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INFLUENCE OF FERTILIZATION ON GROWTH AND QUALITY OF LETTUCE

SUMMARY

The biological characteristics of lettuce and its specific growth and development are the basis for establishing the optimal method of cultivation. In order to achieve appropriate high yields, producers various organic, mineral and microbial fertilizers.

The aim of the study was to determine the effect of fertilization on the growth and quality of different varieties of lettuce. A two-factor experiment (fertilization and variety) was set up on a random block system in a greenhouse without heating, on the territory of East Sarajevo. A non-fertilized control variant was included in the trial.

During the research, the effect of fertilizers (Slavol and Fitofert humisuper) on two varieties of lettuce (Santoro RZ and Kiribati RZ) was examined.

The highest mass of lettuce was recorded on the variant with application of Slavol (309,19 g).The highest percentage of dry matter was achieved by fertilization with Slavol in the Kiribati *RZ* variety – 6,46%, while the lowest percentage was achieved on the control variant in the Santoro RZ variety - 5.10%.

Keywords: fertilization, lettuce, yield, quality.

INTRODUCTION

Vegetable crops have high nutrient requirements. Proper growth and development of plants requires a ratio of nutrients found in the soil. Nutrition of plants, ie. the addition of the necessary nutrients to the plant is done by applying fertilizer. Today, organic and mineral fertilizers are used to feed the plants (Rašević, 2017). Organic fertilizers play a major role in the growth and development of plants. They contain the necessary macro and micro elements and

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improve the physical and chemical properties of the soil (Chaterjee et al.,2005; Chaterjee et al.,2014; Čabilovski et al., 2010).

However, according to many researchers, fertilizing the soil with organic fertilizer for vegetable nutrition alone does not produce good results in achieving high and stable yields. Therefore, various types of organic fertilizers should be applied in combination with mineral fertilizers (Ogbonna, 2008; Ndaeyo et al., 2005; Makinde et al., 2007; Dauda et al., 2008). Mineral fertilizers are products containing nutrients essential for the normal growth and development of plants.As for the production of lettuce, it has been proven that organic fertilizers are more suitable than inorganic fertilizer (Masarirambi et al. 2010). Also, mineral fertilizers can have a detrimental effect on plant quality, declining dry matter content, increasing soil acidity, increases the nitrate concentration in the lettuce cultivar ,degeneration of physical properties, increasing erosion and instability of soil aggregates (Adeoluwa and Adeogun, 2010; Olowoake and Adeoye, 2010; Premuzic et al. 2001).

The application of microbiological fertilizers has economic and environmental justification. Fertilizers and lately bio stimulants have increasingly been used as a tool with the potential to enable a more sustainable agriculture production (Bulgari et al. 2015). Improvement of plant production goes towards significant use of microbial inoculants in the production of non-leguminous plants, including the most important crop and vegetable species. Because the aim of this study was to examine the effects of Slavol bio stimulant and the Fitofert fertilizer on production of the lettuce and draw a conclusion about the effectiveness of their action.

MATERIAL AND METHODS

The impact of different fertilization variants on the growth and quality of two lettuce varieties was investigated during one growing season in 2019. A two-factor experiment was set up in a greenhouse without heating. The experiment was set up according to a random block system, in three repetitions with the size of a test plot of 2 m² (1x2 m).

Within the first tested factor fertilization (A) were variants:a_1) control (no fertilization), a_2) Slavol, and a_3) Fitofert humisuper plus.

Slavol is a universal certified fertilizer and can be used in organic and traditional agricultural production. Slavol is a preparation containing bacteria (nitrogen fixers and phosphomineralizers), plant growth stimulants that produce auxins (indole-3 acetic acid) in the fermentation process in the range of 0.01 to 0.1 mg/l. It affects cell division, stem and coleoptile growth, development of adventitious and lateral roots, flowering and pollination, and fruit quality.

Fitofert hemisuper plus organic-inorganic NPK fertilizer is used for all plant species, and exclusively for leafy vegetables grown on different soils in the field and substrates.

Second tested factor (B) includes the following variants: b_1) Santoro RZ, and b_2) Kiribati RZ.

In the stage of tenological maturity of lettuce we analyzed:

–weight of lettuce (g),

–vitamin C content in fresh leaf (mg100g^{-1}),

–dry matter content in the leaf (%).

The dry matter content in the leaf was determined by drying in an oven at 105°C. Based on the difference between the initial mass of the sample and after drying, the percentage of dry matter was calculated.

Vitamin C was determined by titration method. The significance of the differences of the environments was tested by the two-factorial variance analysis (ANOVA) method using SPSS 4.5 software.

Soil characteristics of the experimental field

Chemical analysis of the soil showed that the soil is an alkaline reaction, low in carbonate and belonging to the group of poorly lime soils, rich in humus, rich in nitrogen, very rich in readily available phosphorus and very rich in readily available potassium.

Table 1. Chemical properties of soil

pH H_2O	pH KCl	$CaCO_3$ %	Humus %	N %	P_2O_5 mg100g^{-1}	K_2O mg100g^{-1}
8,01	7,42	<1%	7,24	0,47	>40	65,41

RESULTS AND DISCUSSION

Weight of lettuce (g)

From the analysis of variance it can be concluded that the fertilization factor had a significant effect on the tested characteristic.

Table 2. Effect of fertilization and variety on the weight of lettuce (g)

Fertilization	Variety		Average for fertilization
	b_1	b_2	
a_1	169,49	135,09	152,29
a_2	268,90	349,48	309,19**
a_3	222,98	181,13	202,06
Average for variety	220,46	221,90	221,18

LSD	A	B	AxB
0,05	85,36	69,70	120,73
0,01	121,34	99,09	171,62

The highest weight of lettuce was recorded on variant a_2 (309.19 g) and compared with the control (152.29 g) and a_3 variant (202.06 g) the difference was statistically significant. Željkovic et al. (2013) confirmed the positive impact of

biostimulant application on the vegetative growth and chemical composition of marigold (*Tagetes patula* L.) belonging to the same family (fam. Asteraceae) as salad.

Similar results are reported by Đorđević et al. (2004) who emphasized that the use of Slavol microbial fertilizer in the production of pepper seedlings significantly influenced the increase in root length and above-ground part of the plant relative to the control variant. The group of authors concludes that the application of microbiological fertilizer stimulates the growth of the aboveground part of the plant by an average of 29% compared to the control variant (Bošković 2010; Govedarica et al., 1998; Đukić et al., 2007; Gecić et al., 2007). This effect of the microbiological fertilizer is explained by the ability of the nitrogen fixers to produce certain physiologically active substances such as auxin, gibberellin, cytokinin and vitamins. They stimulate the respiration energy of plant tissue, the activity of many enzymes, the process of photosynthesis, the absorption of water and minerals.

Dry matter content (%)

The average percentage of dry matter in a salad was in the range of 4 to 9%. In our studies, the dry matter content was from 5.10% to 6.46%.

Table 3. Dry matter content of lettuce leaf (%)

Fertilization	Variety		Average for fertilization
	b_1	b_2	
a_1	5,10	5,59	5,34
a_2	5,40	6,46	5,93**
a_3	5,69	6,01	5,85
Average for variety	5,39	6,02**	5,70

LSD	A	B	AxB
0,05	0,062	0,051	0,287
0,01	0,088	0,072	0,408

The highest percentage of dry matter was achieved in the second fertilizer variant (a_2-Slavol) in the Kiribati RZ variety - 6.46%, while the lowest percentage was achieved in the control variant (a_1 in the Santoro RZ variety- 5.10%. The results of our research show that the dry matter content of salad is directly dependent on fertilization. Similar results are shown by Čabilovski et al. (2010). Also, Parađiković et al. (2009) conclude that% of dry weight of marigold (*Tagetes sp.*) root and leaves was significantly influenced by biostimulator treatment.

Vitamin C

Within the fertilization factor (Table 4), the highest content of vitamin C was found in the control variant (17.78 mg $100g^{-1}$) and the lowest in the variant a3 (10.01 mg 100g-1).

Tabela 4. Vitamin C content in lettuce leaf (mg $100g^{-1}$)

Fertilization	Variety		Average for fertilization
	b_1	b_2	
a_1	23,05	12,52	17,78**
a_2	14,91	7,50	11,02
a_3	12,02	8,01	10,01
Average for variety	16,66**	9,34	12,93

LSD	A	B	AxB
0,05	0,403	0,330	0,570
0,01	0,573	0,469	0,811

The results show that fertilization adversely affected the vitamin C content of the salad. Plakalovic (2018) has similar results. In his research, the author examined the impact of different fertilizer variants ($N_{120}P_{100}K_{120}$; $N_{120}P_{100}K_{120}$ + 30g Fitofert 20: 20: 20 / 100m² / day; $N_{120}P_{100}K_{120}$+ 40g Fitofert 4: 10: 40 / 100m² / day) on the qualitative components of young onions. The cited author concludes that increased amounts of fertilizers do not positively affect the vitamin C content. Similar results are shown by Premuzic et al. (2001) who found that N or bio stabilized compost fertilization does not change lettuce vitamin C content.

CONCLUSIONS

Based on the results of research on the effect of fertilization on the growth and quality of lettuce, it can be concluded:

–The application of microbial fertilizer had a stimulating effect on the growth of the above-ground part of the lettuce.

–The tested varieties of fertilizers with microbiological fertilizer achieved a statistically significantly higher mass of the aboveground part compared to the control variant.

–The dry matter content of the varieties did not different.

–Different fertilization methods did not positively affect the vitamin C content of lettuce. The highest content was recorded on the control fertilizer variant and the lowest content on the variant where organic-inorganic NPK fertilizer was applied.

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