Study regarding the influence of NPK fertilizers on the total nitrogen content from tomato (Lycopersicum esculentum)

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Abstract
Nitrogen is an indispensable element for plants, being the fourth element as a percentage of plants by carbon, oxygen and hydrogen, in his absence they do not develop as a result of inhibition of chlorophyll synthesis and loss of nutritional values of fruits, hence the efficiency of this element in plans fertility of all plants. Conversely nitrogen (N), plants sensitizes the fall and decreases resistance to frost, pests and drought. Tomato culture occupies a leading position in the EU population consumption, the importance of which derives from the rich content of vitamins, carbohydrates, organic acids, mineral salts (potassium more, then, iron, phosphorus, magnesium, calcium, aluminum, iodine, etc.) and energy items therefore be pursued and N content in fruits, due to the application of fertilizer nitrogen content in excess causes toxicity phenomena. The theme of the paper, it aims to conduct various types of simple and combined NPK fertilizers, applied to two types of soil: chernozem and aluviosoil in vegetation pots, on tomato crop, following their remanence in plants and production increase. NPK based fertilizers applied to tomatoes as basic fertilizer are soluble and easily assimilated by plants, dosing being correlated with soil properties and climatic conditions (BALIGAR & al.[4], DAVIDESCU [10], DORNEANU [11]). In terms of experimenting with the application of various doses of fertilizer based on NPK, no differences of values are recorded which ensure statistically compared with the control variant in the case of tomatoes, and in leaves most variants recorded very significant value, less in variants fertilized with N100P100.

Keywords: fertilisation, nitrogen, leaves, chernozem, Lycopersicon esculentum

1. Introduction
Nitrogen (N) is the nutrient most limiting crop production increase. Use proper management practices can optimize nitrogen use efficiency so as to have no residual effects on plants and soil. Following the application on soil nitrogen is lost through volatilization, part is immobilized forms inaccessible, denitrification, these losses are covered by soil, climatic factors, type of fertilizer, and crop management practices (BRADBURY & al. [8]). The soil is the main source of mineral nutrients and water for plants, but its ability to provide plant nutrients needed varies depending on the level of fertility. The removal of nutrients from the soil into the plant by sucking them through leaching or other processes related to the natural dynamics of soil, reducing entail the contents of mobile forms of nutrients and the gradual decline of production capacity of soils.

For these reasons, it is necessary that an objective necessity compensation by applying mineral and organic fertilizers, both in consumption of crops and decrease the mobility of
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To realize its full potential productive cultivated plants need adequate amounts of water, light, carbon dioxide and mineral nutrients (nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, and a number of micronutrients). The need for N is provided to the application of nitrogen fertilizers, where it is absorbed and accumulated in the plant in two forms, ammonia (NH$_4^+$) or nitrates (organic nitrogen) (NO$_3^-$), and is influenced by a number of factors such as the crop species, the period vegetation and soil conditions (SIDDIQI & al. [20], BLOOM [5], NEAȚĂ [19]). 

Ammonium (NH$_4^+$) proved to be a source of nitrate nitrogen equivalent (NO$_3^-$), when supplied at reasonable, with the pH buffer concentration and an appropriate level of macro and micronutrients (SIDDIQI & al. [20]). An immediate effect of the application of nitrogen (N), is an increase yields by 15-20% following their application (ANTON & al. [1], KIRDA & al. [15], ERTEK & al. [13]). In this context it is envisaged nitrate and nitrite content in plants as a result of unreasonable application of nitrogen fertilizers.

Studies show a nitrate content relevant minimum, between 98 ppm and 131 ppm of NO$_3^-$ maximum fertilized tomato, where the maximum permissible limit is 150 ppm nitrate NO$_3^-$.

These results shows that tomatoes are good for consumption (MOIGRĂDEAN [18], LĂCĂȚUȘU & al. [17], SIMION & al. [21]).

Other researches (VOLENEC [24], ARNONE [2], LAITINEN & al. [16], GOULD WILBUR [14]), highlighted that nitrate concentrations in vegetables have the inorganic sources and can be accumulated in plants during vegetation cycle (U.S. ENVIRONMENTAL PROTECTION AGENCY [22]).

The theme of the paper aims to conduct different types of root chemical fertilizers, applied to two soil types in tomato crop in terms of quality production obtained and their remanence in soil. Fertilizing the vegetable crops is based on rhythm and adsorption of nutrients. Thus, the tomatoes during fruiting consume much nitrogen and potassium, therefore it is recommended to use simple or complex fertilizer with high content of active substance. (VOICAN [23]).

### 2. Materials and Methods

The research was conducted in the vegetable house, studying the culture of tomatoes, placed on two soil types namely chernozem and aluviosoil. Qualitative analysis of tomato fruit grown in the two variants of soil were carried out in application of several types of combined fertilizer (urea, potassium chloride (V$_3$), potassium sulfate in V$_6$). Tomato culture was made by transplanting of seedlings (one plant/pot), which matures after 70 days. The tomatoes weight at mature stage were of 120 - 140 g. The Planting seedlings were carried out in early May.

Experiments were placed in vegetation pots in a bifactorial experience with 6 variants of 4 repetitions for each soil type. Factor A has two graduations and is the type of soil (a1 - Chernozem, a2 - Aluviosoil) and factor B, with 6 graduations is the fertilization system, including control (unfertilized). Fertilizers were applied and incorporated into the soil as planting vegetation vessels.

In the experiments on the influence of nitrogen fertilizer on tomato fruit in vegetation house were analyzed the following factors:

**A. Soil type, with graduations:**
- a1 – Chernozem
- a2 – Aluviosoil

**B. Fertilization with graduations:**
- b1 - NoPoKo (unfertilized)
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For the determination of total nitrogen in tomato leaves, the Kjeldahl method was used. This is based on the fact that organic substances by boiling with concentrated H₂SO₄, which in the presence of a catalyst decomposes, (hydrogen peroxide 30 % as an oxidant) releasing their components in different forms: carbon as carbon dioxide, hydrogen and oxygen as water and nitrogen is transformed quantitatively into ammonia nitrogen. Nitrogen is lost during Kjeldahl analysis when the temperature exceeds about 400°C. (BREMEER [9]).

Determination comprises three successive stages: organic matter mineralization; ammonia distillation and titration of ammonia (BRADSTREET [7]).

The calculation was made by the method of experimental data analysis of variance.

3. Results and Discussions

The nitrogen, essential element for plant growth and fruition, is necessary especially during the intense fruition. In the early stages of vegetation, nitrogen leads to a lush growth of plants on the expense of fruiting.

Following the analysis performed on both types of soil studied, reveals a total accumulation of nitrogen in tomato plants.

From the analysis of data on total nitrogen content in the leaves (Table 1), on aluviosol is found out that it varies between 1.21% to variants V4 (P₁₀₀+K₁₀₀), close to unfertilized control variant (V1) with a total N content of 1.23%, not being differences ensured statistically.

Variants V2, V3, V5, are statistically ensured as being very significant, compared to control variant, Nt reaching to values of 1.91% total nitrogen in V2. In the case of variant V4, where doses of P₁₀₀+K₁₀₀, are applied, there is no difference ensured statistically.

Applications of nitrogen increased N concentrations in leaf, tomatoes and vegetative biomass (ERDAL & al. [12]).

Table 1. Average of total nitrogen content in tomato leaves (%) on the two types of soil

<table>
<thead>
<tr>
<th>No. variant</th>
<th>Fertilization with graduations</th>
<th>Aluviosol Average (%)</th>
<th>The difference</th>
<th>Significance</th>
<th>Chernozem Average (%)</th>
<th>The difference</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>N₀P₀K₀ (unfertilized)</td>
<td>1.23</td>
<td>Variant control</td>
<td></td>
<td>1.35</td>
<td>Variant control</td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td>N₁₂₀+K₁₀₀</td>
<td>1.91</td>
<td>0.69</td>
<td>***</td>
<td>1.85</td>
<td>0.49</td>
<td>***</td>
</tr>
<tr>
<td>V3</td>
<td>N₁₂₀+K₁₀₀</td>
<td>1.84</td>
<td>0.61</td>
<td>***</td>
<td>2.50</td>
<td>1.15</td>
<td>***</td>
</tr>
<tr>
<td>V4</td>
<td>P₁₀₀+K₁₀₀</td>
<td>1.21</td>
<td>-0.01</td>
<td>–</td>
<td>1.30</td>
<td>-0.04</td>
<td>–</td>
</tr>
<tr>
<td>V5</td>
<td>N₁₂₀+P₁₀₀+K₁₀₀</td>
<td>1.61</td>
<td>0.4</td>
<td>***</td>
<td>1.51</td>
<td>0.16</td>
<td>*</td>
</tr>
<tr>
<td>V6</td>
<td>N₁₂₀+P₁₀₀+K₁₀₀</td>
<td>1.78</td>
<td>0.56</td>
<td>***</td>
<td>1.83</td>
<td>0.47</td>
<td>***</td>
</tr>
</tbody>
</table>

DL 5% 0.165214 0.124764
DL 1% 0.203903 0.159099
DL 0.1% 0.267751 0.221028
In the case of **chernozem**, the nitrogen content in leaf varies between 1.36% in control variant and 2.11% in variant V3 fertilized with \( \text{N}_{120}+\text{K}_{100} \).

Among the leaves of the tomato there are clear differences in the accumulation of total nitrogen, depending on the type of soil.

Analyzing the data in Table 2 on productions obtained at tomato crop in chernozem, it is found out that the productions vary between 2.35 kg/plant to control version \( \text{V}_{2} \) fertilized with \( \text{N}_{120}+\text{K}_{100} \) and 3.45 kg/plant at variants \( \text{V}_{5} \) and \( \text{V}_{6} \) fertilized with \( \text{N}_{100}+\text{P}_{100}+\text{K}_{100} \).

### Table 2. Determination of tomato production (kg / plant) on the two types of soil

<table>
<thead>
<tr>
<th>No.</th>
<th>variant</th>
<th>Fertilization with graduations</th>
<th>Aluviosoil Average</th>
<th>The difference</th>
<th>Significance</th>
<th>Chernozem Average</th>
<th>The difference</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>( \text{NoPnK}_0 ) (unfertilized)</td>
<td>2.38</td>
<td>Variant control</td>
<td>2.85</td>
<td>Variant control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td>( \text{N}<em>{120}+\text{K}</em>{100} )</td>
<td>4.01</td>
<td>1.63</td>
<td>***</td>
<td>5.2</td>
<td>2.30</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>V3</td>
<td>( \text{N}<em>{120}+\text{K}</em>{100} )</td>
<td>4.17</td>
<td>1.79</td>
<td>***</td>
<td>5.15</td>
<td>2.35</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>V4</td>
<td>( \text{P}<em>{100}+\text{K}</em>{100} )</td>
<td>3.57</td>
<td>1.19</td>
<td>***</td>
<td>4.81</td>
<td>1.96</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>V5</td>
<td>( \text{N}<em>{120}+\text{P}</em>{100}+\text{K}_{100} )</td>
<td>5.3</td>
<td>2.92</td>
<td>***</td>
<td>6.3</td>
<td>3.45</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>V6</td>
<td>( \text{N}<em>{120}+\text{P}</em>{100}+\text{K}_{100} )</td>
<td>5.31</td>
<td>2.93</td>
<td>***</td>
<td>6.3</td>
<td>3.45</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>DL</td>
<td>5%</td>
<td>0.249182</td>
<td>0.200746</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DL</td>
<td>1%</td>
<td>0.389422</td>
<td>0.313727</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DL</td>
<td>0.1%</td>
<td>0.562766</td>
<td>0.453377</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the case of **aluviosoil**, the productions obtained vary between 2.38 kg/plant to control variant and 5.31 kg/plant at variant \( \text{V}_{6} \), fertilized with \( \text{N}_{100}+\text{P}_{100}+\text{K}_{100} \). The lowest average productions were recorded in variant \( \text{V}_{4} \), where N was not used to fertilization.

Statistically speaking, very significant production increases were obtained in all variants.

### 4. Conclusions

In case of combined application of recommended doses of NPK in the experience, the green elements of tomato plants recorded increases of total nitrogen content above the normal.

The nitrogen content accumulated in leaves, as a result of NPK fertilization, is very significant in variants where the nitrogen fertilizer was applied \( \text{V}_{2} \), \( \text{V}_{3} \), \( \text{V}_{5} \) and \( \text{V}_{6} \) and insignificant in both types of soil, when the combined fertilizer (PK) did not contain nitrogen too. Only in variant \( \text{V}_{4} \), \( \text{P}_{100}+\text{K}_{100} \) in which the nitrogen was not used combined, total residual nitrogen was not found in their leaves.

Aluviosol known to be poorer in nutrients better absorbs the combination of fertilizer applied, while chernozem tomato plants available to larger amounts of total N, which reveals to balanced fertilization on soil type aluviosol.

The production differences were ensured statistically as the effect of the application of complex mineral (NPK) of fertilizers in all variants, the increases of maximum production being at doses of \( \text{N}_{120}\text{P}_{100}\text{K}_{100} \).

Total nitrogen found in tomato leaves is useful to future organic fertilization with these plant residues.

### References