Mineral fertilization influence upon soil chemical properties

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Abstract

The objective of the research is to evaluate the way in which certain agrochemical indicators soil are modified under the influence of mineral fertilization using granulated, micro granulated and foliar fertilizers. The chemical pointers taken under consideration are the following, the reaction of soil solution ($pH_{water}$); the total nitrogen content; P mobile and K mobile. Total nitrogen content was determined by the Kjeldahl method; phosphorus was measured using UV-VIS spectrophotometer and potassium content was measured using atomic absorption spectrophotometer.

The present paper shows the results of the research in the experimental field situated in the Didactic Station of Banat’s University of Agricultural Science and Veterinary Medicine, on the changes of the agrochemical indices represented by $pH$, N, P, K in the context of an agricultural system based on field crops and a mineral fertilization system.

Key words: soil fertility, microgranulated fertilizers, granulated fertilizers, foliar fertilizers, agrochemical indicators

Introduction

It is known that the long chemical fertilization has an influence over the chemical properties of the soil: $pH$, N total, P and K mobile. (Borlan, 1994)

The application of larger nitrogen doses diminishes the quantity of cations adsorbed by soil, leading to a decrease of soil $pH$ and degree of base saturation. (Hera, 2002)

Fertilization systems are adapted to all types of agriculture, in the case of conventional agriculture; they are based almost exclusively on synthesis mineral fertilizers, in correlation with pedo-climatic and technological factors. (Sala, 2008)

In the Banat Plain the structure of crop plants is reduced. The area cultivated with leguminous plants (annual and perennial) has become much smaller. The predominant crop plants are wheat, maize and sunflower, and then come barley, two-row barley, soybeans, oil rape, with small impact in the realization of sustainable crop rotation. The rational use of fertilizers and other chemical substances it is compulsory because we should remember that, one of the main objective of sustainable agriculture is to assure food security. The chemical substances increase harvest with approximately 40 % measure up to another technological methods. This is one issue that can not be neglected in the policy of food providing industry.

Frequently, fertilization was not correlated with the reserve in the soil, which leads to unbalanced fertilization, using only nitrogen, in many cases the doses being smaller than the soil necessity.

Material and methods

The research for present paper took place in the experimental field situated in the Didactic Station of Banat’s University of Agricultural Science and Veterinary Medicine. The studies have continued in the Department
Mineral fertilization influence upon soil chemical properties

of Soil Science and Plant Nutrition reaserch labs. The major purpose of present research is to scientifically investigate the issues involved in the increase of crop quality and quantity, soil fertility and the decrease of environment pollution in the case of the controlled use of chemical fertilizers. This will provide new information which will help the transactions from nowadays agriculture to the sustainable one.

Research took place in 2010 - 2011, using the variety of wheat Alex.

The field experiments are the stationary type. In the experimental field, each plot is subdivided in four repetitions which are linear positioned, one next to another. Each micro-plot has 10 x 3.5 m (35 m²) dimension. There are 32 micro plots for wheat crop, 16 of which were fertilized with Nitrophoska and the other 16 were fertilized with Microstar. In the experiment, we used these doses of fertilizers: 20 kg / ha Microstar or Nitrophoska, 150 kg / ha NPK and 20 l / ha foliar fertilizer N⁺.

The soil samples were collected before applying fertilizers.

The project was carried out using the rotation of wheat and maize. These crops cover a significant part of the cultivated land in our area, using varieties of zonal hybrids for the west of our country.

The time and the way of chemical fertilizers administration are extremely important. We should establish in the correct manner the technique of administration for the chemical fertilizers in order to become more efficient. The nutritive substances should be situated as much as possible in the zone of active roots. From field experiments we took soil samples which were analyzed in our labs to observe the changes that may appear following the chemical treatments.

Chemical features of cambic chernozem are determined in the case of our experimental field cultivated with wheat. For this research we have used two types of micro granulated fertilizers (Nitrophoska 13:42:0 and Microstar 10:40:0 + 11SO₃ + 2Zn), one type of granulated fertilizers (20:20:0) and also, one type of foliar fertilizer (N⁺ – 28%).

The natural conditions for our experiment are specific to Banat Plain: the soil is cambic faeoziom (cambic chernozem), weakly gleyed, with neutral reaction (pH = 6.88 - 7.03), the humus content range between 2 and 3.2, nitrogen index IN = 3.09, high base saturation level (over 85 - 87%), the mobile phosphorus supply is poor (P₂O₅AL = 17.4 ppm) and medium supply with potassium (K₂O = 128 ppm).

Results and discussion

The chemical fertilizers bring a lot of modifications in the soil. This is caused by the intensification of physical, chemical and microbiological processes, by the change in consumption by crop plants and also, to other processes and mechanisms which take place in the soil. Using some agro-physical indicators and agrochemical characteristics, we tried to observe some physical and chemical changes in the soil.

The total nitrogen content fluctuates from 0,114 to 0,149. It is highly dependent of humus content from soil. The mobile phosphorus supply varies from 23.68 ppm to 25.83 ppm. This explains the necessity of phosphorus chemical fertilizers use.

Things are better in the situations of mobile potash content, this range between 152.89 to 176.14 ppm. Which means that the soil is medium supplied with this nutritive element.

<table>
<thead>
<tr>
<th>Table 1. Mineral fertilization influence upon soil chemical properties</th>
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<tbody>
<tr>
<td>Index determined</td>
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<tr>
<td>pH in water</td>
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<tr>
<td>N total (%)</td>
</tr>
<tr>
<td>P mobile ppm</td>
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<tr>
<td>K mobile ppm</td>
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</table>

In the case of soil reactions, we can observe a slight soil acidification with pH values going down from 7.04 for the unfertilized field (N₀P₀K₀) to 6.88 – 6.89 for variants using micro granulated fertilizers, granulated and foliar fertilizers. The relatively small limits of pH modification prove good soil plugging capacity.
Table 2. Mineral fertilization influence upon soil chemical properties

<table>
<thead>
<tr>
<th>Index determined</th>
<th>Average values per fertilization variant</th>
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<tbody>
<tr>
<td></td>
<td>No(\text{P}_0\text{K}_0)</td>
</tr>
<tr>
<td>pH in water</td>
<td>7.04</td>
</tr>
<tr>
<td>N total (%)</td>
<td>0.116</td>
</tr>
<tr>
<td>P(_{\text{mobile}}) ppm</td>
<td>24.00</td>
</tr>
<tr>
<td>K(_{\text{mobile}}) ppm</td>
<td>153.14</td>
</tr>
</tbody>
</table>

The total nitrogen content (\(N_t\)) range from 0.114 % in variant \(\text{N}_0\text{P}_0\text{K}_0\) to 0.149 % for variant Microstar NPK 20:20:0 \(N^+\). The manner in which nitrogen is found in micro granulated fertilizers is ammonia; this is also what plants preferred in vegetation period. The wheat assimilation of nitrogen takes place during all vegetation period with various intensities depending of phenologic phases of growing and development.

In soil, the phosphorus content increase with application of phosphorus doses. The micro granulated fertilizers content easy soluble form of phosphorus which is accessible for various plants even in the condition of poor developed root system. Microstar fertilizers content also sulfur and zinc, which helps in growing of roots system and also, increase plant resistance to winter, drought and frost.

The values found after soil analysis shows potassium good supply.

**Conclusions**

All essential nutritive elements have significant role in plants life, each one taking tasks which cannot be substituted.

Rational fertilization which starts with micro granulated fertilizers local application, must assure nutritive substances in easy assimilable forms and in corresponding quantities for plants.

The research revealed the differentiated influence of types and doses of fertilizers (used in various combinations) on the main chemical characteristics of the cambic chernozem at Didactic Station of Banat University of Agricultural Science and Veterinary Medicine.

Mineral fertilization with micro granulated, complex NPK and foliar fertilizers maintains a high level of soil-plant balance regarding the consumption of nutritious elements and ensures balanced nutrition for crops.

Microgranulated fertilizer fertilization resulted in increased total nitrogen content, phosphorus and potassium fertilization in all variants. The appropriate dose was determined for wheat crop for fertilizer application Microstar, NPK 20:20:0, \(N^+\).

**References**

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