Current Trends in Natural Sciences
Vol. 14, Issue 27, pp. 232-236, 2025
https://doi.org/10.47068/ctns.2025.v14i27.027
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

MINERAL NUTRITION OF TOMATOES BASED ON SOIL ANALYSIS

Simona Hogea [1], Gabriela Șovărel[1,*], Marcel Costache[1], Emilia Cenușă[1], Marius Velea[2]

[1] Research and Development Institute for Vegetable and Flower Growing, Str. Calea București, no. 22, 077185, Vidra, Ilfov, Romania
[2]Holland Farming Agro SRL, Str. Drumul Osiei, no. 74, 062395, Bucharest, Romania

Abstract
Tomatoes (Solanum lycopersicum L.) are an important vegetable crop throughout the world, with approximately 181 million tonnes from 5 Mha. In Southern Europe, it ranks as the highest yielding vegetable with 0.2 Mha, and the major producers in the Mediterranean basin are Turkey, Egypt, Italy, Spain, and Morocco. Tomato plants require at least twelve nutrients, also called "essential elements", for normal growth and reproduction. These are nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), boron (B), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn) and molybdenum (Mo). In orde to identify the essential elements soil samples were taken from Giurgiu County, Vărăști village, from a greenhouse where tomatoes are grown. The determinations of the soil sample recorded low ammonium, high amounts of sodium, magnesium, chlorides, phosphorus, nitrates and nitrites. Fertilization recommendations were made to correct the quantities of the main nutrients analyzed. After applying the recommended fertilizers, a soil sample was taken again to compare the results with the first sample.

Keywords: essential elements, fertilization, tomato

1. INTRODUCTION

Tomatoes (Solanum lycopersicum L.) are part of the family *Solanaceae* and are an important vegetable crop throughout the world with approximately 181 million tonnes from 5 Mha, according to the Food and Agriculture Organization Statistics (FAOSTAT). In Southern Europe, it ranks as the highest yielding vegetable with 0.2 Mha, and the major producers in the Mediterranean basin are Turkey, Egypt, Italy, Spain, and Morocco (Panno et al., 2021).

Knowing the role of nutrients in plant life and their influence on harvest quality is of particular importance, because it underpins the measures that are required to ensure optimal plant growth and development and the production of superior quality plant products (Budoi, 2000).

Tomato plants require at least twelve nutrients, also called "essential elements", for normal growth and reproduction. These are nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), boron (B), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn) and molybdenum (Mo) (Sainju et al., 2003).

For high plastic tunnels crops, organo-mineral fertilisation is carried out at tillage and various tractors and machines are used for cultivation and chemical and organic fertiliser applications. Once the young tomatoes are planted, they are fertigated via polyethylene tubing (Boulard et al., 2011).

*Corresponding author, E-mail address: gabriela_sovarel@yahoo.com

Current Trends in Natural Sciences
Vol. 14, Issue 27, pp. 232-236, 2025
https://doi.org/10.47068/ctns.2025.v14i27.027
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Nitrogen is one of the chemical elements with the most complex and important role in the existence of living matter and cannot be replaced by any other nutrient, being, in general, the fourth element in weight in plants, after C, O and H (Budoi, 2000). Nitrogen (N) plays a role in growth and development processes (morphogenesis), in the storage and transfer of genetic information, in enzyme synthesis and enzymatic activity, in photosynthesis, in plant protection and is part of the chemical composition of some vitamins (Budoi, 2000).
The objective of this study was to establish an optimal fertilization plan, based on chemical analyses performed at the Agrochemical Analysis Laboratory, Holland Farming Agro SRL.

2. MATERIALS AND METHODS

The experiment was carried out at a farmer from Vărăști village, Giurgiu county, on tomato crops in cycle II, the Zadurella F hybrid (the plant density being 36 000 plants/ha), in high plastic tunnel conditions, established on July 15.
The soil sample was collected at the end of June 2021 and sent to the Holland Farming Agro (HFAGRO) laboratory, on 01.07.2021, in order to perform analyses for the nutritional elements in a soil sample. The following elements were analyzed: pH, EC, K, P, N-NO3, N-NH4, Ca, Mg, Na, Fe, Mn, Zn, Cu, Mo, B and humus (organic matter).
The soil was pretreated and air-dried at a maximum of 40°C in accordance with the standard ISO 11464:2006. For determinations, the ICP-OES (inductively coupled plasma optical emission spectrophotometry) and SFA (discontinuous flow colorimetric analysis method) methods were used. The pH was determined from an aqueous suspension of soil in a ratio (mass/volume) of 1:2.5.
Na, K, Ca, Mg, B, N-NH4 and N-NO2 + N-NO3 were determined from the aqueous extract, soil:ultrapure water in a ratio of 1:2.5.
Microelements (Fe, Mn, Zn, Cu, Mo) were extracted in DTPA buffered solution in accordance with SR ISO 14870:2002 and P was extracted in 0.5 mol/L sodium bicarbonate solution in a ratio of 1:20 in accordance with SR ISO 11263:1998.
The humus content was determined indirectly, depending on the organic carbon content, by multiplying it by a coefficient of 1.7241.
Fertilization recommendations were made for the entire vegetation period, with the following products: Biocat 15 L, Sodial 2 L, Agrosolution pH Low 10-10-40 + ME 25 kg and Solinure GT 23-10-10+ 5.6 Mg + ME 25 kg, which were applied once a week through the drip irrigation system, the total amount being divided into 3 treatments. The products Agrosolution pH Low 10-10-40 + ME and Solinure GT 23-10-10+ 5.6 Mg + ME were applied alternately.
Biocat 15 (5L) is a liquid humic corrector of plant origin specially designed to be applied through the irrigation system and acts on the soil structure. It has a biological effect, increasing the microbial population that degrades organic matter. It also improves nutrient absorption through the root, after the release of microelements.
Sodial (2L) is a soil salinity corrector based on calcium complexed with organic acids. Calcium replaces the sodium present in the soil, forming sodium sulfate, which can be easily eliminated through the root zone.
Agrosolution pH Low 10-10-40+ Me (25 kg) ensures the cleaning of drippers, reduces the level of bicarbonates, and nutrients dissolve more efficiently, even in hard water. Increases nutrient absorption in plants.
Solinure GT 23-10-10+5.6 Mg + Me (25 kg) is recommended for cooler and less sunny growing periods, contains no chlorides and has a low urea content.

*Corresponding author, E-mail address: gabriela_sovarel@yahoo.com

Current Trends in Natural Sciences
Vol. 14, Issue 27, pp. 232-236, 2025
https://doi.org/10.47068/ctns.2025.v14i27.027
Current Trends in Natural Sciences (on-line) Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-953X ISSN: 2284-9521
ISSN-L: 2284-9521 ISSN-L: 2284-9521

At the end of the growing season, another soil sample was taken to verify the changes that occurred as a result of fertilization with recommended products.

3. RESULTS AND DISCUSSIONS

Following the physicochemical analyses, we found that the pH level and the level of nutrients in the soil are very high, causing the studied plants to experience phytotoxicity. Thus, products were recommended to reduce excesses and restore balance in the soil. Recommendations for growing tomatoes in high plastic tunnel (fig. 1) are found in Table 1.

Figure 1. Zadurella F1 tomato crop under high plastic tunnel

Initial sample results indicate that the soil pH (8.13) is much higher than the recommended upper limit (6.8), indicating an alkaline soil. In the second sample, the pH value is 7.25, being above the optimal limit, but closer to the ideal value for most crops. It is important to regulate the pH, as soil that is too alkaline can reduce the availability of essential nutrients.

The electrical conductivity (EC) values are within normal limits, which indicating that the both samples have a moderate level of dissolved ions (minerals, salts, etc.).

Ammonium is much lower than the lower limit in sample 1, which may mean that the soil does not have a significant amount of available nitrogen in the form of ammonium. In sample 2, the N-NH4 level is 5.4 mg/kg, which is below the recommended lower limit. Although this value is not high, it is a sign that there is no significant accumulation of nitrogen in the soil.

The results indicate that the potassium level is within normal limits.

In both samples (Table 2), the sodium level is well above normal limits. This can be a problem because sodium in large quantities can harm plant development and cause soil salinization.

Calcium is well above normal limits at both sample collection times, suggesting an excess of calcium in the soil. Excess calcium can affect the balance of other nutrients and reduce their absorption.

The magnesium level is well above normal limits, indicating an excess of magnesium, especially in sample 2. This excess can disrupt the nutrient balance of the soil, negatively affecting plant development.

The phosphorus level is much higher than the recommended upper limit, which can lead to a toxic accumulation of phosphorus in the soil, negatively affecting plant development.

*Corresponding author, E-mail address: gabriela_sovarel@yahoo.com

Current Trends in Natural Sciences
Vol. 14, Issue 27, pp. 232-236, 2025
https://doi.org/10.47068/ctns.2025.v14i27.027
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Table 1. Nutrition recommendations for tomato crop

Product	Active substance	How to apply
Biocat 15	Total humic extract 15% + Humic acids 7% + Fulvic acids 8% + Water-soluble potassium oxide (K_2O) 4.5%	0.5 L/ 1000 sq.m. (once a week)
Sodial	40% polyhydroxyphenyl carboxylic acid + 7% water-soluble calcium oxide (CaO)	0.5 L/ 1000 sq.m. (once a week)
Agrosolution pH Low 10-10-40+Me	- 10 % Total nitrogen (N) – 10 % Nitric nitrogen (NO3-N) – 10 % Phosphorus (P) - Phosphoric anhydride (P2O5) - water soluble – 40 % Potassium (K) - Potassium oxide (K2O) - water soluble – 0.16 % Iron (Fe) - water soluble, EDTA chelated – 0.06 % Manganese (Mn) - water soluble, EDTA chelated – 0.01 % Boron (B) - water soluble – 0.010 % Copper (Cu) - water soluble – 0.010 % Zinc (Zn) - water soluble, EDTA chelated – 0.006 % Molybdenum (Mo) - water soluble	6 kg/ 1000 sq.m. (once a week)
Solinure GT 23-10-10 + 5,6 Mg + ME	- 23% total Nitrogen (N): 0.9% nitric nitrogen (NO3-N), 1.2% ammoniacal nitrogen (NH4-N), 20.9% urea nitrogen (Ur-N) – 10% Phosphorus (P) - Phosphorus pentoxide (P2O5) - water soluble – 10% Potassium (K) - Potassium oxide (K2O) - water soluble – 5.6% Magnesium (Mg) - Magnesium oxide (MgO) - water soluble – 16.5% Sulphur (S) - sulfur trioxide (SO3) - water soluble – 0.04% Iron (Fe), EDTA chelate – 0.01% Boron (B) – 0.01% Manganese (Mn), EDTA chelate – 0.002% Mollydium (Mo) – 0.002% Zinc (Zn), EDTA chelate	4 kg/ 1000 sq.m. (once a week)

Table 2. Soil sample analysis results

Parameters	**Sample 1 Values obtained**	**Sample 2 Values obtained**	**Normal range**	**Interpretation for both samples**
pH	8.13	7.25	6.2 – 6.8	Above normal
EC	0.49	0.45	0.11 – 1.5	Normal
N-NH$_4$ (mg/kg)	<2.5	5.4	20.1 – 40.0	Below normal
K (mg/kg)	80.4	119.0	66.1 – 132.0	Normal
Na (mg/kg)	146.0	98.1	5.0 – 10.0	Above normal
Ca (mg/kg)	143.5	255.1	48.0 – 85.0	Above normal
Mg (mg/kg)	77.6	113.9	25.0 – 70.0	Above normal
P (mg/kg)	165.9	333.5	18.1 – 36.0	Above normal
NO_2^- + N-NO_3^- (mg/kg)	71.2	150.2	20.1 – 40.0	Above normal
Fe (mg/kg)	19.4	17.2	15.0 – 50.0	Normal
Mn (mg/kg)	7.5	9.6	5.1 – 20.0	Normal
Zn (mg/kg)	8.6	9.7	1.51 – 3.0	Above normal
Cu (mg/kg)	3.5	3.8	0.51 – 1.5	Above normal
B (mg/kg)	1.4	1.0	0.26 – 0.40	Above normal
Humus (%)	4.15	4.21	2.5 – 4.0	Slightly above

* physicochemical analysis results (HAGRO laboratory)

Nitrite and nitrate levels are much higher than normal limits, indicating an excess of nitrogen in the soil, which can contribute to water pollution and excessive soil acidification.

*Corresponding author, E-mail address: gabriela_sovarel@yahoo.com

Current Trends in Natural Sciences
Vol. 14, Issue 27, pp. 232-236, 2025
https://doi.org/10.47068/ctns.2025.v14i27.027
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

The humus concentration is near the upper limit of the normal range, suggesting that the soil has an adequate amount of organic matter, which is beneficial for water and nutrient holding capacity.
Based on the fertilization recommendations for the Zadurella F1 hybrid, a yield of 87.5 tons per hectare was obtained (second crop cycle).

4. CONCLUSIONS

The soil in Vărăști presents a series of nutrient imbalances, with a significant excess of sodium, calcium, magnesium, chlorides, sulfates and phosphorus. These imbalances can negatively affect soil fertility and plant health. It is recommended to correct soil pH and regulate excessive nutrient levels to ensure healthy plant development.
To preserve the soil-plant-food food chain, it is recommended to optimize the nutrient requirement, thus protecting the environment and repeating physical-chemical analyses annually, aiming at the balance of elements in the soil and the success of crops.
Based on agrochemical studies, we can optimize the plant's nutrition regime, managing to support the harmony of the environment.
The results of the experiments were satisfactory, the goal being to decrease the pH, EC, and salts in the soil by several considerable percentages.
It is recommended to fertilize crops based on an integrated soil analysis service, from all points of view: physicochemical (soil nutrient potential), phytopathological and microbiological (diseases and pests), from the point of view of pesticide residues remaining in the soil, pedological (sandy, loamy, clay soil, etc.).

5. ACKNOWLEDGEMENTS

Paper published within the project POC-A.1-A.1.2.1-2017-„Realization of a new service-innovative Holland Farming”.

6. REFERENCES

Boulard, T., Raeppel, C., Brun, R., Lecompte, F., Hayer, F., Carmassi, G., Gaillard, G. (2011). Environmental impact of greenhouse tomato production in France. *Agronomy for Sustainable Development, 31* (4), pp.757-777. DOI 10.1007/s13593-011-0031-3.

Panno, S., Davino, S., Caruso, A.G., Bertacca, S. Crnogorac, A., Mandic, A., Noris, E., Matic, S. A. (2021). Review of the Most Commonand Economically Important Diseases That Undermine the Cultivation of Tomato Crop in the Mediterranean Basin. *Agronomy, 11*, 2188. https://doi.org/10.3390/ agronomy1111218.

Sainju, U. M., Dris, R., Singh, B. (2003). Mineral nutrition of tomato. *Journal of Food, Agriculture and Environment, 1,* 176-183.

*Corresponding author, E-mail address: gabriela_sovarel@yahoo.com