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Optimizing of systems for nutrition in biological pepper production

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Abstract

The effect of organic fertilizers on the growth and productive manifestations of pepper variety Kurtovska kapia 1 was studied in field conditions. Organic products Amalgerol and Biofa were tested on the basic fertilization with Lumbrikal and Biosol. The studies were conducted during the period 2011-2013 in the "Maritsa" Vegetable Crops Research Institute, Plovdiv. Bioproducts have a positive impact on the number and average weight of the fruit. Fertilization with bioproducts Biofa and Amalgerol on background Biosol results in increase of the number of fruits in pepper averagely with 3.1 fruits plant-1. It was established an increase of the yield in pepper from 6.2% /background Lumbrikal/ to 16.9% /background Biosol +Amalgerol/ towards the control. Feeding with Amalgerol and Biofa on background Biosol results in further increase of the value of this index, as yields are statistically unproven towards that grown on Lumbrikal background. Bioproducts have a positive effect on the average fruit weight. The results in the biochemical analyzes of fruits demonstrate more remarkable variations in the vitamin C content.

Keywords: (*Capsicum annum* L.), biofertilizer, weight fruit, number of fruits, yield.

Introduction

During the past years the agricultural science studied the fertilizers both as a mean for yield increase and for production of agricultural produce with high biological value. The increased requirements for safety foods and pure environment determine the dynamic development of the technologies for plant nutrition. An alternative for application of chemicals in the agriculture is the use of bioproducts that are applied in organic agriculture both as a substitute of the mineral fertilization (Tringovska, 2004, Vlahova, 2013) and an instrument for biological control of diseases on plants (Yankova et al., 2009). It was established that a faster growth of tomato (Tringovska and Kanazirska, 2007), pepper (Vlahova, 2012) and cucumber (Arnaudov et al. 2007) is observed in fertilization with bioproducts. The decrease of the amounts of chemical products by application of new bioproducts is a good strategy for maintenance of nutritional regime of the plants with low energy inputs (Mihov et al., 2012).

It was established that the organic fertilizers keep or improve the quality of the tomato, pepper and cucumber fruit (Tringovska and Kanazirska, 2007; Arnaudov, 2009; Vlahova, 2014). Breeding programs are directed to development of hybrid varieties that are more resistant and suitable for biological production (Antonova G., 2012; Antonova et al., 2012; Todorova, 2013; Todorova et al., 2013; Nacheva et al., 2013).

The purpose of the investigation was to establish the effect of biofertilizes on the biological manifestations and fruit quality of pepper to optimize plant nutrition in integrated pepper production.

Materials and Methods

The experimental work was carried out on strongly leached meadow-cinnamon soil of the experimental field at the "Maritsa" Vegetable Crops Research Institute – Plovdiv with pepper, variety Kurtovska kapia 1. The influence of biofertilizers Lumbrikal and Biosol (used as background) and Amalgerol premium and Biofa (made by feeding in the vegetation) on the biological manifestations and quality of pepper fruit was studied.

Variants

1. Control – non fertilization
2. Lumbrikal – 4000 kg ha-1 (introduced as a basic fertilization)
3. Lumbrikal + Biofa 0,3-0,5% – приложен листно, двукратно.
4. Lumbrikal + Amalgerol premium - 3000 mL ha-1, (foliage feeding**,** double during vegetation)

5. Biosol – 1000 kg ha-1 (introduced as a basic fertilization)

6. Biosol + Biofa 0,3-0,5% (foliage feeding**,** double during vegetation)

7. Biosol + Amalgerol premium - 3000 mL ha-1 (foliage feeding**,** double during vegetation)

The plants were grown from seedlings under an unheated greenhouse. The experiment was set by block method in 4 replications by 120+40/15 cm scheme with area of 9.6 m^2. Plants grown by technology for mid-early production.

The soil has slight mechanical composition, sand-silt with mineral nitrogen content ($N\text{-}NH_4^+$+$N\text{-}NO_3^-$) – 2.4 mg 100 g-1 soil (determined by distillation); movable P_2O_5 forms (by Egner-Reem method) and K_2O (flame photometric) – 20.5 mg and 18.7 mg 100 g-1 soil, respectively; soil reaction $pH_{(H_2O)}$ – 7.0 (potential-metric); soluble salt total concentration – by electro-conductibility (EC mS/cm) and humus content – 2.1% by Tyurin (Томов, 1999).

Indicators of study:

1. Agrochemical analysis of the soil - before setting of the experiment in order to determine the kind and quality of the fertilizers for basic fertilization and monthly – for feeding.

2. Vegetative mass– mass of the stems, mass of leaves and total vegetative mass (kg/plant) - analyze 10 plants of replications in mass fruitfulness.

3. Productivity of plants - number of standard fruits per plant**;** weight of pepper fruit (g plant-1); average weight of the fruit (g fruit-1) **-** analyze 10 plants of recurrence and 10 fruits of replications in mass fruitage; total yield – kg ha-1.

4. Fruit quality – from average sample containing 20 fruits for each variant were analyzed: dry matter content (refractometrical), ascorbic acid (by Tilmans reaction) and total sugars (by Shool in-Regenbogen).

5. Analysis of variance were made for obtaining of results – (Duncan, 1955).

Description of the bioproducts

Lumbrikal – Ecological bioproduct, obtained as a result of nutrition of red Californian worm (*Lumbricus rubellus* Hoffmeister, 1843). with organic remains. It is useful microorganisms rich. Contains nutrients, vitamins, amino acids, antibiotics, hormones (N 1.2-2.0%, P 0.8-1.6%, K 0.5-1.0%, Ca 4.0-6.0%, Mg 0.5-1.0%, Fe 0.5-1.0%, 40-50% organic content, humic acids to 14%, fulvo acids to 7%. Used directly or as an aqueous extract. Manufacturer - farm in Kostievo, Plovdiv.

Biosol – Organic fertilizer with long lasting effects. Nitrogen is well absorbed by the plants as a result of the fact that it is an organic fixed. Ingredients: Contents - Dry matter - 95.60%; CaO - 0.21%; Organic matter - 90.70%; MgO -0.05%; pH (CaCl2) - 3.0; Cl - 0.04%; S - 1.80%; C: N - 06:01; B - 7.1 mg / kg; N (total) - 6-8%; Zn-6.0 mg/ kg; P_2O_5 - 0.5-1.5% Fe-101 mg / kg; K_2O - 0.5-1.5%. Manufacturer - Sandoz GmbH.

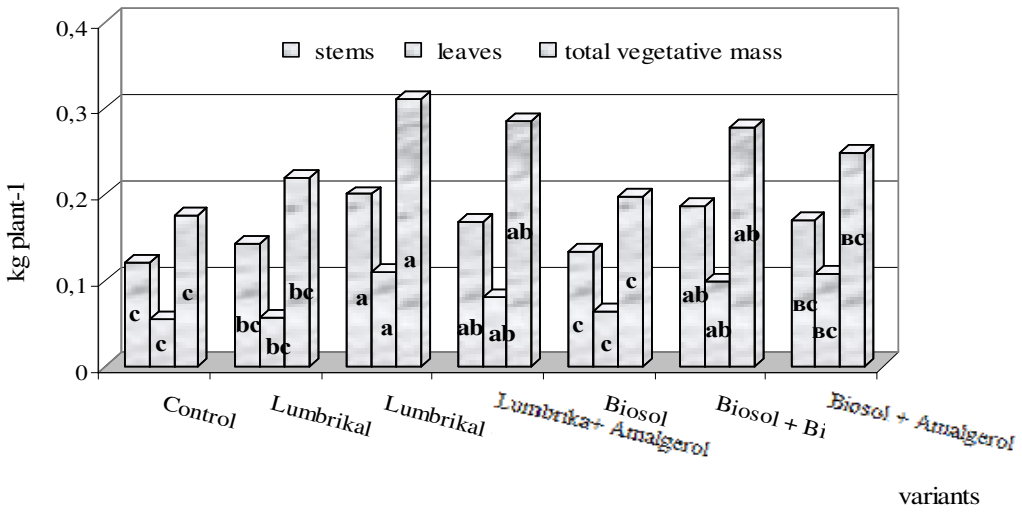
Biofa- Organic fertilizer based on extracts of brown algae. Contents: Organic substances - 11-12%; pH -6,5-7,0; total nitrogen N - 0,20%; total phosphorus (P_2O_5) - 8%; soluble potassium (K_2O) - 14%; CaO - 0.12%; MgO - 0,05%; total sulfur - 0.8-1.0%; trace elements - Cu, Zn, BOP, iron, molybdenum and manganese. Manufacturer: BIOFA Naturprodukte W. Hahn GmbH..

Amalgerol premium - liquid foliar fertilizer 100% absorbed by plants. Amalgerol premium increases microbial activity. The plants are characterized by much more active absorptive surface of the root system, is emphasized their greater resistance to disease and low temperatures. Manufacturer: Hechenbichler GmbH, Austria.

Results and Discussion

The results obtained averagely for the period of study demonstrated that the applied fertilizers have an effect on the growth manifestations of the pepper. The plants grown on Lumbrikal background with application of Biofa and Amalgerol were with the greatest vegetative weight – 0.305 kg plant-1 and 0.285 kg plant-1 towards 0.178 kg plant-1 in the control (Figure 1). The difference between the two treatments was not proven statistically.

The identical trend was also established on Biosol background as the effect of the complementary nutrition with biofertilizers is more slightly expressed. The plants fed with Biofoma in amount 0.278 kg plant-1 are with the greatest vegetative weight, followed by those treated with Amalgerol 0.242 kg plant-1. The positive effect of Biofa applied during the vegetation on the two backgrounds could be explained with the protective effect to diseases.



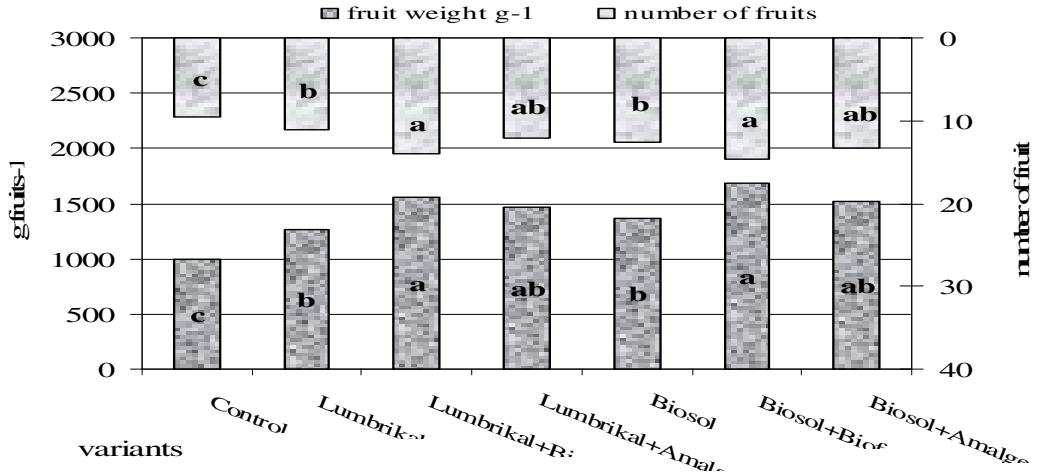
a,b,c – Duncan's Multiply Range Test, P<0.05

Figure 1. Effect of organic products on the vegetative mass of plants

In comparison of the effect of two backgrounds used individually on the vegetative weight of pepper plants was established that in treatment with Lumbrikal – 0.220 kg plant-1 the effect was greater compared to that obtained in fertilization with Biosol – 0.198 kg plant-1. The differences between the treatments with complementary fertilization by using of Biofa and Amalgeron on the two backgrounds were not statistically proven.

The differences between the treatments are more significant as a result of the applied fertilization regarding the leaf weight compared to those for the stems.

It was statistically proven that the bioproducts/applied as a background and for vegetation fertilization/ have a positive effect on the fruit number per plant in pepper variety Kurtovska kapia 1 as the increase was averagely 3.1 fruits plant-1 (Figure 2). The greatest fruit number per plant was obtained after application of Biofa on the two backgrounds – Biosol and Lumbrikal. The increase is 3.3 and 2.9 fruits plant-1, respectively as statistically significant differences are not established. The results for the fruit weigh per plant are analogical.

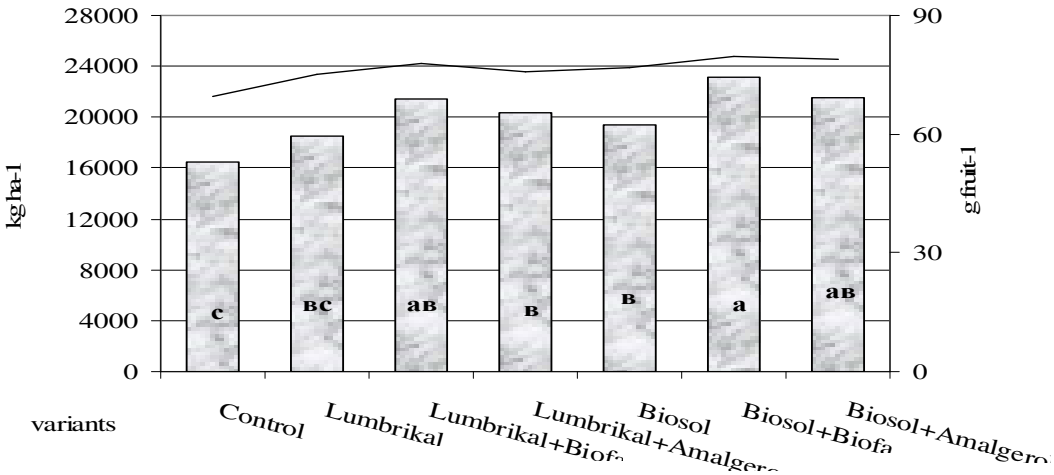


a,b,c – Duncan's Multiply Range Test, P<0.05

Figure 2. Number and weight of fruits per plant

The effect of biofertilizer application on the yield in pepper, variety Kurtovska kapia 1 is from 6.2% /background Lumbrikal/ to 16.9% /background Biosol + Biofa/ more than the control – free of fertilization (Figure 3). The backgrounds applied separately result in yield increase towards the control with 6.2% in Lumbrikal and 9.4% in Biosol. The additional nutrition with bioproducts on background Biosol results in increase of the value of this character. The highest yield per plant was obtained in growing on background Biosol and fertilization with Biofa – 23640 kg ha-1, followed by plants fertilized Amalgerol – 22100 kg ha-1. The differences are not statistically proven.

The fruit weight is an important biometrical character with economic significance. The average fruit weight in pepper was the highest compared the control in the treatments with background Biosol and application of Biofa and Amalgerol. The increase towards the control is with 7.5 g and 6.8 g fruit-1, respectively. Differences in the value of this character between the treatments grown on two backgrounds are insignificant.



a,b,c – Duncan's Multiply Range Test, P<0.05

Figure 3. Influence applied fertilization on yield and average weight of fruit

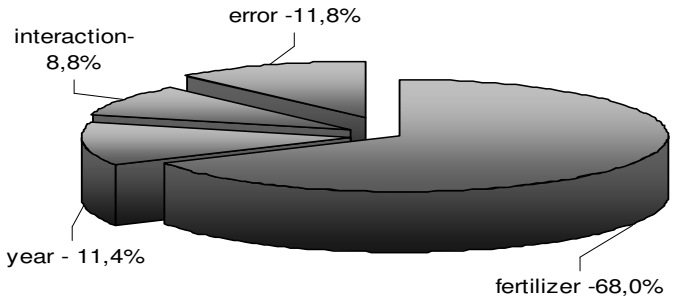


Figura 4. Influence of factors - fertilization and year on the vegetative mass

Fertilization affects more strongly on the change in vegetative mass of pepper compared with year (Figure 4).

The differences in the biochemical characters of the fruits from the pepper variety Kurtovska kapia 1 were analyzed with aim the nutritional regime to be optimized and the biological value to be increased. Biofertilizers have a positive effect on the vitamin C content in basic fertilization with Biosol. The additional increase of this character was established in foliar nutrition wit Biofa and Amalgerol – 230.04 mg% and 224.65 mg%, respectively. The deviations in the dry matter and sugar content in the fruits between the

treatments are small and definite tendency was not established (Table 1).

Table 1. Chemical analysis of the pepper fruits /average for the period/

№	Variants	Ascorbic acid mg %	Total sugars %	Dry matter content %
1.	Control	188.51 c	7.69 ns	9.95 ns
2.	Lumbrikal	201.58 b	7.79 ns	10.12 ns
3.	Lumbrikal+Biofa	215.89 ab	8.02 ns	10.40 ns
4.	Lumbrikal+Amalgerol	208.65 b	8.37 ns	10.28 ns
5.	Biosol	205.23 b	8.25 ns	10.20 ns
6.	Biosol+Biofa	223.02 a	8.37 ns	10.45 ns
7.	Biosol+Amalgerol	221.04 a	7.86 ns	10.38 ns

Conclusions

The vegetative weight is the greatest in the plants grown on Lumbrikal background. The effect of the backgrounds, included in this study is increased after complementary vegetative nutrition with Biofa and Amalgerol.

The bioproducts (applied as background and vegetative nutrition) have a positive effect on the fruit number per plant. The nutrition with Biofa on background of Biosol and Lumbrikal results in increase of their number with 3.3 and 2.9 fruits plant-1, respectively.

Bioproducts increase the yield from pepper variety Kurtovska kapia 1 from 6,2% /background Lumbrikal/ to 16.9% /background Biosol + Biofa/ towards the control. The nutrition with Biofa and Biosol results in additional increase of the value of this character.

A positive effect on the average weight of the pepper fruits was established as a result of the nutrition with Biofa and Amalgerol.

The results from the biochemical analyses of the fruits demonstrate more important variations in the vitamin C content for pepper after fertilization with Biosol. The differences in the dry matter and acid content between the treatments are small and a definite tendency was not established.

References

Antonova, G. 2012. Study on yield and quality characters in cabbage seed obtained in the conditions of organic trial. Cruciferae Newsletter, vol. 31, 22-25

Antonova, G., Masheva, S. and Yankova, V. 2012. Evaluation of head cabbage genotypes in the aspect of their use as initial material for organic breeding. Cruciferae Newsletter, vol. 31, 37-40.

Arnaoudov, B., Tringovska, I. and Kanazirska, V. 2007. Bioproducts: an ecologically friendly decision for high yield of cucumber and tomato greenhouse production. Proceedings of the International Conference Research people and actual tasks on multidisciplinary sciences.; 1: 210-214

Arnaudov, B. 2009. Effect of organic fertilizers on the chemical technological indices of greenhouse cucumbers production cultivated in soil and soilless media. Proceedings of the International Conference “Research people and tasks on multidisciplinary sciences lozenec, Bulgaria 10-12 june,; 1:311-315

Duncan, D. 1955. Multiple range and multiple F-test. Biometrics.; 11: 1-42.

Mihov, M., Antonov, G., Masheva, S. and Yankova, V. 2012. Energy Assessment of Conventional and Organic Production of Head Cabbage. Bulgarian Journal of Agricultural Science Volume 18, 3, 320-324.

Nacheva, E., Masheva, S. and Yankova, V. 2013. Characterization of agrobiological response of mid-early potato breeding lines and varieties in biological production. Plant science, 50, 80-85.

Todorova, V. 2013. Evaluation of some quality characters of pepper organic seeds. Международной научно-практической конференции «Научное обеспечение картофелеводства, овощеводства и бахчеводства: достижения и перспективы» 11-12 декабря 2013 года Казахстан, стр. 516-519. /in English/

Todorova, V., Yankova, V. And Masheva, St. 2013. Manifestations of Bulgarian pepper varieties grown in conditions of organic production. Plant science 50(2), 34-37 /in Bulgarian/

Tringovska, I. and Kanazirska, V. 2007. Effect of some organic fertilizers on plant growth and fruit yield of greenhouse tomatoes. Proceedings of the International Conference

Research people and actual tasks on multidisciplinary sciences,; 1: 32-36

Tringovska, I. 2004. Influence of bacterial fertilizers on biological manifestations of tomatoes. *Vth National Scientific and Technical Conf. "Ecology and health"*, Plovdiv, Bulgaria, 20 May: 233-238

Vlahova, V. 2012b. Influence of Biofertilisers and Agrometeorological Conditions on the Phenological Development of Pepper Cultivated under the Conditions of Organic Agriculture. Journal of agricultural science and forest science, vol.. XI, No. 4, Sofia, 51-56

Vlahova, V. 2013. – Biofertilisers – An Environmentally Friendly Approach in Modern Agriculture. Journal of agricultural science and forest science, vol. XII, No. 3–4, Sofia, 70-76.

Vlahova, V. 2013. The impact of biofertilization on the quality parameters of the pepper fruit (*Capsicum annum* L.) in organic agriculture condition. Scientific paper Series B, Holticulture, Vol. LVII, Bucharest, 289-294

Yankova,V., Markova, D., Todorova, V. and Velichkov, G. 2009. Biological Activity of Certain Oils in Control of Green Peach Aphid (*Myzus persicae Sulz*.) on Pepper. IV Balkan Symposium of Vegetables and Potatoes, Plovdiv, Bulgaria, 9-12 September 2008. Acta horticulturae № 830, v.2, 619 – 625.