

**IMPACT OF BIOFERTILISERS ON PEPPER SEEDLINGS (*CAPSICUM ANNUUM* L.)
UNDER THE CONDITIONS OF ORGANIC AGRICULTURE**

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Abstract

Organic agriculture, as a way of thinking and practice, originated in the first years of the XX century upon the application of various alternative methods of agricultural production. The objective of this study was to found the influence of biofertilisers on the vegetative displays and the parameters of the leaf gas-exchange of pepper seedlings of the variety of "Sofiiska Kapiya" cultivated under the conditions of organic agriculture. This experiment was carried out in 2009 - 2011 in a polyethylene greenhouse of the Agroecological Centre at the Agricultural University – Plovdiv. The biofertilisers included into the study - Boneprot (Arkobaleno), Lumbrical, Baikal EM-1Y and Bio One, were used in conformity with Commission Regulation (EC) No. 889/2008. The combined application of the biofertilisers Baikal EM-1Y and Bio One on the Lumbrical basic fertilisation had a positive effect on the rate of the net photosynthesis (2010, 2011) compared to the separate application on the basic fertilisation, as it improved the physiological status of the plants. The biggest stimulating effect on the height and the number of the leaves for seedlings was reported for the application of the biofertiliser Baikal EM -1Y on two types of basic fertilisations during the three experimental years, thus being a convincing evidence of the positive effect of the application of biofertilisers as a supplement to a basic fertilisation during the period of seedling production for the cultivation of healthy seedlings of good quality.

Key words: *Capsicum annuum* L., organic agriculture, biofertilisers, leaf gas exchange, vegetative growth, seedlings

1. INTRODUCTION

Organic agriculture, as a way of thinking and practice, originated in the first years of the XX century upon the application of various alternative methods of agricultural production (Karov et al., 1998). Organic farming is an approach to agriculture in which the aim is to create integrated, environmentally and economically sustainable agricultural production systems (Stacey, 2003).

It is obligatory that the process of cultivating vegetable cultures, including seedling production is in conformity with the requirements for organic agriculture. Cultivation of high quality seedlings is a necessary condition for improving the vegetative growth, and hence of the yield and the quality of the end production. The development and quality of pepper seedlings in modern organic systems depends on the type and way of application of biofertilisers. Biofertilisers are cheap, eco - friendly, improve soil fertility and plant nutrition within short time, and are effective components in organic farming (Kalidasu et al., 2008). Biofertilisers are the formulation of living microorganisms, which are able to fix atmospheric nitrogen and convert insoluble phosphorus into available one for the use of plants (Mostafa and Abo-Baker, 2010).

There is a close interdependent connection and conditionality between mineral feeding and photosynthesis of plants (Pandev et al., 1980). Photosynthesis provides the primary constructive elements and the necessary energy, and root feeding - the remaining nutritional substances required (Aladzhadzhian, 2002). Tringovska et al. (2005) reports that the efficiency of the cell photosynthetic apparatus is one of the basic assessment criteria for applied fertilisation.

Objectives

The objective of this study was to found the influence of biofertilisers on the vegetative displays and the indicators of the leaf gas exchange of pepper seedlings of the variety of “Sofiiska Kapiya” cultivated under the conditions of organic agriculture.

2. MATERIALS AND METHODS

This experiment was carried out in 2009 - 2011 in a polyethylene greenhouse of the Agroecological Centre at the Agricultural University - Plovdiv, situated on the territory of the certified ecological farm. In order to cultivate unpricked - out seedlings, seeds were used, which were in conformity with the requirements for application in organic agriculture. The seed - bed location in the greenhouse was definitely consistent with the culture from the preceding period of seedling production upon observed rotation.

The seed - time took place in the second half of March. The sizing of the variants was followed by the introduction of the basic fertilisations with biofertilisers Boneprot and Lumbrical (g/m^2). The quantity of biofertilisers was in conformity with the recommendations of the manufacturing companies. The experiment took place into 4 replication with an area of 1 m^2 per replication.

Treatments:

1. Control (non - fertilised)
2. Basic fertilisation with Boneprot (optimum concentration)
3. Basic fertilisation with Boneprot (50 %) + Baikal EM-1Y
4. Basic fertilisation with Boneprot (50 %) + Bio One
5. Basic fertilisation with Lumbrical (optimum concentration)
6. Basic fertilisation with Lumbrical (50 %) + Baikal EM-1Y
7. Basic fertilisation with Lumbrical (50 %) + Bio One

Fertilisation

Two basic fertilisations were used, namely: Boneprot and Lumbrical, applied into the soil through incorporation prior to the time of seeding. The biofertilisers were applied in two concentrations - optimum (corresponding to 70 kg/da for the basic fertilisation with Boneprot and 400 L/da for the basic fertilisation with Lumbrical) and reduced by 50 %.

In the process of seedling cultivation the biofertilisers Baikal EM-1Y and Bio One were introduced twice – into the soil upon the treatment of the experimental plot before seed-time in the following concentrations: for Baikal EM-1Y- solution of 1:1000 (with unchlorinated H_2O), and for - Bio One - solution of 165 ml/da . The second introduction was in the form of feeding, which took place in the end of the seedling period in the same concentrations.

2.1. Materials

Vegetable tested

The research included pepper of the variety of “Sofiiska Kapiya” cultivated as mid - early field production according to the principles of organic agriculture (Panayotov, 2000).

2.2. Characteristics of the biofertilisers included into the study

The biofertilisers included into the study- Boneprot (Arkobaleno), Lumbrical, Baikal EM- 1Y and Bio One, were used in conformity with Commission Regulation (EC) No. 889/2008 on permitted inputs in organic farming.

Boneprot (Arkobaleno, Italy) is a solid organic fertiliser in pellets, and has following composition: (organic nitrogen (N)- 4,5 %; phosphorus anhydride (P₂O₅) total-3,5 %; potassium (K₂O) - 3,5 %; calcium (CaO)-5- 8 %; magnesium (MgO)- 0,8 - 1 %; organic carbon (C) of biological origin- 30 %; humification rate (HR) - 10 - 13 %; degree of humification (DH) - 40 - 42 %; humification index (HI) - 1,3 - 1,4 %; humidity-13 - 15%; pH in water 6- 8. Boneprot is an entirely organic fertiliser consisting exclusively of Cattle manure. These materials are collected from farms which do not use antibiotics and are subject to controlled fermentation for a period of about one year.

Lumbrical (v. Kostievo - Plovdiv, Bulgaria) is a product obtained from the processing of natural fertiliser and other organic waste of the Californian red worms (*Lumbricus rubellus* and *Eisenia foetida*) and consists of their excrements. The commercial product has 45- 55 % humidity and 45- 50 % organic matter content. Ammonium nitrogen (NH₄N)- 33,0 ppm; nitrate nitrogen (NO₃N)- 30,5 ppm; P₂O₅ and K₂O- respectively 1410 ppm and 1910 ppm, MgO- 1,8 %. It contains useful microflora 2×10^{12} pce/g, humic and fulvic acids, nutritional matters. The product activity is 6,5- 7,0 (pH in H₂O).

Baikal EM-1Y (Ukraine) includes the following: effective microorganisms, mixed cultures of useful microorganisms, which are antagonists with respect to the pathogenic and conditionally pathogenic microflora. This is a large group of microorganisms living under a regime of activity upon interaction with the nutritional environment, etc. Bacterial inoculation includes *Lactobacillus casei*, *Lactobacillus lactis*, *Rhodopseudomonas palustris*, and *Saccharomices cerevisiae*. It is used for the activation of microbiological processes in the soil and for increasing of plant yield. The product has the following chemical composition: Organic carbon (C)- 0,15 %; total nitrogen- 0,01 %; total phosphorus (such as P₂O₅)- 0,001; total potassium (K₂O)- 0,02 %; chaminic acids- 0,015 %; pH - 3,2 and secondary microflora, a total titer of 10^6 - 10^7 .

Bio One (USA) consists of living organisms and is 100 % natural liquid concentrated microbiological product. Bacterial inoculation that includes two types of microorganisms- aerobic (*Azotobacter vinelandii*), and anaerobic (*Clostridium pasteurianum*). It is recommended for increasing the nitrogen fixation in the soil. It is applied in the soil.

2.3. Study Parameters

2.3.1. *Biometric parameters* - at the end of the seedling period there were 10 plants per variant analyzed, namely the following parameters: plant height (cm) and number of leaves.

2.3.2. *Leaf gas exchange*

Leaf gas exchange parameters are P_N - Net photosynthetic rate ($\mu\text{mol m}^{-2}\text{s}^{-1}$), E - Transpiration intensity ($\text{mmol m}^{-2}\text{s}^{-1}$) and g_s - Stomatal conductance ($\text{mol m}^{-2}\text{s}^{-1}$), using a portable infrared gas analyser LCA - 4 (ADC, Hoddesdon, England). Measurements were made under a light intensity of $800 \mu\text{mol m}^{-2}\text{s}^{-1}$ PAR, at a temperature of 24 ± 2 °C, an external CO₂ concentration of $390 \mu\text{mol mol}^{-1}$.

Measurements have been taken on normally developed leaves from the central stage of the plant canopy, which are representative of each treatment. Two analyses were carried out on the leaf gas exchange, as the first measurement was taken at the flower bud stage, 15- 20 days after the application of the liquid biofertilisers, and the second one - at the stage of mass fruitfulness.

2.4. *Statistical data processing* - Microsoft Office Excell 2007; SPSS (Duncan, 1955); BIOSTAT. One-way analysis of variance (ANOVA) was used to analyze the differences between treatments. A Duncan multiple - range test was also performed to identify the homogeneous type of the data sets among the different treatments. A BIOSTAT was used to compare the results as compared to the control.

3. RESULTS AND DISCUSSION

3.1. *Effect of biofertilisers on the biometric and physiological parameters of the pepper seedlings*

3.1.1. *Biometric Parameters*

The results from the biometric measurements of the height of the pepper plants showed changes as the treated plants exceeded the controls during the three vegetation years (Table 1). The data obtained showed that the applied biofertilisers affected the height of the seedlings for the study period by an average of 1,55 cm compared to the control.

Table 1. Height of pepper seedlings, variety of “Sofiiska Kapiya”

No.	Treatments	2009		2010		2011		Average for the period
		Mean; St. Dev.	GD	Mean; St. Dev.	GD	Mean; St. Dev.	GD	
1.	Control	16.66 ± 0.342 ^e	Base	16.10 ± 0.207 ^f	Base	15.55 ± 0.127 ^d	Base	16.10
2.	Boneprot (opt.)	18.50 ± 0.065 ^b	+++	17.20 ± 0.254 ^{de}	+++	16.21 ± 0.542 ^c	+++	17.30
3.	Boneprot (50 %) + Baikal EM-1Y	19.20 ± 0.075 ^a	+++	18.50 ± 0.065 ^a	+++	17.74 ± 0.059 ^a	+++	18.92
4.	Boneprot (50 %) + Bio One	18.61 ± 0.185 ^b	+++	17.20 ± 0.220 ^{de}	+++	16.75 ± 0.534 ^b	+++	17.52
5.	Lumbrical (opt.)	17.41 ± 0.586 ^d	+++	17.40 ± 0.312 ^d	+++	16.60 ± 0.046 ^b	+++	17.14
6.	Lumbrical (50 %) + Baikal EM-1Y	18.60 ± 0.067 ^b	+++	17.80 ± 0.012 ^c	+++	17.63 ± 0.082 ^a	+++	18.01
7.	Lumbrical (50 %) + Bio One	17.62 ± 0.531 ^d	+++	17.31 ± 0.213 ^{de}	+++	16.93 ± 0.128 ^b	+++	17.29
	GD 5 %		0.22		0.30		0.33	
	GD 1 %		0.30		0.41		0.45	
	GD 0.1 %		0.41		0.56		0.61	

Duncan's Multiply Range Test with P<0.05

It was found that the highest average value for the period was measured for the variant treated with the biofertiliser Baikal EM-1Y on the Boneprot basic fertilisation i.e. 18,92 cm, followed by the plants treated with the biofertiliser Baikal EM-1Y on the Lumbrical basic fertilisation, i.e. 18,01 cm. In the three years the differences in all variants compared to the control were significant at $P_{0.1}\%$. Also, during the three years, the combined variants on the Boneprot basic fertilisation showed higher values than the optimum concentration on the basic fertilisation. A better effect was achieved upon the application of the biofertilisers on the Lumbrical basic fertilisation compared to the single application on the basic fertilisation in optimum concentration throughout the study period, although an exception was detected after the biofertiliser Bio One (2010). The results showed that the higher average height of the plants was found for the variants with combined application of biofertilisers, in comparison with the single application of a basic fertilisation in optimum concentration.

Upon the biometric measurements of a number of leaves of a plant in the seedling phase, the average result for the experiment period showed that the highest value was obtained upon the application of the biofertiliser Baikal EM- 1Y on the Boneprot basic fertilisation - 8,80 pcs/ plant, as the difference compared to the control was significant at $P_{0.1}\%$ during the three years (Table 2). It was found that the combined application of the biofertiliser Baikal EM- 1Y on both basic fertilisations produced better result than the single application on the basic fertilisation. This finding was not confirmed for the biofertiliser Bio One.

Higher values of average number of leaves per plant in the seedling phase were reported for all variants that also exceeded the values of the control plants during the experimental period. The combined application of biofertilisers during the three years affected positively the total number of leaves upon soil application of the biofertiliser Baikal EM- 1Y on the Boneprot basic fertilisation. This was confirmed by the higher average height of the seedlings.

Table 2. Number of leaves in pepper seedlings, variety of "Sofiiska Kapiya"

No.	Treatments	2009		2010		2011		Average for the period
		Mean; St. Dev.	GD	Mean; St. Dev.	GD	Mean; St. Dev.	GD	
1.	Control	6.67 $\pm$ 1.234 ^e	Base	6.47 $\pm$ 1.246 ^f	Base	5.60 $\pm$ 1.121 ^e	Base	6.25
2.	Boneprot (opt.)	7.87 $\pm$ 0.352 ^d	++	7.80 $\pm$ 0.414 ^d	+++	6.67 $\pm$ 0.488 ^d	+++	7.45
3.	Boneprot (50 %) + Baikal EM-1Y	9.20 $\pm$ 0.414 ^a	+++	9.00 $\pm$ 0.926 ^{ab}	+++	8.20 $\pm$ 0.414 ^a	+++	8.80
4.	Boneprot (50 %) + Bio One	7.07 $\pm$ 0.458 ^e	ns	7.60 $\pm$ 0.507 ^{de}	+++	7.60 $\pm$ 0.507 ^{abc}	+++	7.42
5.	Lumbrical (opt.)	8.40 $\pm$ 0.507 ^{bcd}	+++	7.40 $\pm$ 0.507 ^{de}	++	7.20 $\pm$ 0.414 ^{cd}	+++	7.67
6.	Lumbrical (50 %) + Baikal EM-1Y	8.87 $\pm$ 0.352 ^{ab}	+++	8.40 $\pm$ 0.507 ^c	+++	7.67 $\pm$ 0.488 ^{bc}	+++	8.31
7.	Lumbrical (50 %) + Bio One	7.80 $\pm$ 0.414 ^d	++	7.13 $\pm$ 0.640 ^e	+	7.20 $\pm$ 0.414 ^{cd}	+++	7.38
	GD _{5%}		0.68		0.59		0.51	
	GD _{1%}		0.93		0.81		0.69	
	GD _{0.1%}		1.26		1.09		0.93	

Duncan's Multiply Range Test with $P < 0.05$

3.1.2. Physiological Parameters of the Seedlings

The rate of the net photosynthesis (P_N) during the vegetation year 2009 for the seedlings of the variety of “Sofiiska Kapiya” showed certain dynamics for the single variants, as the highest value was reported upon the optimum concentration on the Boneprot basic fertilisation, where the difference between the average compared to the control was significant at $P_1\%$ (Table 3). A high value of P_N was reported for the plants treated with the biofertiliser Baikal EM- 1Y on the Lumbrical basic fertilisation- $23,1 \mu\text{molm}^{-2}\text{s}^{-1}$, as the difference between the average compared to the control was significant at $P_1\%$. It was found that the higher rate of the net photosynthesis (P_N) was achieved by the combined variants on the Lumbrical basic fertilisation in comparison with those with a single Boneprot basic fertilisation.

In the vegetation year of 2010 the rate of the net photosynthesis (P_N) showed a higher value for the variant characterized with applied combined fertilisation of the biofertiliser Bio One on the Boneprot basic fertilisation- $22,47 \mu\text{molm}^{-2}\text{s}^{-1}$. Upon comparison of both basic fertilisations it was found that there was higher P_N upon the application of the biofertilisers Baikal EM- 1Y and Bio One on the Boneprot basic fertilisation, as the difference between the average compared to the control was significant at $P_{0.1}\%$. Upon optimum concentration of the Lumbrical basic fertilisation, the P_N was higher than the one of the Boneprot basic fertilisation upon optimum concentration as well.

Table 3. Net photosynthetic rate - P_N ($\mu\text{molm}^{-2}\text{s}^{-1}$)

No.	Treatments	2009		2010		2011		Average for the period
		Mean; $P<0.05$	GD	Mean; $P<0.05$	GD	Mean; $P<0.05$	GD	
1.	Control	18.00 ^b	Base	16.70 ^e	Base	18.11 ^e	Base	17.60
2.	Boneprot (opt.)	23.40 ^a	++	20.50 ^{bcd}	++	18.49 ^e	ns	20.79
3.	Boneprot (50 %) + Baikal EM-1Y	22.20 ^a	+	21.80 ^{abcd}	+++	24.19 ^a	+++	22.73
4.	Boneprot (50 %) + Bio One	16.30 ^b	ns	22.47 ^{ab}	+++	22.99 ^{ab}	+++	20.58
5.	Lumbrical (opt.)	17.30 ^b	ns	22.10 ^{abc}	+++	19.80 ^{de}	+	19.73
6.	Lumbrical (50 %) + Baikal EM-1Y	23.10 ^a	++	21.40 ^{abcd}	+++	20.57 ^{cd}	++	21.69
7.	Lumbrical (50 %) + Bio One	21.70 ^a	+	20.14 ^{bcd}	++	21.76 ^{bc}	+++	21.20
	GD _{5%}		3.22		2.17		1.55	
	GD _{1%}		4.58		2.96		2.20	
	GD _{0.1%}		6.63		4.00		3.18	

Duncan's Multiply Range Test with $P<0.05$

In 2011 the rate of the net photosynthesis (P_N) showed better values for the variants with combined fertilisation on the Boneprot basic fertilisation, as the highest value was found for Baikal EM-1Y on the Boneprot basic fertilisation - $24,19 \mu\text{molm}^{-2}\text{s}^{-1}$, followed by Bio One on the Boneprot basic fertilisation - $22,99 \mu\text{molm}^{-2}\text{s}^{-1}$, as the difference between the average one compared to the control was well proven

for $P_{0.1}$ %. Upon comparison of both optimum concentrations, a higher value was reported on the Lumbrical basic fertilisation, which was similar to the result obtained in 2010, as the difference between the average value compared to the control value was significant at P_5 %.

As an average for the period, the biggest impact on the rate of the net photosynthesis (P_N) of the seedlings was reported upon the application of the biofertiliser Baikal EM- 1Y on the Boneprot basic fertilisation - $22,73 \mu\text{mol m}^{-2}\text{s}^{-1}$, which was perhaps due to the microbial nature of the biofertiliser Baikal EM- 1Y and to the fact that it released nutritional elements and biologically active substances in an accessible form.

The Table 4 below presents the intensity of transpiration (E) at the end of the seedling period. In 2009 it was found that the combined application of the biofertiliser Bio One on the Boneprot basic fertilisation resulted in a higher level of intensity of the transpiration (E) - $2,10 \text{ mmol m}^{-2}\text{s}^{-1}$, as the difference between the average compared to the control was significant at $P_{0.1}$ %. The higher level of E was measured upon the combined variants on the Boneprot basic fertilisation, compared to their addition on the Lumbrical basic fertilisation.

In 2010 the maximum E was reported for the variant with the biofertiliser Baikal EM- 1Y on the Boneprot basic fertilisation- $2,80 \text{ mmol m}^{-2}\text{s}^{-1}$, as the difference between the average compared to the control was significant at $P_{0.1}$ %. The higher values of E upon the combined variants on the Boneprot basic fertilisation confirmed the findings from 2009, which showed the better effect of the combinations of biofertilisers.

Table 4. Intensity of the Transpiration - E ($\text{mmol m}^{-2}\text{s}^{-1}$)

No.	Treatments	2009		2010		2011		Average for the period
		Mean; $P < 0.05$	GD	Mean; $P < 0.05$	GD	Mean; $P < 0.05$	GD	
1.	Control	1.38 ^b	Base	1.82 ^d	Base	1.50 ^d	Base	1.56
2.	Boneprot (opt.)	1.26 ^{bc}	ns	2.32 ^{bc}	+	1.61 ^d	ns	1.73
3.	Boneprot (50 %) + Baikal EM-1Y	1.26 ^{bc}	ns	2.80 ^a	+++	1.08 ^e	++	1.71
4.	Boneprot (50 %) + Bio One	2.01 ^a	+++	2.53 ^{ab}	++	1.38 ^d	ns	1.97
5.	Lumbrical (opt.)	2.00 ^a	+++	2.42 ^{abc}	++	1.88 ^c	++	2.10
6.	Lumbrical (50 %) + Baikal EM-1Y	1.02 ^c	++	2.45 ^c	++	2.35 ^b	+++	1.94
7.	Lumbrical (50 %) + Bio One	1.26 ^{bc}	ns	2.15 ^{bcd}	ns	2.70 ^a	+++	2.03
	GD ₅ %		0.25		0.39		0.26	
	GD ₁ %		0.35		0.53		0.38	
	GD _{0.1} %		0.51		0.72		0.54	

Duncan's Multiply Range Test with

In 2011, it was found that E showed higher values upon the variants of combined treatment on the Lumbrical basic fertilisation. The maximum value was reported for the variant treated with the biofertiliser Bio One on the Lumbrical basic fertilisation, followed by the biofertiliser Baikal EM- 1Y on the same basic fertilisation, as the difference between the average compared to the control was significant at $P_{0.1} \%$. It was found that the biofertiliser Baikal EM- 1Y on the Lumbrical basic fertilisation exceeded the optimum concentration of the Lumbrical basic fertilisation, thus confirming the result obtained in 2010.

It was found that during the experiment period there were certain dynamics in the values of the stomatal conductance (g_s) (Table 5).

The maximum was reported for the plants of the variant treated with the biofertiliser Bio One on the Boneprot basic fertilisation (2009, 2010), where there were also higher values of intensity of the transpiration. A good value of g_s was reported for those plants being additionally treated with the biofertiliser Baikal EM- 1Y on the Boneprot basic fertilisation- $0,053 \text{ molm}^{-2}\text{s}^{-1}$ (2010). That could be attributed to the release of nutritional elements and release of biologically active substances in an accessible form. In 2011 the maximum value of g_s was reported for the plants of the variant treated with the biofertiliser Bio One on the Lumbrical basic fertilisation, where the maximum intensity of the transpiration (E) was detected as well.

Table 5. Stomatal conductance - g_s ($\text{mol m}^{-2}\text{s}^{-1}$)

No.	Treatments	2009	2010	2011	Average for the period
		Mean; $P < 0.05$	Mean; $P < 0.05$	Mean; $P < 0.05$	
1.	Control	0.025 ^c	0.033 ^d	0.030 ^c	0.029
2.	Boneprot (opt.)	0.035 ^b	0.033 ^d	0.040 ^b	0.036
3.	Boneprot (50 %) + Baikal EM-1Y	0.030 ^{bc}	0.053 ^b	0.030 ^c	0.038
4.	Boneprot (50 %) + Bio One	0.050 ^a	0.060 ^a	0.030 ^c	0.046
5.	Lumbrical (opt.)	0.050 ^a	0.045 ^c	0.030 ^c	0.041
6.	Lumbrical (50 %) + Baikal EM-1Y	0.030 ^{bc}	0.047 ^c	0.040 ^b	0.039
7.	Lumbrical (50 %) + Bio One	0.030 ^{bc}	0.033 ^d	0.050 ^a	0.038

CONCLUSIONS:

1. The biggest stimulating effect on the height and the number of the leaves for seedlings was reported after application of the biofertiliser Baikal EM-1Y on both basic fertilisations during the three experimental years. This can be regarded as a convincing evidence for the positive effect of the application of biofertilisers as a supplement to a basic fertilisation during the period of seedling production for the cultivation of healthy seedlings of good quality.

2. The combined application of the biofertilisers Baikal EM-1Y and Bio One on the Lumbrical basic fertilisation showed a positive effect on the rate of the net photosynthesis (2010, 2011) compared to the single application on the basic fertilisation, which is a prerequisite for improved physiological status of the plants.

In a number of publications, researchers have found that the values of the parameters of the leaf gas exchange increase under the influence of the bio-fertilisation in organic production of pepper seedlings (Vlahova, 2012) upon cultivation of pepper for mid- early field production (Vlahova, Zlatev and Boteva, 2011; Vlahova, Zlatev and Popov, 2013) for varieties intended for producing red pepper for grinding (Berova and Karanatsidis, 2008) and young tomato plants (Zlatev and Popov, 2013). The present study is in conjunction with these findings and opens new opportunities for further investigations.

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