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Research concerning the zeolites influence, used in the culture substratum, upon the quality of greenhouse grown tomato

Berar V.[1]*, Poşta Gh.[1]

[1]USAMVB Timişoara, Faculty of Horticulture and Forestry

*Corresponding author. Email: berar_viorel@yahoo.com

Abstract The quality of the vegetable products, in the acutal context of Romania, supposes the introduction on a larger scale of some high technologies that will assure the obtainance of high productions needed on the market, checking the main indicators mentioned in the quality standards. The use of 25% zeolites in the nutritious mix on tomato culture in greenhouse, determines significant differences of the fruit quality concerning the content in Ca, Mg and K.

Key words

zeolite, culture substartum, tomato, quality and quantity yield, culture in greenhouse

The quality of the vegetable products, in the acutal context of Romania, supposes the introduction on a larger scale of some high technologies that will assure the obtainance of high productions needed on the market, checking the main indicators mentioned in the quality standards.

The nutritive mixture used in seedling production on tomato cultivation in bags or pots needs to have the following features: a proper structure in order to assure the gases change with the atmosphere, light, high porosity, permeable substratum, high capacity for water retention, abundancy of nutrients and a low content of soluble salts, pH between 6 and 6.5 and a high dab capacity in order to maintain the pH value [6].

Because of the biological vegetable culture concept, the comparative analyze, from the technological and economical point of view, of the substrate mixture components impact upon tomato plants' growth and development by using different organic and inorganic (volcanic tuffs) components with a high role in correcting and improving their physical-chemical features, it is imposed [8].

Clinoptilolites contribute to the fertility level of the mixtures, respectively of the cultural substratum with their content in macro and microelements, depending on the group they are taking part of and provenience, also to other aspects like: the dissociation and retainance of heavy metals in soil's solution, the gradual release of essential heavy soluble macroelements and keeping the nutritional balance during the vegetation period, also maintaining a optimum of humidity in the cultural substratum due to it's granular structure [1, 3, 4, 7].

With their chemical composition, because of salt excess, tomatoes act as alcalisings, having a majour catalyst importance for the human organism [2, 5].

Biological Material and Method

The experiment took place in 2011 at the Didactic and Research Base of the Faculty of Horticulture and Forestry, from B.U.A.S.V.M. Timişoara.

The biological material used in the experiment was represented by tomato hybrid Venezia F_1.

The volcanic tuff used in the experiment belongs to the group of polymineral zeolites, which is clinoptilolite-mordenite-natrolitic zeolites category, identified in Maramureş Hollow, the accumulation from Bârsana.

The experiment was monofactorial, the experimental variants being constituted of graduations of the nutritious mixture components:

V_1 (Mt) – 50% manure, 40% garden soil and 10% sand;

V_2 – 40% manure, 40% garden soil, 10% peat and 10% sand;

V_3 – 50% manure, 10% garden soil, 10% peat, 5% sand and 25% zeolite;

V_4 – 20% manure, 20% garden soil, 5% peat, 5% sand and 50% zeolite;

V_5 – 10% manure, 5% garden soil, 5% peat, 5% sand and 75% zeolite.

The mixture was filled in plastict pots of 10 l volume capacity.

Variant V_0 has been constituted of tomatoes' cultivated in greenhouse soil.

To determine the dry substance the Partner thermoballance has been used, WPS: 210S, Max: 210g; d = 1 mg; humidity programme: 0,2 – 100%;

temperature programme: 50-250ºC; dt = 1ºC/min; dw = 0.01%.

The determination of titrable acidity procedure.

The tarra of the glass used in the experiment is determined and 10,00 g of well mixed sample is added, 100 ml of distilled water is added as well and 1 ml of fenolftaleine sollution (15-20 drops). Everything is mixed well (the magnetic mixing machine can be used as well); in order to titrate the sample a NaOH sollution of 0.3125N is used, until it becomes light pink. The color has to persist at least 20 seconds and the sample has to be continuously shaked. The acidity is usually expressed as %g/100g, using the formula:

$$\frac{\text{ml NaOH} \times \text{N} \times 6{,}4}{\text{g proba}} = \%\text{acid sau g/100g}$$

The extraction of the organic acids (vitamin C).

10g of tomato is collected using the square method and it is mixed in a grinder using quartz sand. The macerate is then mixed with 50 ml of 2% metafosforic acid and it's transfered in conic vase. After it's mixed for 15 minutes the mixture is filtered on filter paper in order to obtain the clear extract that can be kept at -20^{o} C until it's analyzed.

From the tomato samples, the lycopene is extracted in organic solvents and it's spectofotometric determined at 472 and 502 nm. 1g of sample (tomato) is mixed in 25ml of solvent mix (hexan – 95%, ethanol – 96%, acetone – 99% in 2:1:1 proportions), it all mixes and then blended for 30minutes, 10 ml of distilled water are added and then the blending continues for 2 more minutes. The solution is left to segregate in 2 components: one polar and one unpolar. The lycopene concentration can be evaluated using the exttraction coeficient for hexane ($E^{1\%}_{1cm}$) and 3150 la 502nm value. The lycopene content is expressed in mg/100g vegetal material.

λ = 502nm: cang.mg/100g = (E/3,15) * (20/m)

Results and Discussions

The evaluation of the tomato fruits has been realized through titrable acidity determination, vitamin C, lycopene (table 1) and microelement composition (table 2).

Table 1

Average values of the quality index of tomato fruits (Didactic Base Timişoara – 2011)

Variant	Humidity [%]	Dry substance [%]	Titratable acidity [mg/100 g]	Vitamin C [mg/100 g]	Lycopene λ = 502 nm [mg/100 g]
V_0	94.84	5.16	336.2	17.19	6.46
V_1	95.25	4.75	248.6	17.38	9.13
V_2	95.08	4.92	292.1	19.08	4.56
V_3	95.02	4.98	254.3	18.71	8.13
V_4	91.38	8.62	256.5	17.76	6.25
V_5	94.95	5.05	364.4	20.22	8.22

By analyzing the average values of the tomato fruits quality index, presented in lable 1, we can conclude the following:

- the titrable acidity shows the highest values for tomatoes' grown in nutritious mix with 75% zeolite (364.4 mg/100 g), but also for tomatoes' grown in greenhouse soil (336.2 mg/100 g);

- significant values of vitamin C content are noticed in the variants V_3 (19.08 mg/100 g s.p.) şi V_5 (20.22 mg/100 g s.p.) of nutricious mix;

- the highest content in lycopene of tomato fruits is noticed to variant V_1 (9.13 mg/100g).

Table 2

The tomato fruit composition in essential macro and microelements (Didactic Base Timişoara – 2011)

Variant	Ca [ppm]	Mg [ppm]	K [ppm]	Na [ppm]	Cu [ppm]	Zn [ppm]	Mn [ppm]	Fe [ppm]
V_0	61	184	910	30	1.34	1.29	0.38	2.77
V_1	45	240	1225	29	0.68	0.05	0.36	3.29
V_2	55	249	1287	31	1.45	2.21	0.39	1.91
V_3	106	254	1318	72	0.90	0.95	0.33	2.26
V_4	71	247	1271	107	1.10	1.23	0.39	2.53
V_5	53	173	1166	32	1.00	1.19	0.55	2.83

In connection with the experimental data exposed in table 2, it can be observed that significant values of Ca, Mg and K were noticed by variant V_3 (50% manure, 10% garden soil, 10% peat, 5% sand and 25% zeolite).

Conclusions

1. The zeolite use influence on the quality of tomato fruits can be observed on the nutritious mix that consists of 75% zeolite, in vitamin C content and titrable acidity.
2. The use of 25% zeolites in the nutritious mix on tomato culture in greenhouse, determines significant differences of the fruit quality concerning the content in Ca, Mg and K.
3. Using the zeolite in soil mixtures represents an alternative to the classical nutritive substrate, composed of those three or four bases organic and inorganic components.

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