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YIELD AND CHEMICAL COMPOSITION OF BEET (*BETA VULGARIS* SSP. *ESCULENTA* L.) GROWN USING MICROBIAL FERTILIZERS

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Abstract

The systems of production which preclude the application of synthetic products are becoming increasingly popular and important models of sustainable and organic agriculture. This research is aimed at determining the impact of two different types of microbial fertilizers on the yield and quality of beet, to test the opportunity for their wide application in the vegetable crop production. Experiment was set on open field with beet (Beta vulgaris ssp. esculenta), hybrid Kestrel, on soil type alluvium in the village of Jurumleri, near Skopje, during 2013. The application of the fertilizers was foliar during the vegetation, every 7 days. The variants were set depending on the type of microbiological fertilizer: Ø control - not applied treatment with microbial fertilizer; variant 1 - treatment with microbial fertilizer Micro - I Vita containing several groups of azotobacter, nitrifying microorganisms and phosphor-soluble microorganisms; variant 2 - treatment with microbial fertilizer Micro - Vita II containing azotobacter, nitrifying microorganisms, phosphor-soluble microorganisms and iron. The effect of the application of the microbial fertilizers on beet was determined through analysis of: yield (t/ha), water and dry matter content, content of vitamin C, protein content, cellulose content, determination of the total minerals and iron content.
According to the results statistically significant differences were determined between the variants in yield. The highest yield of beet is obtained in variant 2,(69.43 t/ha), ie 26.70% higher compared to the yield obtained with the control. In variant 1 with 58.13 t/ha, was 6.07% higher than the yield of the control. Statistically significant difference was determined between: control and variant 2 (14.63 t / ha) and variant 1 and variant 2 (11.30 t / ha).
Variant 1 had significant higher content, compared with the control, for the following components: vitamin C (6.86%), cellulose (13.79%) and protein (18.18%). While variant 2, compared with the control had significant higher content for the following parameters: vitamin C (14.71%), cellulose (27.59%), protein (44.62%) , minerals (6.25%) and Fe (100%).According to the presented results application of the microbiological fertilizers significantly influenced for increasing of the beet root yield and for improving of the chemical composition.

Introduction

In recent decades the often application of synthetic fertilizers, pesticides, hormones, etc. in the conventional vegetable crop production, in some cases because of lack of knowledge and expertise results with reduced quality and safety of the vegetables, as well with disruption of the natural ecosystem processes (Kovachevih and Oljacha, 2005). Because of that the systems of production which preclude the application of synthetic preparations (pesticides, fertilizers, etc.) are becoming increasingly popular models of sustainable agriculture and are extremely important in the vegetable crop production.
Directions in the sustainable agriculture, primarily the limiting of the application of mineral fertilizers and pesticides, opens greater opportunities for the application of microbial fertilizers, whose main component are microorganisms which through their activity in the soil are providing food for the plants in accessible forms (Matotan 2004; Najdenovska and Djordjevic, 2009). The application of these fertilizers will result with a positive effect if they with an appropriate composition that meets the needs of the crop and if their application is in optimal quantities and at a certain period of vegetation (Lešić et al., 2004).

Material and methods

The experiment was set on open field, in the village of Jurumleri, Skopje, during 2013.
As research material was used - beet (*Beta vulgaris* ssp. *esculenta*), hybrid Kestrel.
The treatment of the beet was with two types of microbial fertilizers:

- ✓ Micro - Vita I, organic fertilizer containing several groups of azotobacter, nitrifying microorganisms and phosphor-soluble microorganisms, and
- ✓ Micro - Vita II, organic fertilizer containing azotobacter, nitrifying microorganisms, phosphor-soluble microorganisms and iron.

Sowing of the beet was on 22 April in experimental plots with a size of 2 m^2, arranged in random block system in three variants with four repetitions.

The variants were set according the type of microbiological fertilizer:

1. Ø control - not applied microbiological fertilizer;
2. Variant 1 - treatment with microbiological fertilizer Micro - I Vita;
3. Variant 2 - treatment with microbiological fertilizer Micro - Vita II.

The application of the fertilizers was foliar during the vegetation, with a solution with concentration of 100 ml/10 L water, every 7 days. The application of both fertilizers began on May 25 and the last application was made on 24 August.

The effect of the application of the microbial fertilizers on beet was determined through analysis of:

- ✓ Yield (t/ha);
- ✓ Water and dry matter content, determined by drying of the fresh plant material at a temperature of 105ºC to constant weight;
- ✓ Content of vitamin C determined by the method of Mury (Voća, 2011);
- ✓ Protein content determined accrual in % of total nitrogen x 6.25 (Jekič et al., 1988);
- ✓ Cellulose content determined by the method of Hoffman (Jekič et al., 1988);
- ✓ Determination of the total minerals with combustion of the air dry material at a temperature of 500 to 550°C to constant weight (Sarič, 1986) and
- ✓ Iron content using atomic absorptionate spectrophotometry.

The results of the research, referred to the morphological characteristics and yield of beets are processed by appropriate descriptive statistical methods and analysis of variance.

Results and discussion

Table 1. Yield of beet for the three variants

Repetitions		Control	Variant 1	Variant 2
	I	53,73	63,18	71,11
	II	53,25	64,57	74,00
	III	60,58	53,51	67,52
	IV	51,64	51,25	65,10
Average yield for the variants		54,80	58,13	69,43
Difference between the control and variants			3,33	14,63*
Difference between variant 1 and variant 2				11,30*
Index %		100,00	106,07	126,70
Standard deviation		3,96	6,73	3,92
Coefficient of variation %		7,22	11,57	5,65
$LSD_{0,05}$= 8,07				

Table 2. Chemical composition of the roots for the three variants

Variant / Component	Control	Variant 1	Variant 2
Water (%)	91,70	91,02	90,89
Index %	100,00	99,26	99,12
Dry matter (%)	8,30	8,98	9,11
Index %	100,00	108,19	109,76
Vitamin C (mg/100 g)	10,20	10,90	11,70
Index %	100,00	106,86	114,71
Cellulose (%)	0,29	0,33	0,37
Index %	100,00	113,79	127,59
Proteins (%)	0,55	0,65	0,94
Index %	100,00	118,18	144,62
Mineral matters (%)	0,96	0,99	1,02
Index %	100,00	103,13	106,25
Fe (mg/100 g)	0,2	0,2	0,4
Index %	100,00	100,00	200

Chemical composition of the roots for the three variants

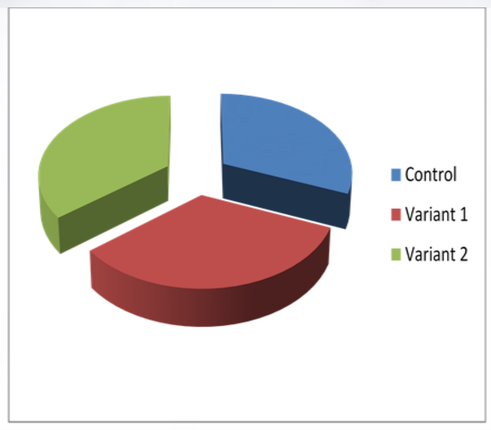

Figure 1. Content of vitamin C in three variants beet

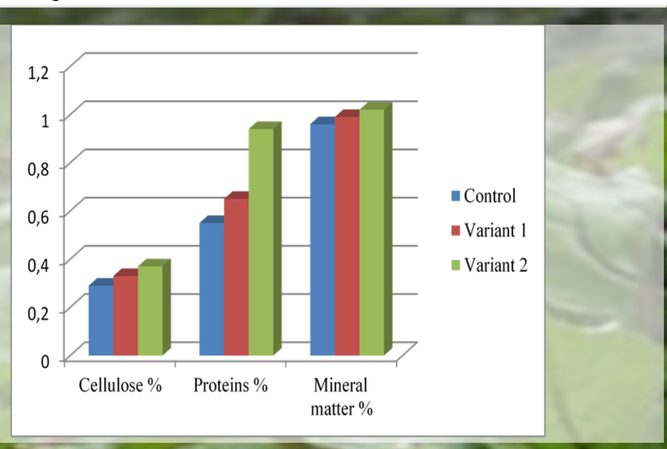

Figure 2. Contents of cellulose, protein and mineral matter in three variants beet

Conclusion

According to the results obtained in our research for the impact of microbial fertilizers on the yield and quality of beet it can be concluded that:

- ✓ The highest yield of beet is obtained in variant 2, where it was applied microbiological fertilizer with balanced ratio of chelated iron, several groups of azotobacter, nitrifying microorganisms and phosphor-soluble microorganisms, ie 26.70% higher compared to the yield obtained with the control. In variant 1, where it was applied microbiological fertilizer containing azotobacter, nitrifying microorganisms and phosphor-soluble microorganisms the yield was 6.07% higher than the yield of the control. Statistically significant difference was determined between: control and variant 2 (14.63 t / ha) and variant 1 and variant 2 (11.30 t / ha).
- ✓ Variant 1 had significant higher content, compared with the control, for the following components: vitamin C (6.86%), cellulose (13.79%) and protein (18.18%).
- ✓ While variant 2, compared with the control had significant higher content for the following parameters: vitamin C (14.71%), cellulose (27.59%), protein (44.62%) , minerals (6.25%) and Fe (100%).

According to the presented results application of the microbiological fertilizers significantly influenced for increasing of the beet root yield and for improving of the chemical composition.