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EFFECT OF MINERAL AND ORGANIC FERTILIZATION ON THE PRODUCTIVITY OF STEVIA (Stevia rebaudiana B.)

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Abstract

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An experiment has been made in the fields of the Agricultural Institute – Shumen during 2013-2015 to study the effect of three organic and mineral products: Bioactive (100ml/da), Humustim (40 ml/da) and mineral nitrogen (20 kg/da), on the productive qualities of stevia (Stevia rebaudiana B.) For that aim I year seedlings were used. The parameters fresh and dry mass of a single plant, and fresh and dry mass yield from one da, were measured.

It was established, that the highest fresh mass yield from a single plant is formed by the variant, treated with mineral Nitrogen (20 kg/da) – the average yield of fresh mass is with 90 g (75.8%) higher than that of the untreated control. The tested organic and mineral products have positive influence on the dry mass yield index for the three years of testing.

Key words: stevia, organic and mineral products, productivity, fresh mass, dry mass

Introduction

Stevia (Stevia rebaudiana Bertoni) is a perennial bushy cross-pollinating plant, with natural area of distribution the humid regions of Paraguay, Columbia and Brasil. Numerous researches for finding new natural, non-caloric sweeteners indicate that stevia is an excellent substituent of sugar. Its sweetness is due to the diterpenic glucosides Rebaudiside A and Stevioside, which are up to 300 times sweeter than sugar (Geuns, 2004).

The adaptability of the plant allows its introduction in different countries (Sumida, 1968; Lewis, 1992). In Bulgaria stevia is cultivated since 1984 in the former Sugar beet Institute – Shumen (Kikindonov, 2013). The positive effects of different biostimulators for increasing the productive capacities of stevia is proved in the reports of some researchers (Das et al., 2007; Mamta et al., 2010; Lei and Yan, 2011; Špicnagel et al, 2011; Jing Wu et al., 2013; Inugraha et al., 2014). There are also data for preparations, increasing the stevia's resistance to different stress factors, low and high temperatures, diseases (Jain et al, 2009; Ren, et al, 2011; Raziye et al., 2015; Mehdi et al, 2017). The content of the active components of the plant – stevioside and rebaudiside A depends in a great extent on the applied agro-technology and the use of organic-mineral products.

The aim of our study is to establish the efficiency of some organic-mineral products' application on the productivity of stevia.

Material and Methods

The experiment has been carried out on the experimental fields of Agricultural Institute – Shumen, during the period 2013-2015. It has been studied the influence of the organic-mineral products Bioactiv (100 ml/da), Humustim (40 ml/da) and mineral Nitrogen (20 kg/da), applied once in the stage of 2-4 branch of the plants. The seedlings used are of the stevia

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variety Stela, bred in Agricultural Institute – Shumen, produced in the Tissue Cultures Lab of the Institute and adapted for field conditions in a green house. The forerunner crop is sugar beet. The soil type is carbonate black soil with 3.3% humus, very high content of CaCO3, and slightly alkaline reaction of the soil solution (pH 7.4-7.8). The planting is in the beginning of May, when the soil temperature is over 100C. Each experimental plot has been planted with 20 plants in 4 repetitions. The treatment has been done with a manual sprayer. Three hillings have been made by hand during the vegetation, and the soils humidity has been kept at 70-75% of the marginal soils humidity by drip irrigation.

The following variants were tested:

1. Treated with organic fertilizers

* Bioactiv – 100% activated epsomit (MgSO4 x 7 H2O).

* Humustim – 41.05% ashes and mineral substances and 58.95% organic matter, including humine acids, fulvic acids, potassium, nitrogen, P, Ca, Mg.

* Mineral Nitrogen – Amonium nitrate (NH4NO3)

2. Control variant – non-treated.

The studied parameters are fresh and dry mass of a single plant, and fresh and dry mass yield per da. Dispersion analysis (Lidanski, 1988) was used for determination of the statistical significance of the differences between the tested variants.

Results and Discussion

The values of the measured weights of fresh and dry mass of a single plant during the period of study are presented on Figures 1 and 2. The tested organic-mineral products have affected positively the harvested fresh and dry mass of a single plant. The biostimulators increase the adaptive capacities of stevia plants in conditions of hot summer vegetation. The comparatively low yields in 2013 are due to the shorten period of adaptation in the green house and the development of fungal diseases. The increase of the fresh mass yield of a plant by the application of organic-mineral products in comparison with the non-treated variant is 18-21%.

The most important indication of the efficiency of a certain agro-technology measure is its effect on the productivity. All the tested applications of organic-mineral products bring to increase of the fresh mass yield per decar, compared to the yield of the non-treated control (Table 1). In 2013, when the time for adaptation in green house was not enough the stevia plants on the field did not react so categorically to the organic-mineral products treatments. The fresh mass yields of the treated variants do not differ substantially from the control variant. But for the next years of tests, in optimum adaptation conditions, the fresh mass yield of all the variants treated with organic-mineral products is higher than the yield of the non-treated control variant. This exceedance is proved statistically for the fresh mass yields from the variants treated with Bioactiv and mineral Nitrogen in 2014 and 2015, as well as for their average values for the entire period of our study. The yields of fresh mass per da of harvested area reach values of 1026.6-1063.2 kg/da for the variants treated with Bioactiv, and 1101.9-1119.2 kg/da for the variants fertilized with mineral Nitrogen. It is obvious, that the highest is the positive effect on the fresh mass yield from one year old seedlings of the treatment with mineral Nitrogen – the plants treated with this mineral fertilizer gave 26.0% higher fresh mash mass yield than the non-treated control of stevia.

The dry mass yield is a significant parameter for the economical value of stevia, because this is the product, which is realized on the market. From the data given on Table 2 we could accept as normal the lower values of dry mass yield in 2013 (from 82.5 to 114.5 kg/da). The interesting fact noted here is, that the strongest is the effect of the treatment with Humustim – the dry mass yield of the treated with Humustim variant is proved higher than the yield of the non-treated control and the variant treated with Bioactive. Similar results were obtained by Vasileva (2015) in pea and vetch. In the next year of tests the yield of dry mass for all the variants is much, almost three times higher than in the previous year (234.6 - 289.3 kg/da). All the variants treated with an organic-mineral product gave proven higher dry mass yield than that of the non-treated control. In 2015 the variant fertilized with mineral Nitrogen gave the highest yield of dry mass – 318.6 kg/ha. And this yield exceeds the yield of the non-treated control, and that of the variants, treated with Bioactiv and Humustim. The average values of the dry mass yield for the three years of testing are 195.0 to 237.7 kg/da. The treatment with organic-mineral products proves to be efficient for the higher dry mass yields of the relevant variants. The variants treated with Bioactiv, and especially the one fertilized with mineral Nitrogen, gave proven higher dry mass yields.

Conclusions

The treatments of one-year old seedlings of stevia with the organic-mineral products Bioactiv, Humustim and mineral Nitrogen have positive effect on the development of stevia plants, resulting in much higher biomass yields.

The fertilization with mineral Nitrogen and the treatment with Bioactive increase significantly the fresh and dry mass yields of stevia plants.

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