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THE INFLUENCE OF FOLIAR FERTILIZATION ON TOMATO LEAVES CHEMICAL CONTENT GROWN IN PROTECTED SPACES

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Abstract

It was examined the impact of foliar fertilization with mineral fertilizers on the chemical content of leaves of tomatoes grown in protected spaces in terms of Strumica region. Experiment was set in six variants and three repetitions. The variants in the experiment were:

1. Control (untreated variant);
2. Chelan sol 11-4-42 + ME;
3. Folifertil 12-4-6 + ME;
4. Potassium nitrate 13-0-46;
5. Ariston 0-0-30;
6. Megagreen ($CaCO_3$ 82.3%, SiO_2 5.56%, MgO 3.02%, CaO 41.7%, Fe 8783 mg/kg, Mn 156 mg/kg).

The experiment was set in 18 rows, and in each variant and repetition was included in 62 plants. During the vegetation were carried out seven treatments with following fertilizers at a concentration of 0.4%.

Before setting up the experiment agrochemical analyses of soil were performed and good fertility was determined with the nitrogen and phosphorus and medium fertility with potassium. Performed chemical analysis of tomato leaves showed that foliar fertilization had a positive impact. In the leaves of five variants with different fertilizers was found higher content of all tested parameters compared with the leaves of control untreated variant. The highest average phosphorus content (0.24%), potassium (0.71%) and zinc (0.017%) obtained in the leaves at variant 2.

The highest average calcium content (4.99%) and magnesium (0.67%) was determined in the leaves at variant 6.

The highest average iron content (0.018%) was determined in tomato leaves of variant 2 and variant 6.

Key words: mineral fertilizers, tomato, leaves

Introduction

For normal growth and development of crops of grate importance is optimal plant nutrition. Plant nutrition affects a number of physiological and biochemical processes that take place in different organs. Each nutrient element has its specific impact on certain parts of the plant.
Tomato is a one-year crop with great economic importance. Fruits are consumed fresh as well as various preparations (Lazic Branka et al., 2001; Tudzarov, 1990). Fruits are characterized by high nutritional value. It is rich in many vitamins, organic and mineral substances. It has high technological value (Vujanovic, 2008; Branka Lazic, 1990). As a result of cultivation in protected spaces can be used throughout the year.
In certain unfavorable climatic and soil conditions, such as insufficient amount moisture, low pH, or unfavorable soil structure, a difficult passage of nutrients through the root system. Thus the plant is sufficiently equipped with the necessary macro and micro elements that affect the quality and quantity of yields (Maksimovic and Jain Nada, 1996; Nenadov, 1985).
In order to achieve good quality and quantity of tomatoes essential is the foliar fertilization.
The leaf is an organ in which the synthesis of organic matter takes place at most. The composition of leaf tissue and symptoms that occur in it are the best indicators for determining the level of nutrients in the soil, and thus the need for fertilization (Jekic and Brkovic, 1986; Saciragic and Jekic, 1988). The chemical composition of the leaves is variable. The presence of certain nutrients in the leaves depends on the stage of taking a leaf samples, the type of plant, mineral nutrition, conditions of cultivation.
In foliar nutrition, nutrients quickly come to chloroplasts where photosynthesis takes place and other physiological and biochemical processes. With faster foliar nutrition prevents deficiency in certain elements that occur in the leaves (Takac, 2009).
The aim of our exploration was to determinate the influence of foliar fertilizing with different mineral fertilizers on tomato leaves chemical content grown in protected spaces in Strumica area.

Material and method

In the Strumica area in the vicinity of the v. Kuklis during the year of 2008 and 2009 the experiment was placed in the protected space of 300 m^2.
Experiment was set in 18 rows. In tests were involving six variants in 3 repetitions.
Material for the work was the tomato’s variety *bele*. The seedling was planted in rows with row by row distance 60 cm, and between plants 40 cm. The experiment was set in conditions of watering. During the vegetation period of tomatoes were applied basic agro-technical measures. Before seeding planting was made soil fertilization with mineral fertilizer NPK 6-10-30 + 2% MgO in the amount of 12 kg in the hall with an area of 300 m^2.
Variants in the experiment were:
1. Control (untreated variant);
2. Chelan sol 11-4-42 + ME;
3. Folifertil 12-4-6 + ME;
4. Potassium nitrate 13-0-46;
5. Ariston 0-0-30;
6. Megagreen.

In each variant and repetitions were included in 62 plants, and total for the entire experiment there were 1116 plants.
Each variant was treated with tasted foliar fertilizer in concentration of 0.4% solution. The application of fertilizers was done with hand spray, by spraying the played leaves. During the

vegetation were conducted seven foliar treatments, starting from the stage of growth of the first fruits.
Five types of mineral fertilizers were used:
1st Chelan sol 11-4-42 + ME (Fe 0.01%, Mn 0.01%, Cu 0.01%, Co 0.001%, Mo 0.001%);
2nd Folifertil 12-4-6 + ME (Fe 0.01%, Mn 0.01%, Cu 0.01%, Co 0.001%, Mo 0.001%);
3rd Potassium nitrate 13-0-46;
4th Ariston 0-0-30;
5th Megagreen ($CaCO_3$ 82.3%, SiO_2 5.56%, MgO 3.02%, CaO 41.7%, Fe 8783 mg/kg, Mn 156 mg/kg).
After completion of harvesting leaves were taken separately for variants that are specified following parameters:
Content of phosphorus (P_2O_5) determined using atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Saric et al., 1986);
Content of potassium (K_2O) determined by incineration of the material with concentrated H_2SO_4 and its determination plamenfotometar (Saric et al., 1986);
Content of calcium (SAT) determined using atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Saric et al., 1986);
Content of magnesium (Mg) determined by applying atomic; emission spectrometry with inductively coupled plasma (ICP - AEC) (Saric et al., 1986);
Content of iron (Fe) determined using atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Saric et al., 1986);
Content of manganese (Mn) determined using atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Saric et al., 1986);
Content of zinc (Zn) determined using atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Saric et al., 1986).

Before setting up the experiment soil samples were taken for agrochemical and analyses were performed on the following parameters:
pH - Reaction determined potentiometric with pH meter (Bogdanovic et al., 1966);
Content of easy available nitrogen – chosen by method of Tjurin and Kononova;
Content of easy available phosphorus – chosen by AL method and reading of spektrofotometer (Bogdanovic et al., 1966);
Content easy available potassium – chosen by AL method and reading of spektrofotometer (Bogdanovic et al., 1966);
Content of carbonates – chosen with Schaiblerov Calcimetar (Bogdanovic et al., 1966).

Results and discussion

The content of macro and micro elements in tomato fruits, among others, largely depends on soil fertility.
To achieve high and quality yields in protected spaces tomatoes requires favourable soil and climatic conditions (Glintic and Krstic, 1990).
Quality tomatoes are getting deep and loose soil rich in easily available nutrients. The optimum soil pH reaction for tomatoes is weakly acidic with a pH value of 5.5 to 6.0 (Lazic Branka, 1990).

Table 1. Agrochemical soil analysis

Order No.	Plot	Depth (cm)	pH		Available forms (mg/100 g soil)			$CaCO_3$ (%)
			H_2O	**KCl**	**N**	**P_2O_5**	**K_2O**	
1	Tomato I part	0-20	7.35	6.65	8.50	24.60	17.90	/
2		20-40	7.40	6.64	7.80	25.80	16.50	/
Average		**0-40**	**7.37**	**6.64**	**8.15**	**25.20**	**17.20**	**/**
3	Tomato II part	0-20	7.43	6.70	8.60	25.70	17.50	/
4		20-40	7.40	6.60	7.80	25.60	17.80	/
Average		**0-40**	**7.41**	**6.65**	**8.20**	**25.65**	**17.65**	**/**

From the data in Table 1 can be concluded that soil which is set experiment had a neutral pH, good fertility with nitrogen and phosphorus, and potassium fertility medium available. There was no presence of carbonates.

From the data in Table 2 can concluded that foliar fertilization had a positive influence on the content of the examined macro and micro elements in tomato leaves. In all variants analyzed parameters had higher content, compared to the control untreated variant.

The highest average phosphorus content (0.24%), potassium (0.71%) and zinc (0.017%) was determined in tomato leaves of variant 2.

According the content of phosphorus, statistically significant differences were obtained on the two tasted levels in variants 2, 3 and 6. According the content of potassium statistically significant difference was obtained on the level 0.05 in the variants 2 and 5 and on the level 0.01 in the variant 2.

The highest average calcium content (4.99%) and magnesium (0.67%) was determinate in the variant 6. Statistically significant differences were obtained for the content of calcium level 0.05 in the variant 2, 4, 5 and 6 and on the level 0.01 in the variant 6.

The highest average iron content (0.017%) was determinate in the leaves from the variant 2 and 6. No statistically significant differences obtained.

Higher content of tested elements in the leaves of treated variants, compared to the control variant leaves was as a result to the chemical composition of used foliar fertilizers. Examined fertilizers contain macro and micro elements present in different ratio. With foliar fertilization enables rapid absorption of nutrients in the leaves of the plant. Absorbed elements are transported to other organs of the plant. In this way foliar fertilization allows the plant to be supplied with the necessary nutritional elements.

Table 2. Content of P_2O_5 K_2O, Ca, Mg, Fe and Zn in % of dry matter
average 2008/2009

Variant	**P_2O_5**	**K_2O**	**Ca**	**Mg**	**Fe**	**Zn**
1	0.11	0.58	2.42	0.43	0.017	0.016
2	0.24	0.71	2.49	0.48	0.017	0.017
3	0.17	0.64	2.59	0.46	0.017	0.016
4	0.11	0.65	2.45	0.47	0.017	0.016
5	0.11	0,67	2.61	0.47	0.017	0.016
6	0.17	0.57	4.99	0.67	0.017	0.017
	LSD 0.05=0.031	LSD 0.05=0.076	LSD 0.05=0.038	LSD 0.05=0.032	LSD 0.05=7.604	LSD 0.05=0.527
	LSD 0.01=0.042	LSD 0.01=0.102	LSD 0.01=0.051	LSD 0.01=0.044	LSD 0.0110.305	LSD 0.01=0.715

Conclusion

According to the results for the influence of foliar fertilization over the content of macro and micro elements in tomato leaves grown in protected spaces can made the following conclusions:
Soil where the experiments were placed is characterized by good fertility with easily available nitrogen and phosphorus, and easily available potassium medium fertility;
In all variants where the foliar fertilizers were used, were obtained higher content of the studied elements compared with leaves from the control variant;
The highest content of phosphorus, potassium and zinc was obtained in the leaves of variant 2 Chelan sol 11-4-42 + ME (Fe 0.01%, Mn 0.01%, Cu 0.01%, Co 0.001%, Mo 0.001%);
The highest average content of calcium and magnesium was obtained in the leaves of variant 6 Megagreen ($CaCO_3$ 82.3%, SiO_2 5.56%, MgO 3.02%, CaO 41.7%, Fe 8783 mg / kg, Mn 156 mg / kg);
The highest average iron content was obtained in the leaves of variant 2 Chelan sol 11-4-42 + ME (Fe 0.01%. Mn 0.01%, Cu 0.01%, Co 0.001%, Mo 0.001 %) and lime. 6 Megagreen ($CaCO_3$ 82.3%, SiO_2 5.56%, MgO 3.02%, CaO 41.7%, Fe 8783 mg / kg, Mn 156 mg / kg);
Statistically significant differences were obtained in all of the studied elements except for iron content.

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