NITROGEN LEVEL IN SOIL AFTER MINERAL FERTILIZATION

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Abstract. *Of all the essential nutrients, nitrogen is required by plants in the largest quantity and is most frequently the limiting factor in crop productivity. Proper management of nitrogen is important because it is often the most limiting nutrient in crop production and easily lost from the soil system. In this paper are presented some results regarding the nitrogen dynamics in soil after mineral fertilization. The researches have been made on soil intensively fertilized with mineral fertilizers without micronutrients. Intensive mineral fertilization was made on winter wheat. The experiments were of bifactorial type, with 5 variants and 4 repetitions. Experimental variants were: nitrogen fertilization* N_0 *(0 kg/ha), 2 –* N_{50} *(50 kg/ha), 3 –* N_{100} *(100 kg/ha), 4 –* N_{150} *(150 kg/ha), 5 –* N_{200} *(200 kg/ha) and Phosphorus and potassium fertilization: 1.–* P_0K_0 *(0 kg/ha), 2-.*$P_{50}K_{50}$ *(50 kg/ha), 3.-*$P_{100}K_{100}$ *(100 kg/ha),4.-* $P_{150}K_{150}$ *(150 kg/ha). Fertilizars used were: ammonium nitrate and complex mineral fertilizer 15:15:15. Parameters analyzed were: pH, total nitogen, amonium nitrogen and nitrates. The usefulness of the resarch is very important, because world-wide every year are applied great amounts of mineral fertilizers and nitrogen is a key element for plants.For the cultivars this type of information is very important because they can apply in a durable and cheap way the fertilizers. The largest quantities of nitrogen were determined in the cold season (December), because the leading low temperatures had reduced the leaching.*

Key words: *nitrogen , mineral fertilization, ammonium, nitrates, soil pH.*

INTRODUCTION

Of all the essential nutrients, nitrogen is required by plants in the largest quantity and is most frequently the limiting factor in crop productivity. In plant tissue, the nitrogen content ranges from 1 and 6%.

Proper management of nitrogen is important because it is often the most limiting nutrient in crop production and easily lost from the soil system.

Nitrogen is a very dynamic element. It not only exists on Earth in many forms, but also undergoes many transformations in and out of the soil. The sum of these transformations is known as the nitrogen cycle. (CAMBERATO, 2001)

Though complex, the nitrogen cycle:

Helps us to understand the complex relationships that exist between the many forms of nitrogen

Provides us with insight pertaining to the availability of ammonium and nitrate, which are the only nitrogen forms usable by plants

To understand the many ways in which N may be lost from the soil

Nitrate is generally a very mobile in most soils. Excessive amounts of nitrate that are not taken up by plants is subject to leaching. Nitrate leaching can have an adverse effect on the environment. Nitrate, which moves through the soil profile during periods of rain, pollutes ground water reserves (CHANEY, 1990).

Surface runoff of nitrate is a source of eutrophication, or algal blooms, in lakes and estuaries. (HTTP://WWW.CTAHR.HAWAII.EDU/MAUISOIL/C_NUTRIENTS01.ASPX)

Nitrogen fertilizer rates are determined by the crop to be grown, yield goal, and quantity of nitrogen that might be provided by the soil. Rates needed to achieve different yields with different crops vary by region, and such decisions are usually based on local recommendations and experience. The quantity of nitrogen supplied by the soil is determined by the quantity of nitrogen released from the soil organic matter, released by decomposition of residues of the previous crop, any nitrogen supplied by previous applications of organic waste, and any nitrogen carried over from previous fertilizer applications. Such contributions can be determined by taking nitrogen credits (expressed in lb/acre) for these variables. (ECKERT, 2011)

MATERIAL AND METHODS

The researches have been made on soil intensively fertilized with mineral fertilizers without micronutrients. Soil type was the cambic chernozem with middle texture from Didactic Station Timisoara, with following properties:

- total density ranged between 2.43 g|cmc and 2.58 g|cmc, lower in higher;
- total porosity has medium values, excepting the soil surface were total porosity has highest value: 47%;
- soil reaction is weakly acid, pH=6.18;
- humus content of soil is ranged between 3.28 si 2.10%, nitrogen indicator is ranged between 3.08 la 2.04;
- phosphorus soil content is low – 15.1 ppm, and potassium content of soil is medium– 184 ppm;
- the value of cationic exchange capacity of soil is 30.35 me/100g.

Intensive mineral fertilization was made on winter wheat. The experiments were of bifactorial type, with 5 variants and 4 repetitions, as it follows:

Factor 1. Nitrogen fertilization

1 - N_0 (0 kg/ha)
2 – N_{50} (50 kg/ha)
3 – N_{100} (100 kg/ha)
4 – N_{150} (150 kg/ha)
5 – N_{200} (200 kg/ha)

Factor 2. Phosphorus and potassium fertilization

1. – P_0K_0 (0 kg/ha)
2. - $P_{50}K_{50}$ (50 kg/ha)
3. – $P_{100}K_{100}$ (100 kg/ha)
4. – $P_{150}K_{150}$ (150 kg/ha)

In order to fertilize the plots, it has been used complex fertilizers NPK15:15:15 and ammonium nitrate (33.5%N).

From field experiment soil samples was taken by depth of 0-20 cm for testing after cropping. Soil analysis was made in Soil Science Laboratory from Faculty of Agriculture Timisoara. pH was determined in water extract (soil: water = 1:2.5). Total nitrogen content was determined by Kjeldahl method.

Soil samples for the determination of nitrate and ammonium ion were collected in three different periods: December, March and June.

The determination of nitrates is based on the property of nitrates to form colored compounds with various organic solutions: with phenol-disulfonic acid forms yellow coloration, with diphenylamine forms blue coloration and with brucina forms blue or yellow coloration.

Ammonia is extracted from the soil with a solution of potassium sulphate (K2SO4) 0,1n, soil solution ratio being 1:3 and it is been colorimetrical dosed with Nessler's reagent.

RESULTS AND DISCUSSION

The reaction is one of the most important factors which influence the process of absorption of various substances by plant roots. except that the pH values exert a strong influence on the change of solubility and accessibility for plants of different chemical elements, but favors in a different way the activity of soil microorganisms, microorganisms that contribute to the mineralization of organic combinations, and then are contributing to atmospheric molecular nitrogen assimilation , to the process of nitrification, etc. (CAMBERATO, 2001)

Most variants had fallen below the weak acid threshold thanks to limit values that was found on witness parcel. Changes in pH downward widened as increased nitrogen rates. The finding is not new, the specialized literature had confirmed long ago the acidifying influence of nitrogen fertilizer (ammonium nitrate was used).

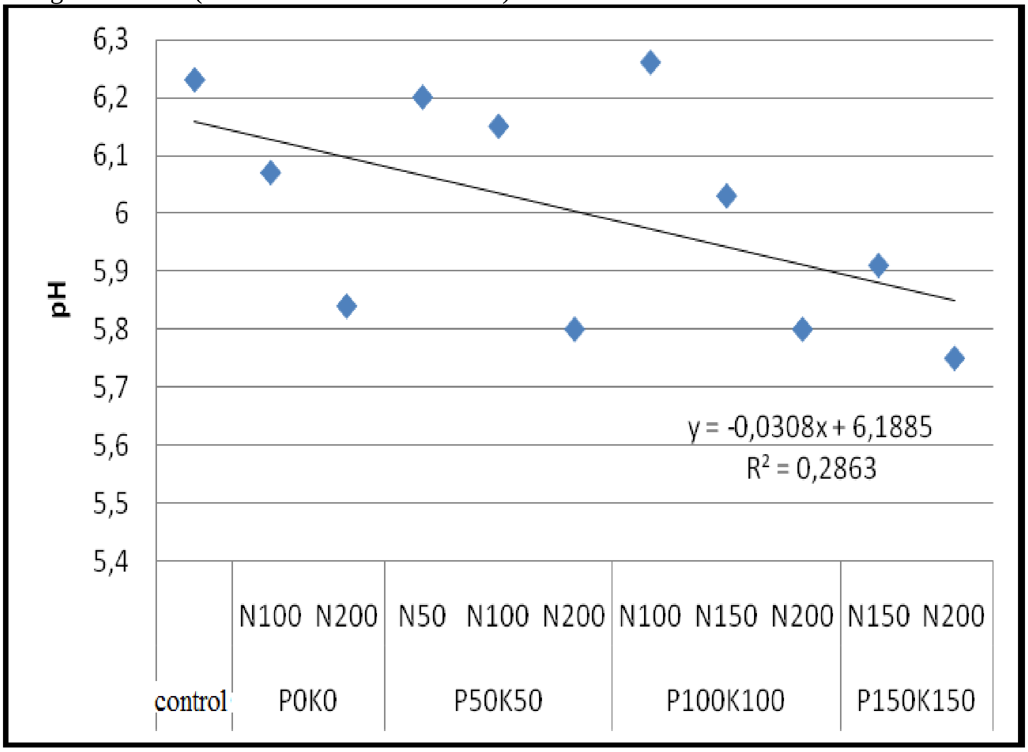

Figure 1. The pH trend of change in soil following application of nitrogen fertilizers.

The content of total nitrogen in soil varies in relation to soil type, pH, humus content, granulometric composition and depth. In deeper horizons total amount of nitrogen decreases together with the content decrease in organic matter on profile. (STEVENSON, 1982)

Mineral fertilization brought over a total nitrogen in the processed horizon of 0.01 to 0.02% with a maximum on variants that have applied doses of nitrogen fertilizer (N150). Also it was found an increase of total nitrogen concentration and in the fertilized variants only with phosphorus (0.01 to 0.032%) nitrogen coming from underground debris plus provided by mineral fertilization.

Yet rather large quantities of fertilizers applied (P150 K150 N200), is expected to increase more insurance status of soil with total nitrogen in particular for worked sequence, growth that is maintained within a limited interval, controlled by a slightly higher reaction of environment .

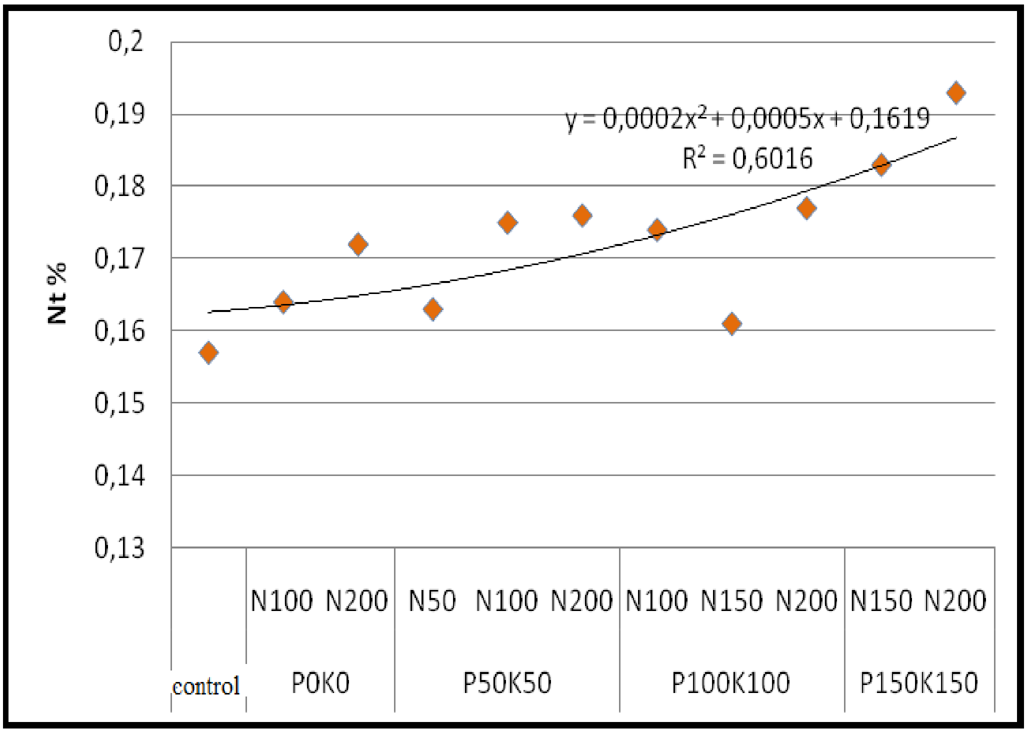

Figure 2. Influence of mineral fertilization on total nitrogen content in soil (0-25cm)

For plant nutrition reserves are not only interested in the total soil nitrogen and readily accessible forms to plants, consisted of simple inorganic compounds (NH4 +, NO3-, NO2-). These forms are released from organic nitrogen of soil but can also come from fertilizers. (BRADY AND WEIL, 2003)

The amounts of nitrogen released from soil organic matter are depending on the balance between mineralization and immobilization of nitrogen.

One of the first stage in nitrogen release from organic compounds depends on a range of microorganisms, which convert proteins and then amines and amino acids to ammonia (ammonification).The ammonium resulted can be converted to nitrate and nitrite (nitrification) can be used directly by the superior plants or it can be fixed in the state of more or less accessible in the colloidal network of the ground or in the crystalline network of argillaceous minerals. The ammonia form of nitrogen (NH4 +)can be absorbed and retained by the colloidal soil material. For this reason it is very little subject to leaching losses. (CHANEY, 2001)

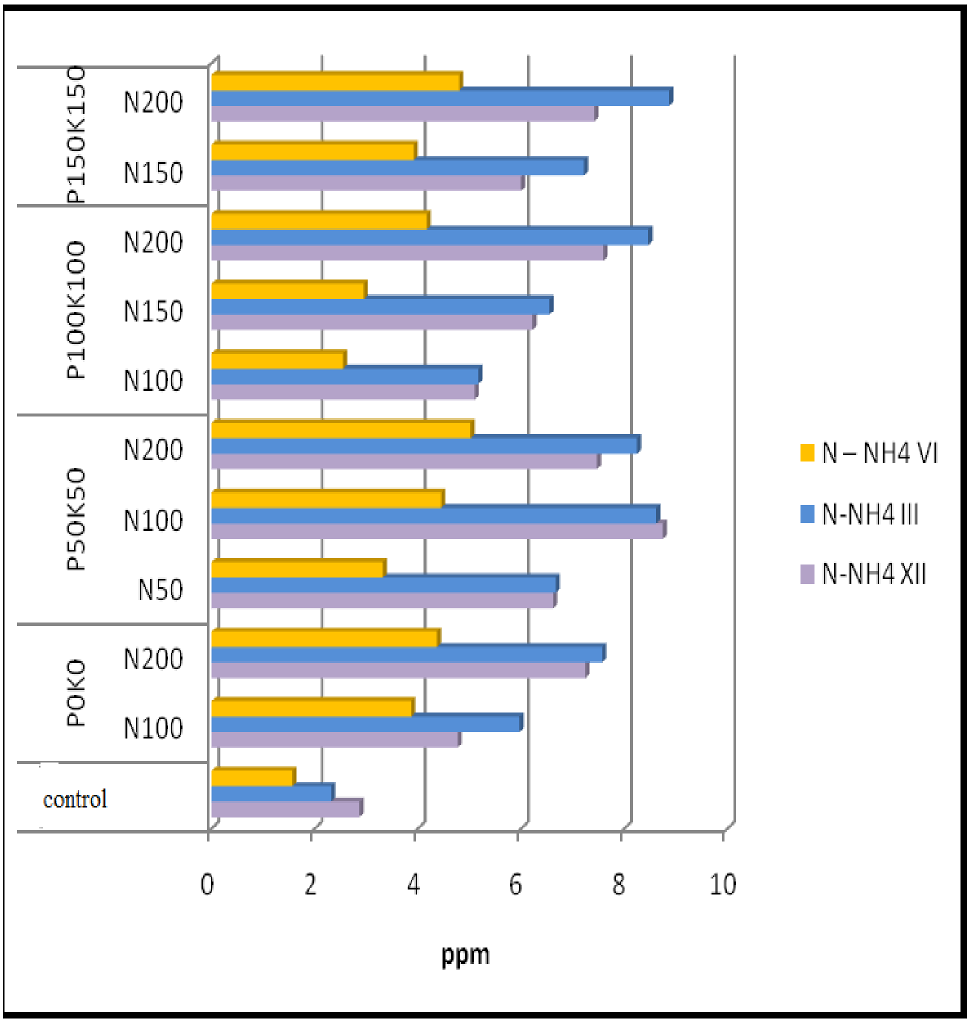

Figure 3.Influence of mineral fertilization on ammonium nitrogen content in soil (0-25cm)

In the mineral fertilization setting the largest quantities of ammonium nitrate have been achieved following administration of large amounts of nitrogen fertilizer. Highest amounts were determined in the cold season (December).

The harvests from March and June especially, have given lower values due to ammonia volatilization losses. These losses were partially blurred by the weak-moderately reaction of acid in horizon of processed soil, high adsorption capacity, conditional capacity of granulometric composition in which predominate clay fraction (33-40%) and also by the high percentage of humus, and also by the cloudiness and pluviometric witch are higher in this part of the country.

In-depth, the decreasing of ammonia nitrogen is slowly with values that are consistent with the insurance levels from the processing layer.

Nitrate nitrogen (N-NO3) is found in the soil solution exclusively in the form of diffusible ions. Even if it is found in small amounts in the soil this form along with the ammonia form has a great importance because they are forms used by plants. (CHIEN ET. ALL, 2009)

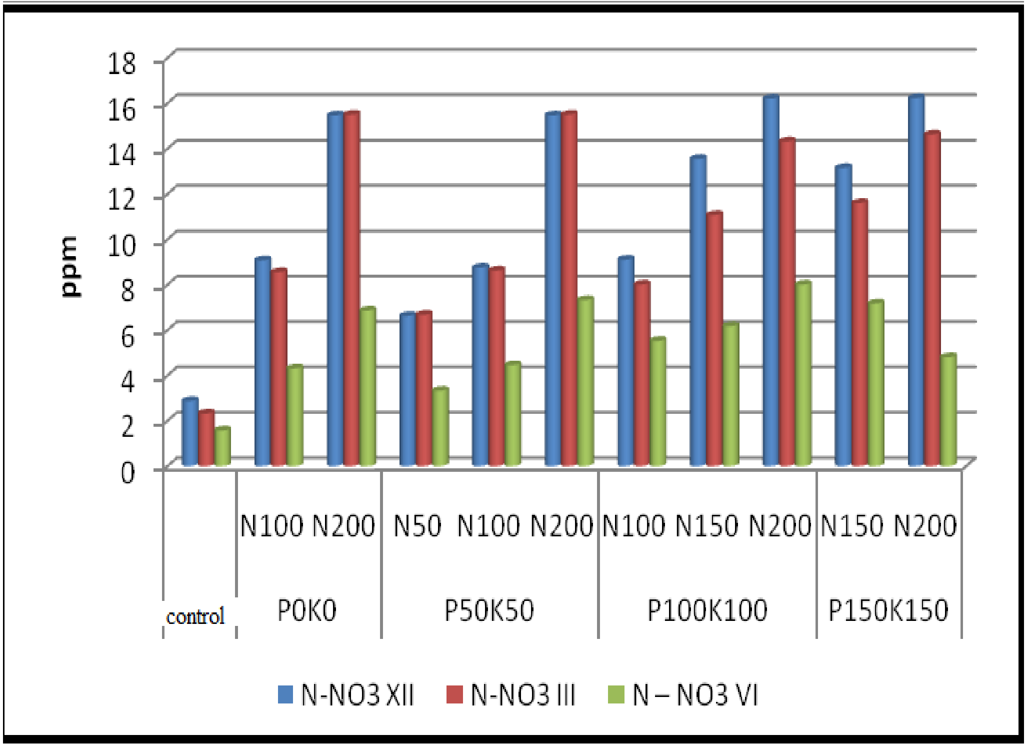

Figure 4. .Influence of mineral fertilization on nitrates content in soil (0-25cm)

Even if nitric nitrogen is conditioned by ammonia form, however, in all the experiences it is found at higher levels of ammonia, due to most of its electrical passivity towards colloidal micelles who keep it longer in solution due to pH values that grow progressively in depth, due of good soil aeration on chernozem soils and high temperature in summer season.

In the mineral fertilization situation, nitrate nitrogen values increase proportionally with the dose applied, without being influenced by the application of phosphorus and potassium fertilizers. Values starts from a minimum of approx. 3 ppm (medium insurance) increasing to more than 10 ppm (high content) in case of nitrogen doses of fertilizer above 150 kg / ha. The period with the highest amount of nitrate nitrogen recorded in the soil is the winter period when rainfall is low and temperatures are lower, which reduces the possibility of leaching. In profile, nitric nitrogen decreases gradually toward depth, with higher values in March and lower values in December and June.

CONCLUSIONS

1. Application of mineral fertilizers has led to the enrichment of the total nitrogen content by 0.01 to 0.02% , with a maximum where have been applied 150 kg.haN^{-1}.

2. Fertilization also resulted in an increase in the total nitrogen content in the variants fertilized only with phosphorus and potassium (0.01 to 0.032%), the extra nitrogen was coming from a plus underground remnants provided by mineral fertilization.
3. The ammonia form of nitrogen (NH_4^+) can be adsorbed and retained by the colloidal soil material. For this reason it is very little subject to leaching losses.
4. The largest amount of ammonium was determined in variants were nitrogen was applied in highest quantities
5. The highest values of NO_3^- were determined in December regardless of fertilization variants due to its negative charge, the NO_3^- ion cannot be retained by the soil colloidal complex, and therefore it is easily leached.
6. Smaller amounts of total nitrogen were determined in March and June this fact can be attributed to leaching and consumption by plants.

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