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Original Article

Determination of Nitrate Pollution Levels on an Argic Phaeozem in Order to Apply Fertilizers

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Abstract

Unlike other essential plant nutrition elements, soil nitrogen does not come from rocks or minerals from the earth's crust, its appearance and accumulation is subject to a number of biological processes. The nitrogen content of the soil is closely related to the soil organic matter content, in the composition of which nitrogen enters at a rate of about 5%. Lately, for assessing the level of available nitrogen in the soil, it becomes more widely spread the method of determining the nitrification ability that is based on biological nitrogen mineralization in soil under controlled incubation. In Romania, nitrate poisoning is still a problematic reality, especially in the northeastern region of the country. Elevated nitrates / nitrites in soil composition caused 84 cases of acute poisoning in Romania, and even deaths, just four years ago. Soil nitrates come from atmospheric nitrogen fixation by many plant species (vegetables) and are present even in the absence of nitrogen fertilization, the latter being but another major source of nitrates. Nitrates in groundwater come from the rainwater washing of nitrates that naturally exist in the soil surface (thus reaching the water table), or they can have fertilizer as a source. The natural nitrate concentration in groundwater is normally less than 10 mg/l. In most communes and villages in Romania, water from the wells is polluted with substances from animal waste, manure stored directly on the ground and not waterproofed latrines in private households. Soil nutrient pollution has negative consequences on crops and the environment. Excess nutrients weaken crop plants, making them more vulnerable to diseases and pests. This excess reduces plant resistance to drought, heat and cold, and production decreases. The last 30-40 years signal in a variety of situations, the generalization growth of $N\text{-}NO_3^-$ concentrations in soil, water and plant products and the phenomenon of excess nitrates is especially linked to the activities in agriculture and to uncontrolled organic and mineral fertilizing technologies [4].

Keywords: fertilizers, nitrates, soil nitrate pollution

1. Introduction

Nitrogen is considered one of the essential elements required in order to achieve crop production, holding roles in determining the quantity and quality of consumable products.

Effects of nitrogen fertilization are due to the presence, in the nutrient medium of bioaccessible ionic forms of this element (NO_3^- ŞI NH_4^+) and the productivity of their presence on crops resides in their essential and particular roles and are due also to the interactions, mostly positive with other nutrition elements or other factors that potentiate the specific effects and the nutritional interrelations effects [3].

Nitrogen is present in the soil in the form of different compounds which in terms of accessibility for the plants can be divided into three groups:

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a) insoluble organic compounds, difficult to break down, unassimilable for plants;

b) readily hydrolyzable organic compounds, which constitute a reserve of assimilable nitrogen;

c) mineral compounds readily soluble, form directly assimilated by plants.

Regarding the situation of soil fertility appreciation in terms of soil nitrogen content, are taken into account the last two mentioned groups.

By determining easily hydrolyzable organic compounds, are obtained indications of the capacity of soil to continuously renew the supply of mineral nitrogen; the amount of these compounds is less variable depending on the environmental conditions. The soluble mineral compounds, represented by nitrates, ammonia salts, and to a lesser extent by nitrites constitute the most mobile form of nitrogen in the soil, their amount varies depending on numerous climatic, biological and pedological factors. The determination of these compounds is generally used for characterization of assimilable nitrogen in the soil system.

Nitrates are nitrogen compounds that occur naturally in the soil, but may also be spread through fertilizers. Plants use nitrogen in nitrates for their own metabolism and to produce proteins. Nitrate is extracted from the soil through the roots and is distributed in the whole plant to be converted to protein compounds with high energy through photosynthesis. Surplus remaining contaminates groundwater, being found in rivers, lakes or groundwater and ultimately drinking water. Nitrate levels in ground and drinking water may become considerable, depending on the predominant form of land use.

2. Material and Method

The soil analyzed for the determination of nitrate nitrogen is an argic pheozem harvested from a depth of 0-20 cm. These types of soil are known in the specialty literature as degraded chernozems, highly levigated or very strongly degraded chernozems.

In SRCS (1980) this soil type is defined by a molic horizon (Am), chromes less than 2 and a clayey horizon B (Bt), having at least at the top, values and chromes lower than 3.5 for the wet material and values less than 5.5 for dry material both outside and inside the structural elements.

Nitrates of fresh soil samples were extracted quantitatively using a K_2SO_4 0.1 n solution and it is colourimetrically dosed with phenoldisulphonic acid in an alkaline medium. Nitroderivatives formed between phenoldisulphonic acid and nitric anion in alkaline environment, become yellow, the colour intensity is directly proportional to the concentration of the solution and sample reading is conducted using a UV-VIS spectrophotometer [2].

Determination analysis of nitrate nitrogen was achieved respecting the methodology recommended by the ICPA (1981, 1987) in the Soil-Plant Analysis Laboratory within Agricultural Chemistry of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca and are presented in Table 1.

Table 1. Determination of nitric nitrogen in the analysed soil

Conducted analysis	**Measuring unit**	**Values obtained on soil samples**				
		P1	**P2**	**P3**	**P4**	
Determination of nitrate nitrogen	mg NO_3^-/ kg soil	19.2	27.36	39.21	127.98	
		P5	**P6**	**P7**	**P8**	
		24.2	16.02	14.65	34.08	
		P9	**P10**	**P11**	**P12**	
		47.9	34.16	29.24	25.86	
		P13	**P14**	**P15**	**P16**	**P17**
		44.3	39.43	21.15	12.81	18.5

3. Results and discussions

From an agrochemical point of view, the soil is slightly acidic, following the limits of correction and protection of the reaction (pH). It has a high supply in humus, medium in phosphorus and high in potassium, probably due to the application in the area of manure exclusively. The values obtained from analyzed soil samples frame the soil in supply nitrates states highly differentiated - normal, good and very good representation of N- NO_3^-. Based on this spatial differentiation of the nitrates content is the application of nitrate nitrogen resources in the form of organic resources (manure, farm manure and composts) and variable mineral N mineral represented (Fig. 1).

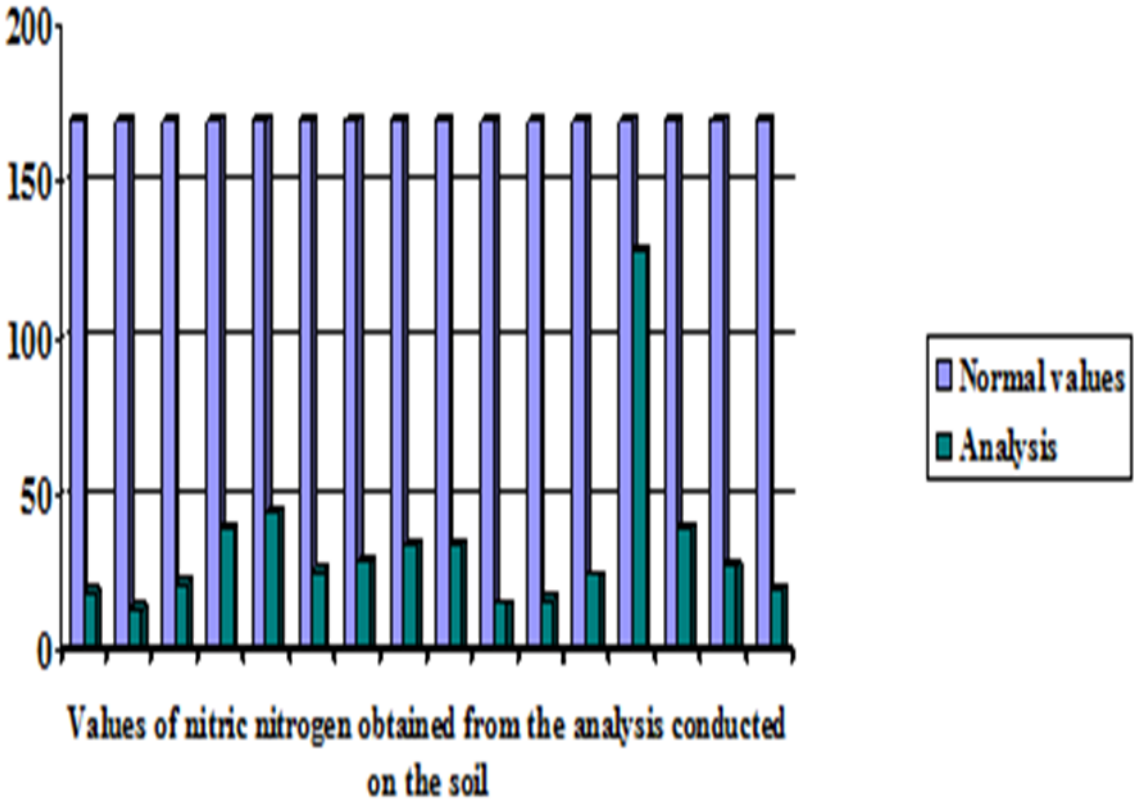

Figure 1. Values of nitrate nitrogen obtained on the type of soil analyzed compared to normal admitted values

4. Conclusions

On the analyzed soil, exhibiting a normal and good nitrates state of supply could be applied organic and mineral fertilizers in accordance with requirements of the crop that is going to be founded and nutrient needs of the crop;

For soil samples where the nitrate nitrogen insurance state is high, application, as organic resources and mineral fertilizers of nitrogen is not done in order not to exceed the maximum admitted limit of 170 kg of Total N/ ha;

If case the maximum permissible limit is exceeded and nitrates are found in excessive amounts in the soils, they become toxic to humans and plants.

References

[1] ICPA, 1981, Agrochemical soil analysis methods in order to establish the necessary amendments and fertilizers, Publisher ICPA Bucharest;

[2] Marghitaş M, C. Băluţiu, 1996, Agrochemistry, Practical Works, Tipo Agronomia, Cluj-Napoca;

[3] Rusu M., M. Mărghitaş, T.Mihăiescu, I. Oroian, A. Dumitraş, 2005, Agrochemistry Treaty. Publisher Ceres, Bucharest.

[4] Rusu M., 2016, Multiannual Agrochemical Research (Synthesis 1965-2016), Academic Pres, Cluj-Napoca;.