IX INTERNATIONAL SYMPOSIUM ON AGRICULTURAL SCIENCES AND
XXV CONFERENCE OF AGRICULTURAL ENGINEERS OF REPUBLIC OF SRPSKA
AGRORES 2020

The impacts of microbial fertilizer application on the health condition and quality of the tomato fruit

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Abstract

The research aims to obtain the results of the impact of an application of microbial fertilizers in combination with mineral fertilizers on the health and chemical composition of tomatoes. The study was conducted in 2013 and 2014 on the basic experimental plots in two variants (1. inorganic fertilizer and chemical crop protection + microbial fertilizer Slavol, 2. inorganic fertilizer and chemical crop protection-control). In the year 2013, there was no significant presence of diseases and pests, except for the occurrence of *Tetranychus urticae.* In early June 2014, the symptoms of *Phytophthora infestans* appeared only in the control variant. In both years of the study, the average total soluble solids, total acidity, and content of N, Mg, K, Cu were higher in the variant with applied microbial fertilizer. Content of nitrates, lycopene, P, Fe and Zn varied depending on the year and treatment. The application of microbial fertilizer has contributed to better health, and the contents of some tomato fruit quality parameters were increased.

Key words: tomato, Slavol, diseases, pests, quality

Results and Discussion

1. Health condition of tomatoes

In June 2013, there were symptoms of an attack of the two-spotted spider mite (*Tetranychus urticae*) (Fig. 2.), while there were no other pests and diseases. According to Spasov et al. (2006), organic fertilizers may reduce pest attack (*Aphididae, Helicoverpa armigera Hb., Trialeurodes vaporariorum Westwood., Thripidae* and *Leptinotarsa decemlineata Say.*). At the beginning of June 2014, there were symptoms of the presence of *Phytophthora infestans* (Fig.3.) only in the control variant.

2. Tomato fruit quality parameters

According to research objectives, the numerical parameters are obtained and represented in Table 1.
The Pearson correlation matrix as a parameter analysis is used to determine the correlation between the studied statistical parameters.
Total soluble solids and total acidity relation (r = 0.476), nitrates (r = 0.216), vitamin C (r = 0.367), total nitrogen (r = 0.236), total potassium (r = 0.313), iron (r = 0.319) and zinc (r = 0.220) indicates a weak positive correlation.
Total soluble solids and copper content relation (r=0,671) indicates a strong positive correlation. Total soluble solids and Mg and P content relation indicate a negative correlation.
Total acidity in relation with vitamin C indicates moderate positive correlation, and weak positive correlation in relation with nitrates (r = 0.120), lycopene (r = 0.107), K (r= 0.210), Fe (r = 0.124) and Cu (r = 0.289).
Content of nitrates and N content relation (r=0.758) indicates a strong positive and significant correlation.
The content of Mg in relation with the content of P (r = 0.943) in tomatoes indicates a very strong positive correlation and strong positive correlation with the content of K (r = 0.678), Fe (R = 0.647) and Zn (r = 0.769).
A very strong positive correlation indicates parameter P with Zn (r= 0,809) and a strong positive correlation with the content of K (r=0.692).
Based on the Pearson's correlation coefficients presented above, it can be concluded that parameter correlations are strong, positive and statistically significant which would mean that the application of microbial fertilizer had a significant influence on analysed chemical parameters in tomatoes in both years.

Material and Methods

The research was carried out in the village Hodbina (43°14´N17°51´E), near Mostar (Bosnia and Herzegovina). Cultivar tomatoes Hector F1 are planted in a greenhouse (Fig. 1) of 360 m^2 during the two growing seasons, 2013 and 2014. The planting in 2013 was done on April 3, while in 2014, the tomatoes were planted on March 11, planted in two-row strips, wherein the spacing between the rows was 80 cm, distance in the row 50 cm and 40 cm between rows. During the growing season, crop care was done by applying certain agricultural practices. The experiment was set up in a randomized block schedule in 4 repetitions with two variants on the basic experimental plots: Variant 1. Inorganic fertilizer and chemical crop protection + microbial fertilizer Slavol ; Variant 2. Inorganic fertilizer and chemical crop protection – Control
The value of all measurements are presented by means with a two-factor analysis of variance (ANOVA) for all aspects of impacts of microbial fertilizers in the years 2013 and 2014, a total soluble solids, total acidity, nitrates, vitamin C, lycopene, N, Mg, P, K, Fe, Zn and Cu. The lowest statistical significance that can exist in comparisons was determined using the Tukey Kramer test. Pearson correlation analysis was performed as a parametric analysis to analyze the correlation between the studied parameters.

Table 1. Chemical composition of tomatoes depending on treatment and year of study

	Slavol		Control	
	2013	2014	2013	2014
Total soluble solids (˚Briks-a)	4.58	4.24	3.85	3.87
Fruit acids (%)	0,41	0,31	0,26	0,24
Nitrates (mg/kg)	141	209	176,3	115,6
Vitamin C (%)	39,7	27,1	18,9	28,5
Lycopene (mg/100g)	8,58	7,81	9,1	6,66
N (%)	0,18	0,44	0,17	0,26
Mg (mg/kg)	111,9	97,2	120,7	77,5
P (mg/kg)	257,2	179,5	264,5	169,8
K (mg/kg)	1756.5	1572.1	1723.0	1339.7
Fe (mg/kg)	9,1	6,9	11,7	4,3
Zn (mg/kg)	2,7	1,1	3,07	1,07
Cu (mg/kg)	1,3	0,85	0,9	0,7

Table 2. Correlation matrix (Pearson)

Variables	Total soluble solids	Fruit acids	Nitrates	Vitamin C	Lycopene	Total N	Mg	P	K	Fe	Zn	Cu
Total soluble solids	1	0.476	0.216	0.367	0.060	0.236	0.096	0.052	0.313	0.319	0.220	0.671
Fruit acids	0.476*	1	0.120	0.553	0.107	-0.030	-0.081	-0.029	0.210	0.124	0.046	0.289
Nitrates	0.216*	0.120*	1	-0.240	0.289	0.758	-0.132	-0.234	0.134	0.119	-0.106	-0.230
Vitamin C	0.367*	0.553*	-0.240*	1	-0.053	-0.089	-0.183	-0.057	-0.013	-0.262	-0.169	0.343
Lycopene	0.060	0.107*	0.289*	-0.053	1	-0.075	0.173	0.231	0.138	0.269	0.280	0.203
Total N	0.236*	-0.030	0.758*	-0.089	-0.075	1	-0.317	-0.467	-0.200	-0.083	-0.467	-0.257
Mg	0.096^{ns}	-0.081	-0.132*	-0.183*	0.173*	-0.317*	1	0.943	0.678	0.647	0.769	0.603
P	0.052^{ns}	-0.029	-0.234*	-0.057	0.231*	-0.467*	0.943*	1	0.692	0.609	0.809	0.574
K	0.313*	0.210*	0.134*	-0.013	0.138*	-0.200*	0.678*	0.692*	1	0.425	0.690	0.534
Fe	0.319*	0.124*	0.119*	-0.262*	0.269*	-0.083	0.647*	0.609*	0.425*	1	0.749	0.528
Zn	0.220*	0.046	-0.106*	-0.169*	0.280*	-0.467*	0.769*	0.809*	0.690*	0.749*	1	0.569
Cu	0.671*	0.289*	-0.230*	0.343*	0.203*	-0.257*	0.603*	0.574*	0.534*	0.528*	0.569*	1

Fig. 1. Greenhouse

Fig.2. *Tetranychus urticae*

Fig 3. *Phytophthora infestans*

Conclusions

The results of the analysis of fruit quality parameters and health conditions of tomatoes treated with microbial fertilizer Slavol in 2013 and 2014 can be used for better understanding of the complex interactions between plants and microorganisms. During the research, the health status of Slavol-treated tomatoes was better, indicating that the application of microbial fertilizer contributes to a better plant condition and increases resistance to stressful situations. The results of the research showed that the application of Slavol had an impact on some quality parameters, such as the content of total soluble solids, total acidity, N, Mg, K, Cu. It can be concluded that the application of adequate agronomic measures of nutrition and crop protection with the addition of microbial preparations can be used as the basis for the improved growth and production of high yields of high-quality tomatoes in Herzegovina.