# CHANGE IN TIME OF AGROCHEMICAL SOIL PARAMETERS AFTER TOMATO MINERAL FERTILIZATION

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**ABSTRACT**
The paper presents the results regarding the effect of different NPK fertilization doses on change, during three years of agrochemical soil parameters after tomato mineral fertilization. The following agrochemical indicators were analyzed: pH, humus, total nitrogen, mobile phosphorus and mobile potassium content.
The experience was done in a cambric cernosium soil, with low acidity reaction, very good content in nitrogen, phosphorus and potassium and the high natural fertility potential favorable vegetables cultivation in Romanian Western Plain area. The experimental field is located in temperate climatic area, characterized by Koppen classification in the formula Cfbx. The study was performed on control soil samples (without fertilizers) and soil samples after differentiated NPK fertilization in variable dozes: $N_{30}P_{30}K_{30}$, $N_{45}P_{45}K_{45}$, $N_{60}P_{60}K_{60}$ and $N_{120}P_{60}K_{60}$. Tomato fertilization with mineral fertilizer determines, in time, significant modifications of agrochemical soil parameters. To preserve the soil quality must find the optimum dose of NPK fertilizer in tomato crop fertilization.

**Keywords**: agrochemical soil parameters, mineral fertilization, tomatoes

## INTRODUCTION

The fertilization doses and the application methods in tomatoes fertilization were to determine in correlations between agrochemistry factors. Most soils do not naturally possess all the nutrients that are needed to produce top quality yields, crop after crop. Tomato (*Lycopersicum esculentum*) is one of the popular and most consumed vegetable in the world. Tomatoes need moderate to high levels of phosphorus and potassium.

The pH value of soil is one of a number of environmental conditions that affects the quality of plant growth. The soil pH value directly affects nutrient availability. Plants thrive best in different soil pH ranges (www.savvygardener.com). Optimum soil pH for tomatoes cultivations is between 6.0-6.5 (MANESCU, 2003).

The soil humus, or organic colloidal fraction is composed of highly decomposed residues of plant and animal remains (HODGES, 2010), having an important role in its fertility (MILES, 2003). Soil organic matter is distinguished by its high moisture retention, low plasticity, low cohesion, and the dark color it imparts to the soil. The structure of soil organic matter is extremely complex, with many different types of functional groups which can contribute negative charges as well as interact in other more specific ways with cations and organic molecules. Humus does not readily fix exchangeable cations but maintains these ions in an easily exchangeable form. Mineralization of soil humus releases some amounts of nitrogen, phosphorous and sulfur from organic forms, and can dramatically influence the availability of micronutrients. The availability of nutrients to plants is determined by the form and chemical properties of the element, the soil pH, interactions with soil colloids, microbial activity and soil physical conditions such as aeration, compaction, temperature, and moisture (HODGES, 2010).

Nitrogen is a basic component of humus. Concentrations in Romanian soil is between 0.09-0.35% N (LIXANDRU, 1990) up to 0.38% N (GOIAN, 1994). Nitrogen is one of the main nutrients required for plant growth and is therefore applied to crops in large amounts to ensure big yields. Nitrogen fertilizer was often used in excess in the past; as a consequence, soil and water were subject to heavy pollution.

Phosphorus it has low mobility and availability in soils. It is difficult to manage because it reacts so strongly with both solution and solid phases of the soil. As a result, mobility through the soil is extremely limited. While phosphorus occurs in a multitude of inorganic and organic forms in the soil, the plant available forms of phosphorus are limited primarily to solution $HPO_4^{-2}$ and $H_2PO_4^-$, with the dominant form determined by the soil pH. In soils with pH between 4.3 and 7.0, the $H_2PO_4^-$ form predominates (HODGES, 2010). The total phosphorus content in soil in Romania ranges from 0.05-0.3% $P_2O_5$, respectively 0.02-0.12% P (GOIAN, 1994).

Potassium is relatively mobile in the soil, meaning it is readily leached through the soil profile and can be lost from the root zone. Although potassium does move through the soil, if large quantities need to be applied it is best to work it into the soil. Only 1-3% of total soil potassium is potassium exchangeable (GOIAN, 1994).

Complex NPK fertilization maintains a high level of soil-plant balance regarding the consumption of nutritious elements and ensures balanced nutrition for crops (SALA, 2010).

## MATERIAL AND METHOD

The experiments were carried out over a period of 3 years: 2006, 2007, 2008. Soil samples were taken 0-25cm depth and were collected in spring 2006, before the establishment of tomato crop and in each year, in June, after tomato crop establishment. The fertilization was applied in spring, with four weeks before tomatoes plantation (DUMAS, 2003). Were use dry/granulated fertilizers NPK 15:15:15 and the nitrogen high dose supply with urea application. pH was determined in aqueous suspension, 1:2.5 soil-solution proportions, using the potentiometric method. The humus was determined by titrimetric method after Walkley-Black (1943). The total nitrogen content was determined by using the Kjeldahl method using UDK 127 Distillation Unit and DK6 model Digester Unit from Velp Scientifica. Mobile phosphorus content was extracted with ammonium lacto-acetate by using the Egner-Riehm-Domingo method (P-AL) using Spectrophotometer UV-VIS SPECORD 205 by Analytik Jena. The concentration of mobile (changeable) potassium was used in the same ammonium lacto-acetate extract (Egner-Riehm-Domingo) (K-AL) by flame photometry (MAIA, 1983). Were used chemicals and reagents from Merck; deionized water.

## RESULTS

Timisoara city receives, thanks maritime air masses from the northwest, a higher rainfall with a multiannual average values of 631.0 mm. The climate conditions of the area are characterised by average annual temperature of 10.7 $^0$C. To characterize the area were used meteorological data recorded at the Meteorological Station of Timisoara, in the period 2006-2008 and multiannual average.

In the period when our research was carried out, the temperature values recorded were higher than the multiannual average (*Table 1*).

**Table 1. The air temperatures recorded at the Meteorological Station Timisoara**

| Years | Monthly average temperatures [$^0$C] | | | | | | | | | | | | Annual average [$^0$C] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| 2006 | -1.7 | 0.0 | 5.0 | 12.4 | 16.2 | 19.5 | 23.6 | 20.1 | 17.5 | 12.0 | 6.4 | 2.1 | 11.10 |
| 2007 | 4.0 | 6.0 | 9.0 | 13.0 | 18.3 | 22.5 | 24.1 | 23.0 | 14.9 | 11.0 | 4.2 | 0.1 | 12.51 |
| 2008 | 1.8 | 4.8 | 8.3 | 12.4 | 17.8 | 21.6 | 21.9 | 22.6 | 15.4 | 12.3 | 7.1 | 3.6 | 12.47 |
| Multiannual average [$^0$C] | -1.2 | 0.4 | 6.0 | 11.3 | 16.4 | 19.6 | 21.6 | 20.8 | 16.9 | 11.3 | 5.7 | 1.4 | 10.85 |

Source: National Meteorological Administration

*Table 2* shows montly precipitation for three experimental years and annual average. The precipitations has irregular nature. In the second experimental year the total rainfall was the maximum annual sum values (662.4 mm) and in the third year the highest monthly values was in June (157 mm).

**Table 2. The rainfall recorded at the Meteorological Station Timisoara**

| Years | Monthly average precipitations [mm] | | | | | | | | | | | | Annual sum [ mm] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| 2006 | 30.0 | 42.0 | 49.0 | 78.8 | 50.2 | 87.8 | 50.4 | 98.0 | 21.0 | 17.4 | 31.3 | 21.3 | 577.2 |
| 2007 | 26.0 | 92.0 | 57.0 | 4.4 | 69.4 | 65.2 | 46.4 | 65.0 | 62.0 | 57.0 | 92.0 | 26.0 | 662.4 |
| 2008 | 45.7 | 22.6 | 78.4 | 44.7 | 49.0 | 157 | 45.7 | 24.8 | 51.5 | 17.5 | 53.1 | 55.1 | 645.1 |
| Annual average [mm] | 40.9 | 40.2 | 41.6 | 50.0 | 66.7 | 81.1 | 59.8 | 52.3 | 47.1 | 54.8 | 48.6 | 47.8 | 631.0 |

Source: National Meteorological Administration

Soil agrochemical parameters before experiment were followed: pH=6.34, humus=3.00, N=0.29%, P=163.00 ppm, K=160.00 ppm. The analysis show that soil its favorable for tomatoes cultivation (DAVIDESCU, 1992; MANESCU, 2003). A soil test does not end when the results are determined in the laboratory. Those results must be related to the expected level of plant response and the appropriate rate of fertilizers required eliminating nutrient deficiency (HODGES, 2010).

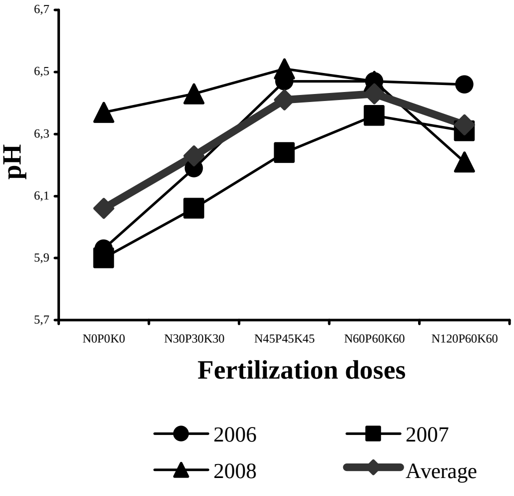

**Figure 1. Change of soil pH after tomato mineral fertilization**
Source: own research

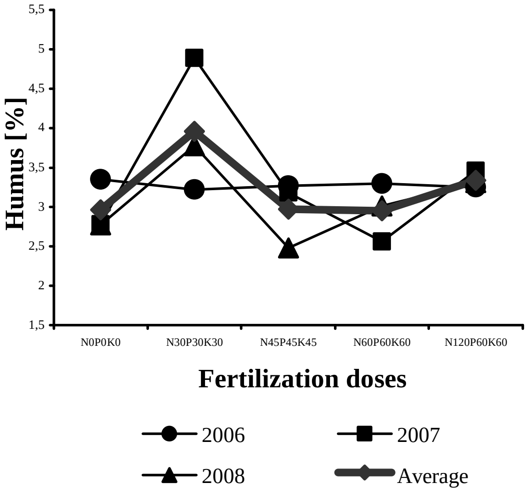

**Figure 2. Change of soil humus after tomato mineral fertilization**
Source: own research

Over the three experimetal years, soil pH change (*Figure 1*). pH increases from one experimental year to another of the unfertilizerd variant and the variants fertilized with low NPK fertilization doses and decreases at higher fertilization doses. While the fertilization with nitrogn, phosphorus and potassium has an significant influence on soil pH, the application of urea nitrogen form to decrease of soil pH and affect availability of plant which for other nutrients.

Rainfall also affects soil pH. Water passing through the soil leaches basic nutrients such as calcium and magnesium from the soil. They are replaced by acidic elements such as aluminum and iron. For this reason, soils formed under high rainfall conditions are more acidic than those formed under arid conditions (www.savvygardener.com).

In *Figure 2* we observed that the humus has a linear dependence in the first experimental year on all fertilization doses. In the second experimental year the humus values shows a jump from the unfertilized variant (2.78%) to $N_{30}P_{30}K_{30}$ fertilization doses (4.89%) after falling to normal levels. At the maximum fertilization doses studied ($N_{120}P_{60}K_{60}$) the humus soil content it keeps the same values as the control.

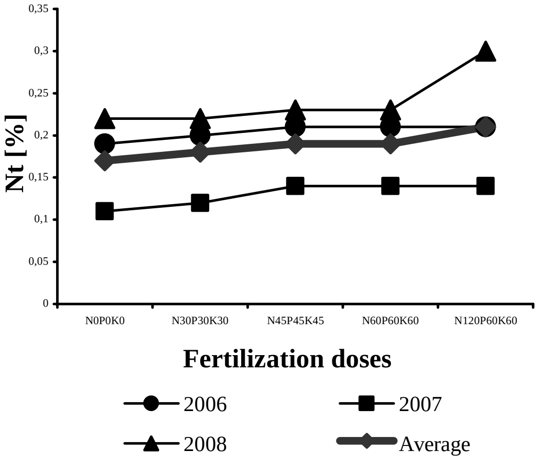

**Figure 3. Change of soil nitrogen after tomato mineral fertilization**
Source: own research

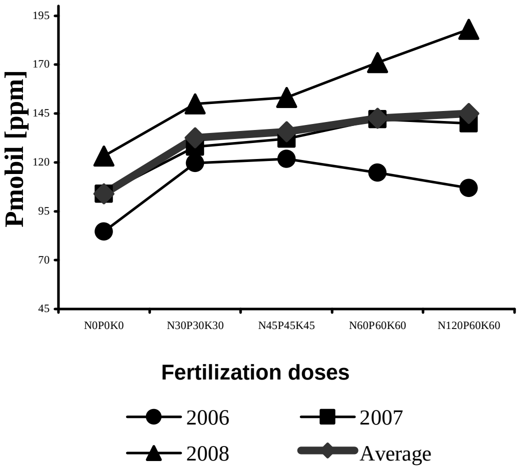

**Figure 4. Change of soil phosphorus after tomato mineral fertilization**
Source: own research

Total nitrogen content in soil increases, compared with control samples (RADULOV, 2009), in all experimental years, between 0.11-0.30% N (*Figure 3*). In 2007 the percentage of total nitrogen in the soil is below the average experimental years, has a linear dependence of all fertilization doses because when urea is applied to the soil surface, N loss as gaseous ammonia is possible, especially with warm, dry conditions and a soil high pH (HODGES, 2010).

Phosphorus is relatively immobile in soil. Phosphorus moves very slowly in mineral soils and thus tends to build up over time when the amount of phosphorus added in fertilizer and organic matter exceeds the amount removed in the harvested portions of crops (www.soil.ncsu.edu). Due the fixation process of phosphates in the soil, only 15-50% of the phosphorus content of mineral fertilizers comes to be used by the plants, the rest is retained in the soil in the form of inaccessible compounds (GOIAN, 1994).

Mobile phosphorus concentrations increased on all levels of fertilization from one experimental year to another (*Figure 4*).

From previous research it is known that the phosphorus uptake can also be affected by cool soil temperatures, water-logged soil conditions and soil pH (HODGES, 2010).

Potassium is also mobile in soil; the accumulation of potassium also depends upon soil texture (Osmond, 2008**)** and movement is primarily through diffusion. It is much less mobile than nitrate nitrogen, but more mobile than phosphorus (Hodges, 2010).

Potassium is soluble in water and can be leached out of the soil profile into the groundwater (Sainju, 2003).

Only 1-3% of total potassium in soil is potassium changeable (Goian, 1994).

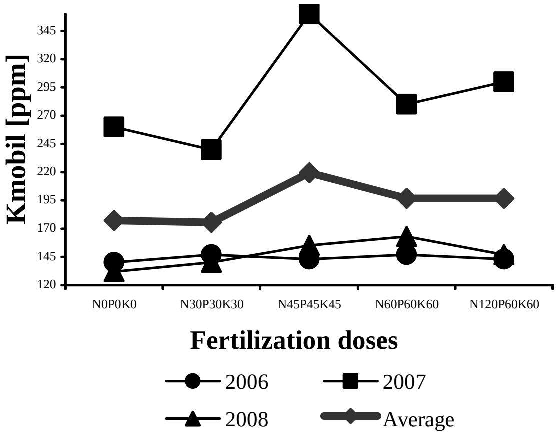

**Figure 5. Change of soil potassium after tomato mineral fertilization**

Source: own research

Potassium content is within the limits of the control samples values. Potassium remains from the soil in the same range, between 140-147ppm from the experimental year 2006 and 132-163 ppm from 2008 (*Figure 5*). The highest value of potassium soil was observed by $N_{45}P_{45}K_{45}$ fertilization doses (360 ppm). The potassium content of soil in 2007 was more than average experimental years, due to the meteorological conditions: low rainfall and high temperatures.

## CONCLUSIONS

The experience was done in a cambric cernosium soil, with low acidity reaction, very good content in nitrogen, phosphorus and potassium and the high natural fertility potential favorable tomatoes cultivation.

The soil acidity increases with mineral fertilizers application from the slightly acid pH to moderately acid pH.

The highest rate of fertilization ($N_{120}P_{60}K_{60}$) not affect the humus content in soil; it’s was almost the same value as control sample.

Fertilization with mineral fertilizers in small and average doses determines annual linear increase of nitrogen soil and considerable variations to high doses of fertilizer.

Mobile phosphorus concentrations in soil have increased from one experimental year to another due to residual effect of the phosphorus fertilizers in the soil and the meteorological conditions.

Potassium accumulation in soil depends of soil texture and the meteorological conditions.

To preserve the soil quality must find the optimum dose of NPK fertilizer in tomato crop fertilization.

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