BOOK OF PROCEEDINGS

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"Agrosym 2023"

Jahorina, October 05-08, 2023

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INFLUENCE OF BIOFERTILIZERS ON YIELD AND QUALITY OF LETTUCE GROWN IN THE OPEN FIELD

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Abstract

The production of lettuce is very profitable due to the short vegetation period and the possibilities of its cultivation throughout the year. On average, the salad contains 94% water, 2% sugar, 0.6% crude cellulose, 0.6% mineral matter and 1.2% crude protein. It is rich in vitamins C, B_1 and B_2, and many mineral elements. Great influence on the quantitative and qualitative properties of lettuce in addition to the variety and production conditions has a proper diet. The application of mineral fertilizers results in high yields, but their inadequate application can cause various problems such are: decrease in dry matter content, deterioration of salad quality, increase in soil acidity, degeneration of physical properties, increase in erosion and instability in land aggregates. In order to reduce the use of chemicals and increase the yield in the same time, the improvement of plant production is moving in the direction of introducing biofertilizers. In recent years there has been a trend of decreasing the usage of mineral nutrients, primarily nitrogen, phosphorus and potassium (Haytova, 2013), in which bio stimulators play a significant role. Therefore, the goal was to determine the impact of biofertilizers on the yield and quality of lettuce and to investigate the possibility of streamlining the crop by using biostimulators in lettuce nutrition. The two-factor experiment was set on a private plot in district Vranjes, East Sarajevo by using the randomized block in 3 replications. The highest yield of lettuce was obtained in the variant with the application of the biofertilizer Bioplant flora (630.50 g – please state the unit), whereas the lowest was recorded in the control variant of fertilization (468.00 g). The highest percentage of dry matter was noted in the third variant of fertilization (Bioplant flora) in the variety Majska kraljica (6.45%), whilst the lowest percentage was reached in the control variant of the same variety (4.14%).

Keywords: *lettuce, biofertilizer, yield, quality.*

Introduction

Lettuce is rich in vitamins E, B_1, B_2, B_3 and B_6, folic acid, vitamin C and minerals such as sodium, potassium, magnesium, calcium, phosphorus and iron, which is why it is very beneficial to health. Some of the advantages of lettuce regarding its healthful properties: it has an anti-inflammatory effect, reduces cholesterol, improves sleep, acts as an antioxidant, is beneficial for heart health and has an anti-cancer effect (Ergović, 2019). The biological characteristics of lettuce and its specific growth and development are the basis for determining an optimal production method. To achieve appropriate high yields, it is supplemented with different fertilizers, which are of great importance during the growth and development of lettuce and also affect its qualitative characteristics. Applying different fertilizer systems, organic and mineral, high yields of good quality can be achieved in greenhouse vegetable production (Bogdanović et al., 2011; Bogdanović et al., 2012).

However, improper mineral fertilization, especially in winter when plants do not get enough light, creates ideal conditions that lead to the accumulation of significant amounts of nitrates, especially in leafy vegetables. Negative consequences of using mineral fertilizers lead to the leaching of nitrates into groundwater, toxic effect of heavy metals and harmful organic substances, and the appearance of weeds. In this context, the following sections of the paper will explain the role and importance of biofertilizers and how their proper application affects the growth and yield of various vegetable crops, especially leafy vegetables (Bogdanović, 2014).

Materials and methods

In order to test different types fertilization on the yield and quality of two varieties of lettuce, the study was conducted in 2022 in an open field in Vranješ, in the area of the city of East Sarajevo (Entity of Republic of Srpska, Bosnia and Herzegovina). The two-factor experiment was set by using the randomized block in 3 replications.

The size of the experimental plot was $2m^2$ (1m x 2m). The total area of the experimental field was 36 m^2. The distance between the plants was 0.30m, and the distance between the rows was 0.20m. A total of 600 plants per/$36m^2$. The manual irrigation was applied in the trial field. The basic characteristic of the land on which the experiment was set up were: 5.52 pH (in KCl); <1% $CaCO_3$; 5.56% humus; 0.17 % total nitrogen; 3.40 P_2O_5 mg/100g; 29.84 K_2O mg/100g.

This experiment included three fertilization variants (factor A) and two lettuce varieties (factor B). The tested factor (A) included the following variants: a_1 - control variant, a_2 - Slavol and a_3 - Bioplant flora. Within the second factor studied (B), two varieties were analyzed: b_1 - Majska kraljica, and b_2 - Ljubljanska ledenka. The average yield per sample was determined based on the average mass of the aerial part of the plant and the number of plants on the sample plot.

Among the ḫemic properties, the following were analyzed: the content of dry matter (%), and the vitamin C content in the leaf (mg $100g^{-1}$). Dry matter content was determined by the difference between the initial weight of the sample and the weight after drying. The drying of the plant material was carried out in a drying oven at 105^0C to a constant mass. Vitamin C (mg $100g^{-1}$) was determined by the titration method.

The obtained results were processed by the variance analysis method for a two-factor experiment (ANOVA). The significance of differences between individual environments was tested by LSD test.

Results and discussion

Total yield

According to Lazić at al (2001) yield of lettuce is different and can go from 1.5 to 4 (kg m^{-2}) depending on variety and time of production. The average green lettuce yield in our research is 5.6 (kg m^{-2}).

Table 1. Total yield (kg m^{-2})

Fertilization	Variety		Average for fertilization
	Majska kraljica (b_1)	Ljubljanska ledenka (b_2)	
Control variant (a_1)	4.39	4.96	4.68
Slavol (a_2)	5.76	6.31	6.04
Bioplant flora (a_3)	5.70	6.91	6.30
Average for variety	5.28	6.06	5.67
LSD	A	B	AxB
5%	1.56	1.28	2.21
1%	2.23	1.82	3.15

Regarding the use of biofertilizer, the highest yield was achieved on the a_3 variant (6.30g) , which is statistically higher in comparison to the control variant a_1 (4.68g). Differences in yield between variant a_2 and a_3 were not statistically significant. Team of authors concludes that the use of microbial fertilizer stimulates the growth of the stem at an average of 29% compared to control variant (Bošković 2010; Govedarica et al., 1998; Đukić et al., 2007; Gecić et al., 2007). This effect of microbial fertilizer can be explained by the ability of nitrogen fixation to produce certain physiologically active substances such as auxin, gibberellin, cytokinin and vitamin. They stimulate the aerobic respiration of the plant cells, i.e activitiy of many enzymes, process of photosynthesis, water and mineral absorption. Differences between varieties in obtained yields were not statistically significant, which is parallel to the results of Kulina (2019).

Vitamin C content

Vitamin C is an important factor in human nutrition. This vitamin takes part in numerous biological processes and is the strongest antioxidant among the vitamins.

Table 2. Vitamin C content (mg $100g^{-1}$)

Fertilization	Variety		Average for fertilization
	Majska kraljica (b_1)	Ljubljanska ledenka (b_2)	
Control variant (a_1)	8.53	10.66	9.59
Slavol (a_2)	10.66	8.10	9.38
Bioplant flora (a_3)	12.37	10.66	11.51
Average for variety	10.52	9.80	10.16
LSD	A	B	AxB
5%	1.89	1.53	2.67
1%	2.69	2.18	3.80

Regarding the use of biostimulators, the highest content of the mentioned vitamin was recorded in variant a_3 (11.51mg $100g^{-1}$), which is statistically higher than variants a_1(9.59mg $100g^{-1}$) and a_2 (9.38mg $100g^{-1}$). By analyzing the interaction, it was determined that the variety b1 on the variant a_3 (12.37mg $100g^{-1}$) had a statistically significantly higher content of the given vitamin compared to the other examined variety from the fertilization variant a_2 (8.10mg $100g^{-1}$).

Dry matter content (%)

The content of dry matter in lettuce ranged from 4.14 to 6.45%. The highest percentage of dry matter content was recorded in the third variant of fertilizer (Bioplant flora) in the Majska kraljica variety - 6.45%, while the lowest percentage was achieved in the control variant of fertilization in the same variety

Table 3. Dry matter content (%)

Fertilization	Variety		Average for fertilization
	Majska kraljica (b_1)	Ljubljanska ledenka (b_2)	
Control variant (a_1)	4.14	4.54	4.34
Slavol (a_2)	4.92	4.95	4.93
Bioplant flora (a_3)	6.45	5.23	5.84
Average for variety	5.17	4.90	5.03
LSD	A	B	AxB
5%	0.28	0.22	0.37
1%	0.39	0.31	0.53

From the analysis of the variance (table 3) we can establish that on the third fertilizer variant a_3 there is statistically significantly higher percentage of dry matter content (5.84%) in comparison to the a_2 (4.93%) and controll (a_1) fertilizer variant (4.34%). The results of these researches show that the percentage of dry matter content in lettuce is associated directly with the fertilization. Čabilovski et al (2010) have shown similar results. Likewise, Parađiković et al (2009) conclude that the percentage of dry matter content of marigold (Tagetes sp.), which belongs to the same family as lettuce, was under a significant influence of biofertilizer.

Conclusion

Based on the results of the research "Influence of biofertilizers on yield and quality of lettuce produced in the open field", it can be concluded that the yield achieved during the research was at a satisfactory level. The lowest yield was in the control variant of fertilization, and the highest in the variant Bioplant Flora. The differences between the achieved yield within the varieties were not statistically significant. The use of biofertilizers had a positive effect on the content of vitamin C. The maximum content of vitamin C was recorded in the variant Bioplant Flora. Application of biofertilizer had a positive effect on the total dry matter content of lettuce plants compared to the control treatment. The highest content of dry matter was recorded on the variant fertilized with Bioplant flora.

References

Bogdanović, D. (2014): Mineral fertilizers and fertilization. Manual. Novi Sad, Faculty of Agriculture.

Bogdanović, D, Ilin, Ž., Čabilovski, P., Marinković, D. (2011): Dynamics of NO3-N in soil under early cabbage in depending on fertilization systems and mulching. Yearbook of scientific papers 35 (1), 57-67.

Bogdanović D., Ilin, Ž., Čabilovski, R. (2012): Dynamics of NO3-N the soil under pepper as dependent on fertilization systems and mulching. International symposium for agriculture and food. XXXVII Faculty-economy meeting VII simposium for vegetable and flower production. Proceedings, Skopje, Macedonia, 12-14 december, 355-363.

Bošković L. (2010): The influence of bistimulators on soil microbial activity and plant growth of Camellia sp. and Cupressus macrocarpa. Master's thesis. University of Montenegro. Faculty of natural sciences. Podgorica.

Čabilovski, R., Manojlovic, M., Bogdanovic, D. (2010): Monitoring of mineral nitrogen dynamics in soil and adoption by lettuce crop after application of organic fertilizers. Yearbook of scientific papers of the Faculty of Agriculture in Novi Sad. Year 34, no. 1. 46-52.

Đukic, D. A., Jemcev V. T., Kuzmanova, J. (2007): Soil biotechnology. Novi Sad: "Future".

Ergović, L. (2019): The influence of a biological preparation on the adaptation of lettuce seedlings. Graduate work. Osijek: Faculty of Agrobiotechnical Sciences.

Govedarica, M., Milosević, N., Djukić D. A., Mandić L. G. (1998): Effect of Azotobacter chroocroccum and Azospirillum lipoferum strains on sugar beet yield and soil microbial activity. Acta Agriculturae Serbica 3, 29-37.

Gecic, J., Mrkovacki, N., Cacic, N. (2007): Application of different types of sugar beet inoculation with Azotobacter chroocroccum, Annual of scientific papers, Volume 31, No. 1, 47-54.

Haytova, D. (2013): A review of foliar fertilization of some vegetables crops. Annual Research and Review in Biology, Page 455-465.

Knežević D. (2023): The influence of biofertilizers on the yield and quality of lettuce. Master's thesis. Faculty of Agriculture, University of East Sarajevo.

Kulina, N. (2019): Effects of microbiological fertilizer application in spring salad production. Master's thesis. Faculty of Agriculture, University of East Sarajevo.

Lazic B., Djurovka M., Markovic B., Ilin Z. (2001). Vegetable growning(III).University of Novi Sad: Faculty of Agriculture.

Parađiković, N., Zeljković, S., Đurić. G., Vinković, T., Mustapić-Karlić, J., Kanižai, G.,Iljkić, D. (2009): Growth and development of velvet (Tagetes erecta L.) under the influence of substrate volume and biostimulator treatment. In Proceedings of the 44th Croatian and 4th International Symposium of Agronomists, Lončarić,Z., Marić, S. (ed.), 786-790, Osijek, Croatia, Faculty of Agriculture in Osijek.