THE PRESENCE OF HEAVY METALS IN RHUBARB ACCORDING BY TECHNOLOGY

PREZENȚA METALELOR GRELE ÎN REVENT, ÎN FUNCȚIE DE TEHNOLOGIA APLICATĂ

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Abstract. *Rhubarb(Rheum rhabarbarum L.) is a perennial vegetable plant, adapted to temperate climate in Romania but he is a little known and widespread.Such as rhubarb found favorable conditions for growth and development in our country,contributing to the diversification assortment,mentioning the advantage wich is not required establishment of culture each year.Through the application of differentiated technology, the content of heavy metal in rhubarb stalks differs of the cultivar and the harvesting period. Based on these considerations, the aim of the present study was to highlight the content of any heavy metals (Cd, Cr, Pb, Mn, Si) in one cultivar of rhubarb,variety Victoria. In all samples, the Cd content was below the detection limit, respectively below 10 ppm, and the other contaminants was respected in large the maximum admissible; is recommended in case of exceeding the maximum limit, vegetable product can□t be consumed.*
Key words: *Rheum rhabarbarum, contaminants, fertilizers*

Rezumat. *Reventul sau rubarba este o plantă legumicolă perenă, adaptată climatului temperat al României fiind însă foarte puțin cunoscută și răspândită. Astfel că, reventul a găsit condiții bune de creștere și dezvoltare în țara noastră, contribuind la diversificarea sortimentului, prezentând avantajul că nu necesită înființarea culturii în fiecare an. În urma aplicării unor măsuri tehnologice diferențiate, conținutul de metale grele acumulat în pețiolii reventului, diferă în funcție de cultivar și de perioada de cultivare. Bazându-ne pe aceste considerații, scopul acestui studiu, a fost de a scoate în evidență prezența unor metale grele (Cd, Cr, Pb, Mn, Ni, Si) la un cultivar, respectiv soi Victoria, în funcție de tehnologia aplicată. În toate probele, conținutul de Cd a fost sub limita de detecție a aparatului, respectiv sub 10 ppm, iar ceilalți contaminanți au respectat în mare limitele maxim admise; deși este recomandat în cazul depășirii limitei maxime admise, produsele legumicole să nu fie consumate.*
Cuvinte cheie: *Rheum rhabarbarum, contaminanți, fertilizanți*

INTRODUCTION

Rhubarb is a perennial vegetable plant, which can contribute to diversification of the assortment, thus the advantage of not requiring annual crop

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establishment (Stan *et al.,* 2003).

Stalks are the edible part of the plant with a sweet-sour taste (2% carbohydrate) containing organic acids (ascorbic, tartaric, citric, malic, oxalic), minerals (0.5-0,6%,) and 5% protein. Stalks of rhubarb are used in the preparation of compotes, jams, marmalades and other desserts. Rhubarb has a significant importance from ecological point of the view, as: being a perennial, does not require setting up each year; not requiring treatment plant; rhizomes exploring a large area of ground, so it can be cultivated and land with pesticide residues and heavy metals; and it can be grown on slopes, less fertile (Munteanu *et al*., 2008; Stoleru *et al.,* 2014; Răileanu *et al.,* 2015).

The contaminants are the elements, which in large quantities or over limit can cause damage in terms of product quality and cause further illness and even environmental issues (Hura and Hura, 2007; Brădățan, 2007). Heavy metals, according to the degree of toxicity, acting differently on the physiological and biochemical processes. Downturn appearance and necrosis or chlorosis are some of the symptoms of heavy metal toxicity in plants. By eating contaminated food chemical, heavy metals such as neurodegenerative causes malfunctions (Hura, 2005; Brădățan, 2007).

Heavy metals, due to the potential toxic are danger for the environment and human health or animal. Heavy metals in the soil are usually naturally in low concentrations, which has a beneficial role (Zn, Mg, Se), but with increasing concentration, are toxic both to plants and animals or man. Currently, the doses are not established rhubarb and technological measures for the implementation of fertilization, leaf stalk consumable being the many contaminants can accumulate (Hura and Hura, 2007).

The aim of the study was to evaluate the influence of fertilization measures on the production and contaminants from edible.

MATERIAL AND METHOD

An experiment with a rhubarb crop was carried out in an experimental plot at UASVM Iasi, during 2014-2015.

The experimental crop was established in 2013, by seedlings of 60 days, with a distance design of 100 x 75 cm (N= 47°11'34,09" E= 27°32'59,75"). Seedlings were been produce in concordance with specific literature, in a hot greenhouse.

The soil from the stationary is a mold chambic soil type, easy antropic, whit the following physicochemical properties, in the substrate of 0-60 cm: clay 32 %, ph=7,11; EC=252.3 µS/cm2, $CaCO_3$=1.03%, OM=28.23 mg/kg, C/N = 5,20, N=4.53 g/kg, P=106.66 ppm, iar CEC = 20.9 meq/100g.

To achieve its purpose, treatments were applied fertilizers in organic farming systems organic and conventional as follows: Orgevit® = 1100 kg/ha (applied in five stages, the first stage in early April and the following 10 in 10 days), Nutrifine®=700 kg/ha (applied in five stages, the first stage in early April and the following 10 in 10 days) and Micoseed®=60 kg/ha (applied in three stages, the first stage in early April and the following 10 in 10 days, that the treatment 4 and 5 was used Nutryaction®=5 l/ha)

Micoseed® It is a fertilizer based on microorganisms, particularly based *Glomus sp.* Nutrifine® a synthetic chemical complex type NPK 20-20-20. Orgevit® 100% organic poultry which is in the form of drops.

The total yield and dynamic of production, according with fertilization regimes, was carried out by weigh the stalks, for every harvest.

The biological material used for the analysis was represented stalk. Stalk is sweet, pink patches develop on a ribbed green, pink color is more intense at the bottom of the stem and faded green uniform top.

The principle of humidity determination is based to loss of the drying oven at a temperature of 102 ° C, until a constant mass. The loss will be calculated as a percentage relative to the initial mass of the sample.

Determination of heavy metals in vegetables is by dry mineralization. This consists in the destruction by carbonization and incineration (450-500 °C) oven sample; ash being thus passed by dissolving in dilute hydrochloric acid.

The results on the content of heavy metals in rhubarb stalks have been conducted at the UASVMB Timisoara.

RESULTS AND DISCUSSIONS

Results regarding to the total yield on rhubarb

The dates for total production are presented for both years in the Fig.1. In all experimental versions the yield is higher to Control.

The average yield of rhubarb, during 2014 period, ranged from 26.54 t / ha in the control version to 45.45 t/ha in the variant fertilized with Micoseed®. Positive significant differences to the control have been obtained in the versions fertilized with Orgevit® (31.08 t/ha) and the Nutrifine® (41.63 t/ha).

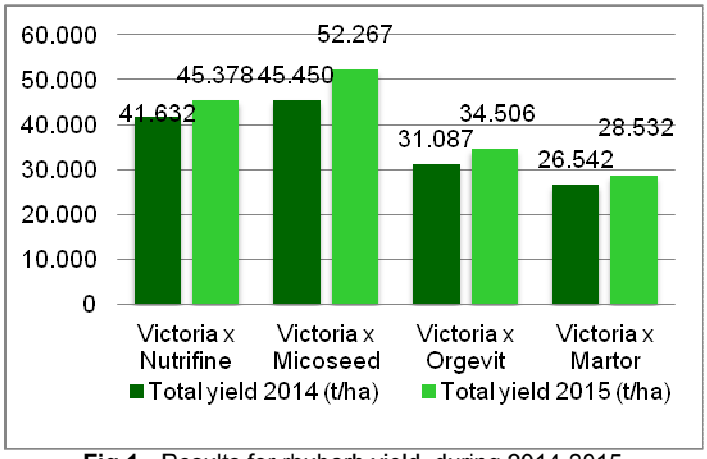

Fig.1 - Results for rhubarb yield, during 2014-2015

Average yield of rhubarb, during 2015 period, varied from 28.53 t / ha in control version to 52.26 t / ha in the same experimental version, fertilized with Micoseed®. Positive significant differences than to control were obtained by using Orgevit® (34.50 t/ha) and the Nutrifine® (45.37 t/ha) fertilizers

Results on the dry matter content and humidity

The dry matter content and water from vegetables, are the primary factors to the optimum development of metabolic processes. In the experimental study we can conclude, the maximum dry matter was obtained in the organic version (9.63%) and the lowest in the chemical treatment (7.85%). The humidity is inversely proportional with organic matter content.

Table 1

Rezultate privind conținutul de dry matter and humidity

Treatment applied	Biochemical analysis		Total %
	s.u. (%)	u. (%)	
Nutrifine	7,85	92,15	100
Micoseed	8,13	91,87	100
Orgevit	9,63	90,37	100
Un-fertilized (control)	9,14	90,86	100

According to the different references (Butnariu and Buta, 2014; Ciofu *et al.,* 2004; Stan *et al.,* 2003), the water content varies between 90.37% and 92.15% in rhubarb, which shows us that the results obtained are around values other authors.

Results on the heavy metal contents in rhubarb

The dates on heavy metal contents are shown in Table 2. The cadmium content was below 10 ppm, below the detection limit of equipment. The maximum limit allowable for Cd in vegetable leaf should be less than 50 mg/kg FW, which shows that the results not exceed the maximum admitted limit (MAL).

Chromium content in the experimental versions widely varied from 70 mg/kg FW in the fertilized version with Orgevit® up to 115 mg/kg FW in Control. The dates confirm that MAL is exceeded more two2 times in Control. In the fact not the fertilization system influences the accumulation of heavy metal in edible part of rhubarb. The content of Cr from stalks was around 80 mg / kg, in the both versions chemical respectively biological fertilized.

The higher quantity of chromium in the Control can be explained by the fact that this element comes from soil as residue. Provided with not fertilized crop, the root of the rhubarb has a physiological tendency to develop a deep root system and explore a large area of soil especially in the depth.

Thus, the rhubarb extracts nutrients along with different contaminants from soil, which have been at greater depths. Because the rhubarb is a perennial species, year by year the root system is larger.

By the application of fertilizers near the roots, plants explores a lower soil surface, the system is less developed and thus not of great depth takes some heavy metals.

Table 2

Heavy metal contents in the rhubarb samples

Experimental version		Heavy metals contents				
	Cd (mg/kg)	Cr (mg/kg)	Pb (mg/kg)	Ni (mg/kg)	Si (mg/kg)	Mn (%)
Victoria x Micoseed	□ 10	80	13	53	29,03	0,26
Victoria x Orgevit	□ 10	70	8	49	29,39	0,30
Victoria x Nutrifine	□ 10	81	23	43	28,24	0,32
Victoria x Martor	□ 10	115	18	61	28,58	0,17
MAL*	50	50	50	50	50	5

*-MAL – maximum admitted limit

The lead content in all experimental versions allowed the maximum concentrations of 50 mg / kg. Nevertheless, the highest lead content was achieved in chemical fertilization, respectively 23 mg/kg FW.

Nickel content in the experimental stationary ranged from 43 mg/kg FW in the chemical fertilized version to 61 mg/kg FW to Control. From the results can be said that in the same case of chromium, nickel content is not influenced by fertilization regime applied more even in the unfertilized version. Thus, MAL was exceeded in control and microorganism version.

The content of silica slightly varies, depending on the experimental variant, the higher was determined in organic fertilizer 29.39 mg/kg FW and the lower in the chemical version, respectively 28.24 mg/kg FW.

In the case of manganese, the highest concentration was in chemical version of 0.32% and the lowest was registered in control sample 0.17%, which shows that Mn accumulation in the stalks of rhubarb is influenced by nutrition system. By using organic fertilizers and those of micro-organisms, to ensure concentration of Mn values between 0.26% and 0.30%, without exceeding the limit of 5%.

CONCLUSIONS

Regards to total production, in 2015 was obtained significant positive difference (+ 14.98%) compared to 2014. The highest yield for version fertilized with Micoseed® (52.26 t/ha in 2015), and the lowest for control sample (28.53 t/ha in 2015).

Higher dry matter content in Orgevit® fertilized version (9.63%) signifies accumulation of nutrients in plants, including dry mass. The content of Cr and Ni higher in stalks of rhubarb from the control sample compared to fertilized variants indicates that the content is not influenced by fertilization regime.

In most experimental versions MAL for contaminants have been exceeded, except in any situations. In this case, further research must be separate for each nutrient. For products where limits have been exceeded, their consumption is not recommended as it can cause neurodegenerative diseases is recommended that harvesting be done earlier.

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