, N-NH_4 and N-NO_3 analysis. The incubation was preceded by a seven-day pre-incubation to reactivate the microorganisms, this approach is inspired by the incubation technique of Stanford and Smith, (1972).

2.3. Statistical analysis

Data were analyzed using SPSS version 23.0 for Windows (SPSS, Inc. Chicago, IL, USA). Means and standard deviations (SD) were calculated after verifying normality of distributions using the Kolmogorov-Smirnov procedure. For Soil treatment data were analyzed using a multifactorial three-way (Soil [Siliana, Roumanie] × Treatment [N NH_4, N PO_4] × Concentration [0.5 N, 1 N]) ANOVA. Greenhouse-Geisser corrections were used when the assumption of sphericity (Mauchly’s test) was violated. To help protect against type II errors, an estimate of power (ώ) and effect size (η2p) were calculated. Bonferroni-adjusted pairwise post hoc comparisons were performed where appropriate. Significance level was set a priori at $P < 0.05$.

3. Results and discussion

3.1. Physico-chemical soil properties

The physico-chemical properties of the two soils presented in Table 1; The results showed that the clay content was lower in the Siliana-Tunisia soil compared to the soil of Oltenia-Romania which had the highest clay content (59.93%) and the lowest sand content. (10.5%). The pH is near neutral and the electrical conductivity is low (EC) of the studied soils. Moreover, the OM is lower in the soil of Oltenia-Romania (1.27%), Siliana-Tunisia soil had the highest content of phosphorus (P) and total nitrogen (NT).

3.2. Soil of Siliana-Tunisia

Laboratory experiments with soil incubated under controlled conditions are away from real conditions of use but offer greater ease of realization. The incubation time (t) influenced all evaluated parameters (pH, EC, PO_4, N-NH_4, N-NO_3) (Table 2). During the first week of incubation there was an increase in pH for all treatments that could be related to the processes of chemical reactions involved in mineralization and the release of nutrients (Hirzel et al., 2018).
From the second week, a decrease in soil pH was observed in all treatments (Fig. 1), the lowest pH obtained 6.14 in the case of (NH_4; 1N) in Siliana soil, are the result of the nature and the concentration of the added element for 6 weeks of incubation, ammonium is an acidifying product. This acidification is explained by the generation of organic acid (Fageria et al., 2014; Hirzel et al., 2018), similar results have been proven by Moughli, (2000) long-term incubation and Goh, (2013) short-term incubation, therefore, the use of ammonium has an acidic effect, due to nitrification, on the soil more than PO_4.

Then, the use of chemical fertilizers causes the acidification of agricultural soils, which explains the usefulness of the organic amendments that serve to increase soil pH due to the complexation of Al aluminum and the increase of the cations basics in soil solution (Bulluck et al., 2002).

Table 1: Characteristics of the two soils; Tunisian and Romanian in pre-incubation

Soil	Tunisian	Romanian
Climatic conditions	Warm temperate	Cold temperate
Pedological context		
Type	Vertic Xerofluvents	Vertisol
Texture	Clayey loam	Clayey
Structure	Subangular	Subangular
Granulometry		
Sand (%)	14.4	10,5
Silt (%)	39.97	29,55
Clay (%)	45.62	59,93
Physicochemical properties		
Bulk density (g/cm^3)	2.16	1.25
pH	7.75	7.86
EC (µs/cm)	214	255
Organic material (%)	1.92	1.27
Total nitrogen (%)	0.74	0.55
Total phosphorus (ppm)	27.2	23.8

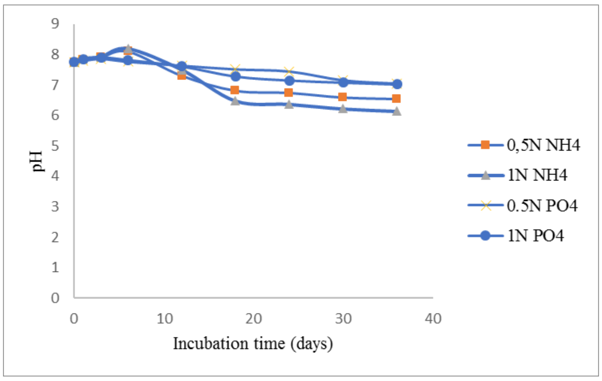

Fig. 1. Effect of incubation period and different treatment on the evolution of soil pH; Siliana soil

Table 2. Interaction analysis for each soil between the different concentrations of treatments added during the incubation period.

		0.5 N NH_4	**1 N NH_4**	**0,5 N PO_4**	**1N PO_4**	**Main Effects**			**Interactions**			
						Sol	**Traitement**	**Concentration**	**Sol* Traitement**	**Sol* Concentration**	**Traitement * Concentration**	**Sol* Traitement * Concentration**
pH	**Tunisia Soil; Siliana**	7.29±0.62‡	7.16±0.84¶	7.56±0.29	7.47±0.34	*F*=0.625 *P=0.441* η^2_p=0.04 *ώ*=0.12	*F*=1.68 *P*=0.213 η^2_p=0.09 *ώ*=0.23	*F*=18.87 *P*=0.001 η^2_p=0.54 *ώ*=0.98	*F*=6.42 *P=0.022* η^2_p=0.29 *ώ*=0.66	*F*=2.17 *P=0.160* η^2_p=0.12 *ώ*=0.28	*F*=11.66 *P=0.004* η^2_p*=0.42* *ώ*=0.89	*F*=7.74 *P=0.013* η^2_p=0.33 *ώ*=0.74
	Romania Soil;Oltenia	7.43±0.71‡†	6.98±0.58	7.10±0.60	7.12±0.64							
CE (µs/cm)	**Tunisia Soil; Siliana**	271.44±27.74‡†∗	288.67±31.74¶	250.78±22.94¶∗	256.11±25.92∗	*F*=7.79 *P=0.013* η^2_p=0.33 *ώ*=0.75	*F*=52.19 *p*<0.001 η^2_p=0.77 *ώ*=1.00	*F*=81.56 *p*<0.001 η^2_p=0.84 *ώ*=1.00	*F*=7.40 *P=0.015* η^2_p=0.32 *ώ*=0.72	*F=0.86 P=0.787 η2p=0.01 ώ=0.06*	*F=4.89 P=0.042 η2p=0.23 ώ=0.55*	*F=12.67 P=0.003 η2p=0.44 ώ=0.92*
	Romania Soil;Oltenia	313.00±45.32‡†	322.22±46.02¶	299.56±30.82¶	311.56±39.26							
N-NH_4 (mg/kg)	**Tunisia Soil; Siliana**	7.49±4.05†	10.48±4.99¶	6.06±4.06¶	5.38±3.46	*F=0.03 P=0.861 η2p=0.01 ώ=0.05*	*F=33.25 p<0.001 η2p=0.68 ώ=1.00*	*F=28.35 p<0.001 η2p=0.64 ώ=0.99*	*F=0.85 P=0.370 η2p=0.05 ώ=0.14*	*F=16.08 P=0.001 η2p=0.50 ώ=0.96*	*F=33.34 p<0.001 η2p=0.68 ώ=1.00*	*F=3.24 P=0.091 η2p=0.17 ώ=0.40*
	Romania Soil;Oltenia	9.37±5.05‡†	10.50±4.90¶	5.83±3.47¶	5.03±3.62							
N-NO_3 (mg/kg)	**Tunisia Soil; Siliana**	9.88±7.33‡†	6.70±7.35¶	4.84±5.29	3.84±3.33	*F=0.02 P=0.895 η2p=0.01 ώ=0.05*	*F=20.43 p<0.001 η2p=0.56 ώ=0.99*	*F=0.84 P=0.372 η2p=0.05 ώ=0.14*	*F=1.81 P=0.198 η2p=0.10 ώ=0.24*	*F=1.12 P=0.001 η2p=0.50 ώ=0.96*	*F=1.84 P=0.194 η2p=0.10 ώ=0.25*	*F=1.51 P=0.237 η2p=0.09 ώ=0.21*
	Romania Soil;Oltenia	6.41±5.13	7.67±7.25	4.21±4.12¶	5.58±5.58							
PO_4 [%]	**Tunisia Soil; Siliana**	0.07±0.02‡	0.07±0.03¶	0.10±0.03	0.14±0.05	*F=2.22 P=0.156 η2p=0.12 ώ=0.29*	*F=28.45 p<0.001 η2p=0.64 ώ=0.99*	*F=26.64 p<0.001 η2p=0.63 ώ=0.99*	*F=2.04 P=0.173 η2p=0.11 ώ=0.27*	*F=3.21 P=0.092 η2p=0.17 ώ=0.39*	*F=24.35 p<0.001 η2p=0.60 ώ=0.99*	*F=8.41 P=0.010 η2p=0.34 ώ=0.78*
	Romania Soil;Oltenia	0.09±0.04†	0.07±0.01¶	0.10±0.03¶	0.23±0.13							

Data are means (±SD), Before training (P1), After training (P2), Effect size (η2p), Statistical power (ώ).
‡ significant differences ($p<0.05$) from treatment with 0,5 N PO4 of the same soil
¶ Significantly different ($p<0.05$) from treatment with 1N PO4 of the same soil
† Significantly different ($p<0.001$) from treatment with 1 N NH4 of the same soil.
∗ Significantly different ($p<0.05$) from Roumanie sol with same treatment and concentration.

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From the second week, a decrease in soil pH was observed in all treatments (Fig. 1), the lowest pH obtained 6.14 in the case of (NH_4; 1N) in Siliana soil, are the result of the nature and the concentration of the added element for 6 weeks of incubation, ammonium is an acidifying product. This acidification is explained by the generation of organic acid (Fageria et al., 2014; Hirzel et al., 2018), similar results have been proven by Moughli, (2000) long-term incubation and Goh, (2013) short-term incubation, therefore, the use of ammonium has an acidic effect, due to nitrification, on the soil more than PO_4.

Then, the use of chemical fertilizers causes the acidification of agricultural soils, which explains the usefulness of the organic amendments that serve to increase soil pH due to the complexation of Al aluminum and the increase of the cations basics in soil solution (Bulluck et al., 2002).

The electrical conductivity (EC) represents the total salinity of the soil, defines the total amount of soluble salts in the soil, and is either of constitutional origin or provided by anthropic activity. The highest EC value was recorded by adding NH_4 (Fig. 2); which is necessarily explained by the release of N (Li et al., 2015). Similarly, during the incubation period, the addition of either ammonium or phosphorus contributed to increase the values of the electrical conductivity of the soil (Fig. 2), compared to the initial values, which is explained by the specific characteristics of the elements added on the salinity represented by its partial salt index (Boukhalfa-Deraoui et al., 2015).

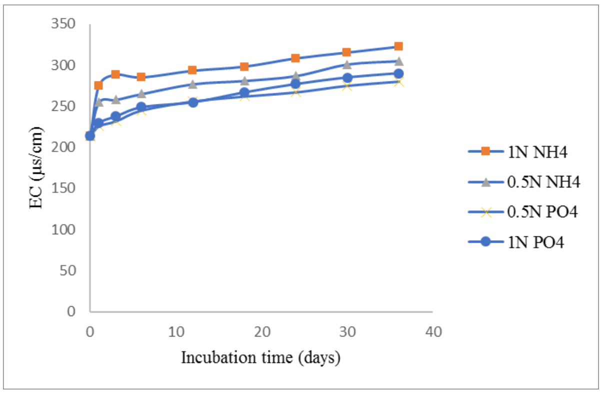

Fig. 2. Effect of incubation period and different treatment on the evolution of EC; Siliana soil.

During the incubation period, there are variations in the amount of N-NH_4 mineral nitrogen from Siliana-Tunisia soil in samples with treatments (Table 2), showing an increase in the first week of incubation, with some changes during the incubation period (Fig. 3) as confirmed by the interaction between soil and treatment ($p<0.05$). This increase in concentration could react to desorption reactions of the clay fraction. Then the values drop gradually from the second to the sixth week, but they do not disappear at the end of incubation. From the first week, the mineral nitrogen is mainly in nitrate form, the ammoniacal nitrogen having become negligible by its immobilization or nitrification ($p<0.001$). It has long been known that, in the presence of ammonium and nitrates in the soil, it is ammonium which is preferentially used by microorganisms, the nitrates being immobilized only when ammonium is no longer available (Broadbent et al., 1962). Nitrogen net immobilization (gross immobilization - gross mineralization) is commonly observed in similar experiments resulting in a decrease in mineral N in the soil (Beloso et al., 1993; Bernal et al., 1998).

About the evolution of the quantities of N-NO_3 mineral nitrogen, a marked decrease in the amount of nitrate (N-NO_3^-) is observed in all the treatments during the first week of incubation (Fig. 4).

This decrease can be explained by a process of immobilization of soil nitrates. Then there is an increase starting from the second week.

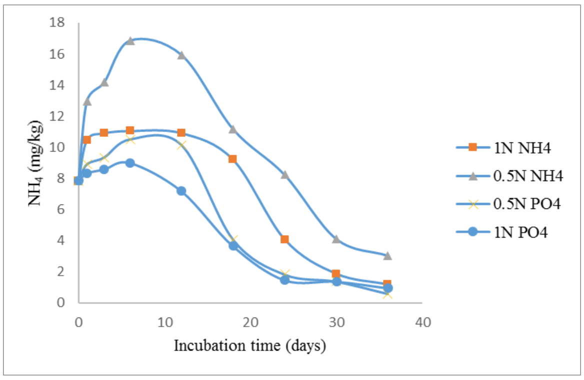

Fig. 3. Effect of incubation period and different treatment on the evolution of N-NH_4; Siliana soil.

These variations can be explained by a reorganization of this element, and also an immobilization by the microorganisms for their metabolism (Tremblay et al., 2001), or its denitrification in the case a lack of oxygen (Parnaudeau, 2005), due to poor aeration of the soil samples. When it comes to the evolution of the quantities of N-NO_3 mineral nitrogen, a marked decrease in the amount of nitrate (N-NO_3^-) is observed in all the treatments during the first week of incubation (Fig. 4). This decrease can be explained by a process of immobilization of soil nitrates. Then there is an increase starting from the second week. These variations can be explained by a reorganization of this element, and also an immobilization by the microorganisms for their metabolism (Tremblay et al., 2001), or its denitrification in the case a lack of oxygen (Parnaudeau, 2005), due to poor aeration of the soil samples.

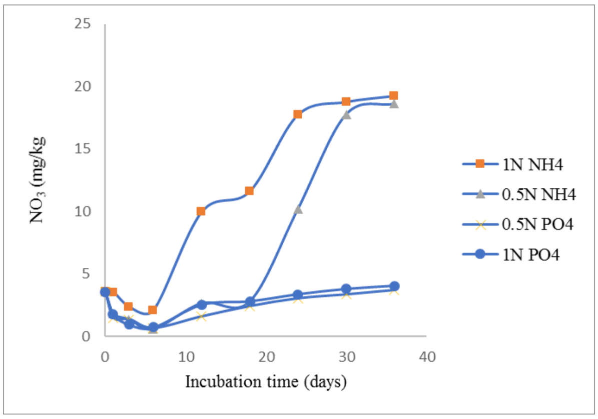

Fig. 4. Effect of incubation period and different treatment on the evolution of N-NO_3; Siliana soil.

PO_4 concentrations during the incubation period increased with time until the 4th week in all treatments (Fig. 5). This increase in PO_4 concentration could be related to anion exchange reactions with organic compounds of the soil (Eghball et al., 2004). Then there is a decrease towards the end of the incubation period, that could be related to pH, which is one of the important factors affecting the retention of PO_4 in soils, and at pH <7, P binding with Fe and Al occur, which is why it is often the least available nutrient for plants (Bubba et al., 2001). Generally, all treatments had small changes during the incubation period with differences between the times indicated by the interactions between incubation time and treatment. For this reason, it was always advisable to avoid fertilizers use of organic amendments that increase the solubility of PO_4, which may respond to an organization effect of PO_4 associated with biological activity and complex formation of soil organic compounds (Silva et al., 2016).

For any treatment applied, there is a decrease in the amount of available phosphorus. This decrease is probably due to the immobilization of phosphorus which reacts with Ca_2^+, and especially in the case of a non-migrant irrigation causing the transfer of phosphorus into unavailable forms.

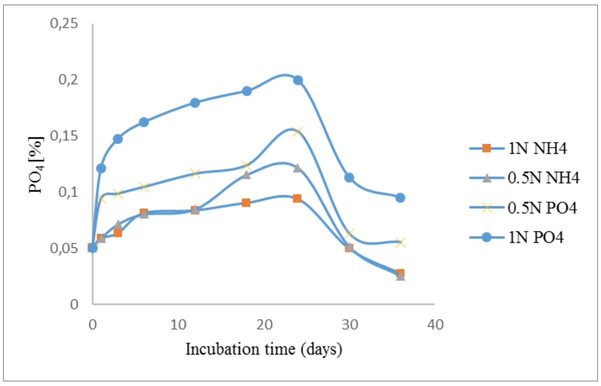

Fig. 5. Effect of incubation period and different treatment on the evolution of PO_4; Siliana soil.

Soil of Oltenia-Romania

All the parameters evaluated (pH, EC, N-NH_4, N-NO_3, and PO_4) of the soil of Romania (Oltenia) were affected by the incubation time (T) and the added treatments of nitrogen and phosphorus (Table 2). During the incubation period and under the effect of all treatments, a change in pH (Fig. 6) was observed, such as the highest pH value; 7,86 was obtained at the beginning of the experiment by adding PO_4 at 0.5N, and the lowest pH values; 6,15 were obtained after an advanced period of incubation, adding NH_4 to 1N.

A decrease of the soil pH of Romania over time, for all the treatments (Fig. 6), as for the soil of Tunisia, the pH neutrality was impacted to give a moderately acidic pH. The pH value the lowest is obtained by the addition of ammonium, which is related to a strong presence of nitrogen compounds (Muñoz-Vega et al, 2016). This decrease in pH could be explained by a high concentration of nitrified ammonia, as demonstrated (Fageria and Nascente, 2014; Hirzel et al., 2014). The latter proves that the presence of nitrogen compounds induces a process of acidification of the soil.

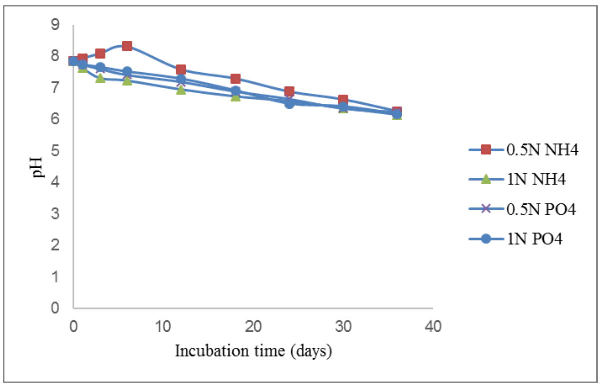

Fig. 6. Effect of incubation period and different treatment on the evolution of pH; Oltenia soil.

Regarding the evolution of soil salinity (EC) (Fig. 7), the results of all treatments show an increase during the incubation period. The figure shows a significant relation between the (EC) soil and the addition of nitrogenous and phosphate chemical elements ($p<0.05$). The highest value was recorded after the application of the ammonium, which may be explained by a high rate of N release (Li et al., 2015).

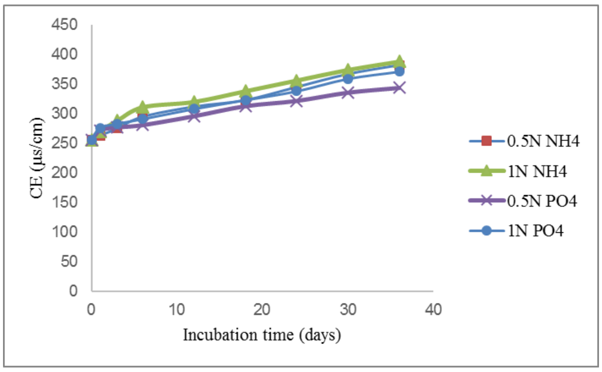

Fig. 7. Effect of incubation period and different treatment on the evolution of EC; Oltenia soil.

The N-NH_4 available in soil samples from Romania-Oltenia varied with the added elements, moreover, a very significant increase in the first week of incubation is related to the nutrient levels that have been added and to the soil texture of Oltenia which is a clay soil (Table. 1). It is also confirmed by the interaction between the incubation time, the applied treatment and the soil (Table. 2), during the incubation time, the values fall gradually, but it does not disappear at the end of incubation as for the soil of Siliana-Tunisia. Explaining that from the first week, the mineral nitrogen is mainly in nitrate form, the ammoniac having become negligible by its immobilization or nitrification (Fig. 8). It has long been known that in the presence of ammonium and nitrates in the soil, it is ammonium which is preferentially used by microorganisms, the nitrates being immobilized only when ammonium is no longer available (Broadbent and Tyler, 1962; Jansson et al., 1955). Nitrogen immobilization (gross immobilization - gross mineralization) is commonly observed in similar experiments resulting in a decrease in mineral nitrogen present in the soil (Beloso et al., 1993; Bernal et al., 1998).

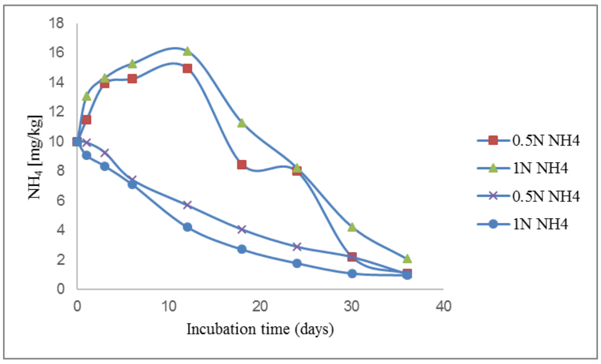

Fig. 8. Effect of incubation period and different treatment on the evolution of N-NH_4; Oltenia soil.

The evolution of the quantities of N-NO_3 for all treatments (Fig. 9) showed a decrease in the amount of nitrate during the first week of incubation that is slightly different to that of Siliana-Tunisia. This decrease can be explained by a process of immobilization of soil nitrates. Then there is an increase starting from the second week. These variations can be explained by a reorganization of this element and also an immobilization by the microorganisms for their metabolism (Tremblay et al., 2001) or its denitrification in the case a lack of oxygen (Parnaudeau, 2005), due to poor aeration of the soil samples.

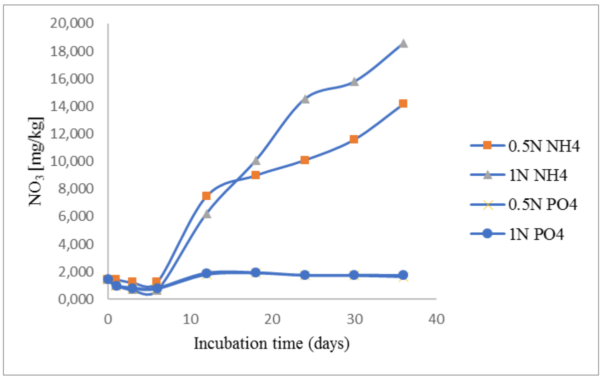

Fig. 9. Effect of incubation period and different treatment on the evolution of N-NO_3; Oltenia soil.

Interpreting the evolution of PO_4 (Fig. 10), different effects can be observed. An increase in available P has been observed, over time of incubation, following the application of different treatments of phosphorus, this is associated with the rate of P added and the speed of its release knowing that the soil of Oltenia is dominated by the clay fraction. Generally, the release of PO_4 in soils depends on soil characteristics, particularly in the texture. The increase in soil phosphorus release can be affected by clay content, soil $CaCO_3$ and soil phosphorus content (Kaloi, 2011). High pH clay soils may have more P problems due to captivity of this element with other cations such as Ca and Na (Rajput et al., 2014).

The application of the different ammonium concentrations during the incubation period shows a very slight evolution over time, and the PO_4 contents were similar to the initial values, with a decrease towards the 6th week, it could be related to different N release rates (Li et al., 2015).

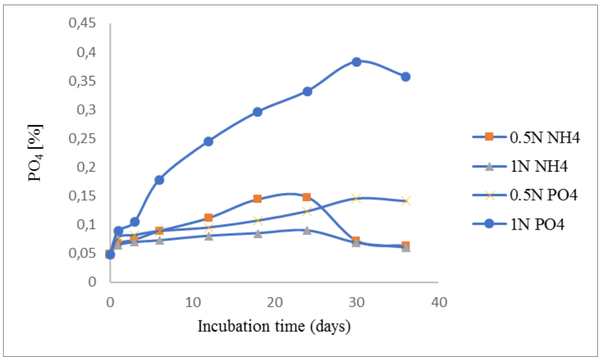

Fig. 10. Effect of incubation period and different treatment on the evolution of PO_4; Oltenia soil.

Tunisian and Romanian soils were similar in their properties, approximately, except there slightly higher clay content in Romanian soil. It is known that clayey soils with high pH have more capacity to reduce the transformation and the movement of N compounds (Pansu et al., 2006) and have more P problems due to the bondage of P with other cations such as Ca and Na (Rajput et al., 2014). Result of the current study showed that the incubation of ammonium and phosphorus fertilizers, in soil with high clay content have more significant effects on the evolution of the different parameters, over time.

Both soils showed during the incubation period, the evolution of each parameter had different trends that interacted with the added nutrient, and generally resulted in decreased pH and increased salinity, using ammonium in the soil.

Evaluating the effectiveness of the two most important elements of mineral fertilizers; ammonium and phosphor, tested in the soil shows that for each treatment caused an increase in the amounts of N and P compared to the control (without treatment). Regardless of the treatment, there is a progress in decreasing the amount of ammonium and phosphorus availability.

This decrease is probably due to the immobilization of phosphorus reacts with Ca and Na (Rajput et al., 2014) and about ammonium react with the clay content (Pansu et al., 2006). During the incubation period, an increase in the values of electrical conductivity was observed; however, the applied fertilizers have caused soil acidification in all treatments (Hirzel et al., 2018; Boukhalfa-Deraoui et al., 2015). Therefore, the application of mineral fertilizers in the soil has several effects on soil functional properties, most often salinity and soil pH. It is in this context that current research is geared towards the appropriate reasoning of mineral fertilizers through the materialization of an optimal fertilizer dose that promotes a high economic profitability of agricultural crops, but also a better preservation of the chemical environment of the soil. Moreover, following this study we note that, even, our soils are within the limits of agricultural soils (Nziguheba and Smolders, 2008), but we must always study the doses of mineral fertilizers, as they are a net source of trace metals and their long-term application can increase the total metal concentration in the soil and hence in the food chain (Jones et al., 1987a).

4. Conclusion

The aim of this research was to study the evolution of nitrogen and phosphorus, the most important elements of mineral fertilizers, in too soils, in relation to the treatments added and soils characteristics. In fine-textured agricultural soils, rich in organic matter, the incubation of N and P showed significant effects on the evolution of the studied parameters, the nitrogen and phosphorus in soils. The result of this experiment indicate that the use of chemical fertilizers had different effects on soil pH, salinity (EC), NH_4, NO_3, and PO_4 concentrations in both agricultural soils (Siliana-Tunisia and Oltenia-Romania). Whatever the treatment used during the incubation time, there is an increase in salinity (EC), NO_3 and PO_4, and a decrease in pH and NH_4. This decrease is probably due to the immobilization of ammonium. The applied treatments caused soil acidification, for both soils, the different results of the chemical parameters evaluated are explained mainly by the initial properties of each soil. Therefore, Mineral fertilizers are a net source of trace metals and their long-term application can increase the total metal concentration and affect the soil properties and hence in the food chain, then our soils are within the limits of agricultural soils, but we must always study the doses of mineral fertilizers to increase agricultural production by maintaining the "health" of the soil and environmental sustainability.

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