ASSESSMENT OF HEAVY METALS CONTENT ON TOMATOES UNDER ORGANIC SYSTEM

EVALUAREA CONȚINUTULUI DE METALE GRELE LA O CULTURĂ DE TOMATE ÎN SISTEM ECOLOGIC

SIMINCIUC Camelia Gianina*[1]*, MUNTEANU N.*[1]*,
***HAMBURDĂ Silvia Brînduşa*[1]*, STOLERU V.*[1]
e-mail: vstoleru@uaiasi.ro

Abstract: *The paper presents a study on heavy metal content on a tomato crop fertilized according to Regulation 834/2007, compared to conventional crop, in a poly-tunnel, in Iasi area. The defined purpose of this study was to evaluate the extent that fertilization regime influence the content of heavy metals in two cultivars of tomatoes. The method for determining the content of heavy metals is based on measurement by atomic absorption spectrometry (AAS).Following the disclosure of this data, we conclude that the bioaccumulation content of heavy metals depends to a great extent and fertilization that are within crop system in which they are grown, and a number of factors such as climate and soil temperature.The Orgevit fertilizer applied on Ismini F1 crop, achieved the highest yield (148.8 t/ha) compared with Brillante F1, where the high production was registered in chemical version (139.7 t/ha). Copper, lead and nickel in larger quantities in tomato fruits were found in chemically fertilized versions, regardless of cultivar.*
Key words*: organic crop, tomatoes, heavy metals*

Rezumat: *In lucrarea de fata se prezintă un studiu cu privire la continutul de metale grele la o cultură de tomate fertilizată ecologic comparativ cu o variantă fertilizată chimnic (convențional), în solar, în condițiile zonei legumicole Iași. Scopul definit al acestui studiu este de a evalua masura in care regimul de fertilizare influențează conținutul de metale grele din fructe, la două cultivare de tomate. Metoda de determinare a conținutului de metale grele se bazează pe măsurarea prin spectrometrie de absorbție atomică (AAS). În urma prezentării acestor date, putem concluziona că conținutul de metale grele din sol dar și bioacumularea acestora, depinde într-o mare măsură și de fertilizările care se fac în cadrul unei culturi, sistemul în care acestea sunt crescute, dar și de o serie de factori precum, clima temperatura și solul. Ismini fertilizat cu Orgevit a obtinut cea mai ridicata productie (148.8 t/ha), comparativ cu Brillante unde cea mai mare productie a fost inregistrata in varianta fertilizata chimic (139.7 t/ha). Cupru, plumbul si nichelul in cantitati mai mari in fructele de tomate au fost gasite in variantele fertilizate chimic, indiferent de cultivar.*
Cuvinte cheie: *cultura ecologică, tomate, metale grele*

[1] University of Agricultural Sciences and Veterinary Medicine of Iaşi, Romania

INTRODUCTION

Tomatoes belongs the most popular vegetables from consumers, because they are very balanced in terms of the composition in nutrients (Munteanu, 2003).

Thus, it came as tomatoes with Solanaceae vegetables species in the group, have a large surface area for the production of vegetables in our country. However, organic tomato crop is poorly represented among organic vegetable crops because they are not yet established specific technologies to ensure and maintain soil fertility, weed, disease and pest control (Munteanu, 2003; Stefan *et al.,* 2013; Stoleru *et al.*, 2014).

The need to protect and respect than to environment and consumers, proved to be necessary emergence of a specific legal framework in the field of organic vegetable, simply to prove that the products obtained are in accordance with the regulations and their quality is one appropriate .

Thus, the term that defines organic farming within the European Community countries use different synonyms, but which all come together and are in compliance with EC Regulations 834/2007 and 889/2008 (Stoleru *et al.,* 2014).

For the determination of heavy metals such as lead (Pb), manganese (Mn), copper (Cu), nickel (Ni) and zinc (Zn), from tomato fruits, it is imperative to make in determining the quality of production obtained in determining the market value of crop technologies (Al-Lahham et al., 2007; Amin et al., 2013; Rodriguez-Iruretagoiena et al., 2015).

In general, the price of vegetable products that are made available to the consumers should be reflected in their quality.

Heavy metals such as Pb, Cu, Mn, Ni and Zn, can have both beneficial effects on plants, but also some negative effects. As is well known, heavy metals are among the elements that exhibit bioaccumulative this encouraging them to increase the amount of plant / fruit (Bulgariu *et al.,* 2006; Amin *et al.,* 2013).

The elements they reach the ground after chemical fertilization, which are then taken up by plants, in turn consumed by humans or animals, thus affecting biological a chain.

Although well-known effects of heavy metals, they are still used by man in order to increase production to meet consumer needs. Crop exposure to these elements excessively, leading to their toxicological and developments in products of plant origin, and their influence on humans and animals (Gu *et al.,* 2015).

The study of heavy metals accumulation in tomato fruit and thus a very important element of study, both the crops in the field, but especially those grown under covered areas.

MATERIAL AND METHOD

The experiments were organized in Adamachi V. farm that belong UASVM Iasi. To obtain seedlings, the sowing was carried out in 24. 02. 2014. Planting was done around 17/04/2014, using seedlings with 50 days old. The crop was established in 5 beds with 2 rows per each bed. Plants were individual stringhing being run on a single stalk, providing a density of 27770 plants/ha. After planting, each plant was irrigated with 1 l water/pl., having a temperature of 18- 22 °C.

On the tomato crop, were applied specific works care to ensure good plant vegetation, and to obtain early production and an appropriate quality to cover production costs (Munteanu, 2003; Stoleru *et al.*, 2014). The biological material was represented by two hybrid cultivars such, Brillante and Ismini.

The organic crops, exclude the use of chemically synthesized substances, and therefore have been used in organic and biological fertilizers. For this purpose were used substances such as Orgevit and Micoseed that can be used in the organic crop, compared with a chemically version, fertilized with Nutrifine. Samples were collected and prepared for laboratory analysis, according regulations laid down in the legislation, Ministry Order 147/23- 2005.

Soil and vegetable sampling was carried out under good conditions to perform analyzes so that they are representative for the product tested, the identification and assessment of heavy metals.

The principle of the method used to determine heavy metals. The method is based on the measurement by atomic absorption spectrometry (AAS) the concentration of an element in a regal aqua sample extract prepared according to ISO 11466. The principle of the method is charring and incineration organic matter in the sample in a furnace at 450 - 500°C, the resulting ashes went into solution by dissolving HCl, diluted (Butnariu, 2014).

The dates collected have been statistical analyzed by one-way analysis of variance (ANOVA) and least significant differences (LSD) at 5%, 1% and 0.1% confidence levels for production. For the contaminants, the statistical significance were carried, compared with maximum accepted limit (MAL).

RESULT AND DISCUSSIONS

The productivity of a tomato crop can be assessed by: number of fruit/plant, average weight of fruit, fruit numbers from a flowering, fruit weight/plant or early and total production (Tabel 1).

Concerning to the number of fruits per plant, the variations are not very high, having values ranging between 20 to 26 fruits per plant. Average fruit weight varied between 195- 239 g/fruit at the Ismini cultivar and 167 to 205 g of Brillante F1 cultivar.

Determining the average weight of fruit per plant, it has highlighted out that under Ismini F1 cultivar, the highest average weight of a fruit obtained from plants treated with Orgevit and the lowest on control version, compared to Brillante where the high average weight/fruit was obtained under chemical fertilization.

After processing the dates, it was found that the Ismini F1 has achieved the highest production were those fertilized with Orgevit, and the lowest on the unfertilized plants. At the Brillante F1 cultivar, the situation is different in plants fertilized with Nutrifine obtained the highest production and those treated with Orgevit, yielding the lower production.

Following the analysis performed, tomato fruit content of heavy metals varied on the cultivar used and practiced fertilization system (Tabel 2).

Table 1

Tomato productivity indices

Experimental versions	Average fruits/plant	Fruit average wight (g)	Weight fruit/plant (kg)	Total yield (kg/ha)
Ismini F1+ Orgevit	26	206, 114	5, 358	148818***
Ismini F1+ Micoseed	25	198, 604	4, 965	137880**
Ismini F1+ Nutrifine	21	239, 714	5, 033	139794**
Ismini F1/ Martor	20	195,702	3, 914	108692ns
Brillante F1+ Orgevit	22	167, 696	3, 689	102452ns
Brillante F1+ Micoseed	24	205, 554	4, 933	136997**
Brillante F1+ Nutrifine	25	201, 246	5, 031	139715**
Brillante F1/ Martor	21	186, 1	3, 908	108527ns

LSD 5%=13127 t/ha; LSD 1%=20596 t/ha; LSD 0.1%=33208 t/ha
ns-non significantly; **-positive distinct significantly; ***-positive very significantly

Table 2

Heavy metal contents in tomato fruits

Experimental versions	Heavy metal contents				
	Cu (ppm)	Mn %	Ni (ppm)	Zn (ppm)	Pb (ppm)
Brillante+ Orgevit	36	0,29	38	133	22
Brillante+ Micoseed	25	**0,56**	52	**186**	5
Birillante+ Nutrifine	47	0,24	69	147	**34**
Brillante/ Martor	**19**	**0,19**	37	**127**	**0**
Ismini+ Orgevit	38	0,31	40	152	**34**
Ismini+ Micoseed	39	0,39	34	158	11
Ismini+ Nutrifine	**52**	0,42	**76**	178	28
Ismini/ martor	27	0,24	**31**	140	**0**

In order to determine the content of heavy metals, the samples have been collected from all experimental variants were determined following elements: Cu, Mn, Pb, Ni and Zn. The content of heavy metals was determined and evaluated in accordance with the maximum admitted limits (MAL) of legislation.

The copper was quite large variations in the two cultivars, but its values were within the rules prescribed by the law organic farming. The copper content varied from 19 ppm in Brillante-Control version to 52 ppm in Ismini fruits chemical fertilized, this version is alone version where the MAL (50 ppm) was exceeded. The content of manganese in the majority of samples was within allowed limits, only in one version the content was higher (Brillante treated with Micoseed), the percent was 0.56 %. The content overcome the MAL is not harm the quality of tomato fruits, because as you well know, manganese plays a role in intensification of photosynthesis, transpiration and synthesis reactions, thus contributing to increase production and improve quality.

The Ni contents varied from 31 ppm in the Ismini Control to 76 ppm in the same cultivar fertilized with synthetic fertilizers. This fact is confirmed, same in the Brillante cultivar, where the Ni content was over MAL (69 ppm).

In the Brillant version fertilized with Micoseed, the Ni content was over MAL, which shows that favors the passage Ni fertilization of soil microorganisms, in the form of poorly soluble forms accessible for the plant, probably in the form of Ni^{2+}.

The Zn content in the experimental study was overcome in more samples. The zinc content varies quite large but is not a real danger, since it is an element that occurs naturally in soil and plants, fulfilling a vital role in the process of flowering, plant growth and fruit.

Regarding the Pb content in tomato fruit, it was found a wide variation in some variants studied, ranging from undetectable in both control versions to 34 ppm in chemical and organic fertilizing variants.

In the experiment carried out on the tomato crop has shown that heavy metal values are greatly influenced by the type of fertilizer and less than cultivar used in crop establishment.

CONCLUSIONS

1. The results, both on the production and the content of heavy metals of tomatoes, highlight the key role that it has on their fertilization. Ismini and Brillante cultivars react differently to organic fertilization compared to the other two fertilization types.
2. The Orgevit fertilizer applied on Ismini crop, achieved the highest yield (148.8 t/ha) compared with Brillante, where the high production was registered in chemical version (139.7 t/ha).
3. Copper, lead and nickel in larger quantities in tomato fruits were found in chemically fertilized versions, regardless of cultivar.
4. The amount of Zn has been overcome in most experimental versions, except the control variants, where the 150 ppm limit is not exceeded.

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