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YIELD OF GREENHOUSE TOMATOES IN CONVERSION TO ORGANIC PRODUCTION

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Abstract

A study on some elements of the organic tomato production technology in steel glasshouses was carried out during the period 2012-2013 on the experimental field of the Agricultural University in Plovdiv. The following organic fertilizers were tested: Evrobio; Osmo Bio garden; Biofa; Orgamax; Agrobiosol; Naturale; Lumbrikompost; Alga 600 PO 2; Hemozim bio 5 $N_5P_3K_6$; Hydrolysed proteins; Softgard. The organic fertilizers were introduced in their recommended norms. The influence of organic soil fertilizers and foliar spray on the productivity of greenhouse tomatoes grown by applying late production technology was studied. The productivity of the plants was determined as follows: early yield - 5 picks - kg/ha; total yield - the end of the vegetation (5 inflorescence) kg/ha. It was found that the organic fertilizers could provide for the primary nutrient needs when growing tomatoes in greenhouses by applying a late production technology. Some of the studied variants exceeded the control with chemical fertilizers $\mathbf{N_{44}:P_8:K_{52}}$ in total yield by 1.70 to 29.73%.

Keywords: greenhouse tomato, biological production, yield.

INTRODUCTION

Organic vegetable production, under greenhouse conditions in particular, usually is related to lower yields. Some of the performed studies state this assertion (Pascale, 2004). Most commonly, however, the studies are done on separate elements of the technology of organic production, or only separate organic fertilizers are tested for root, leaf or combined application (Chapagain & Wiesman, 2004; Gravel et al., 2012; Hidalgo – Gonzales et al., 1998; Kolota & Osinska, 2000; Márquez-Hernández, et al. 2013; Tringovska, 2012**;** Yu et al., 2010; Liu et al., 2012; Martins et al., 2010, Nakano, 2003; Surrage et al., 2010; Yildirim, 2007; Haytova, 2013a; Haytova, 2013b). The results in this case are quite multidirectional, too.

The number of the studies is low, and in our country, we lack surveys on the combined effect of a larger range of organic fertilizers with root, leaf, nutrient reserving and vegetative application under greenhouse conditions.

To clarify these matters with the greenhouse tomatoes, an experiment was set when keeping the requirements of organic production.

MATERIALS AND METHODS

For the period 2012-2013 a soil experiment was set to study the elements from the technology for organic tomato production. The effect of fertilization with organic fertilizers and combinations from them on the productivity of the greenhouse tomatoes – grown in accordance with the technology for late production was studied. The experimental work was conducted in the steel-glasshouses in the experimental field of the Agricultural University – Plovdiv with indeterminate tomatoes – sort Fado F_1. The experiment was conducted in geoponic environment under all the requirements for organic production (with application of a complete technology for organic production). A drip irrigation system was used, which is also used for fertigation with the liquid organic fertilizers. Plant protection was applied with organic agents. Various combinations between 8 organic fertilizers for root fertilization and 3 fertilizers for leaf application were studied. The following 15 variants were studied: $N_{44}:P_8:K_{52}$; 2. $N_{44}:P_8:K_{52}$ + Wuksal Macromix; 3. Evrobio + Osmo Bio garden + Biofa; 4. Orgamax + Osmo Bio garden + Biofa; 5. Agrobiosol + Osmo Bio garden + Biofa; 6. Naturale + Osmo Bio garden + Biofa; 7. Lumbrikompost + Osmo Bio garden + Alga 600 PO 2; 8. Evrobio + Hemozim bio 5 $N_5P_3K_6$ + Biofa; 9. Orgamax + Hemozim bio 5 $N_5P_3K_6$ + Biofa; 10. Agrobiosol + Hemozim bio 5 $N_5P_3K_6$ + Biofa; 11. Naturale + Hemozim bio 5 $N_5P_3K_6$ + Biofa; 12. Evrobio + Lumbrikompost + Hydrolysed proteins + Softgard; 13. Orgamax + Lumbrikompost + Hydrolysed proteins + Softgard; 14. Agrobiosol +

Lumbrikompost + Hydrolysed proteins + Softgard; 15. Naturale + Lumbrikompost + Hydrolysed proteins + Softgard. Two variants with mineral fertilization were used as a control: NH_4NO_3, TSP (46% P_2O_5) and K_2SO_4 under optimal levels for greenhouse tomatoes - N_{44}:P_8:$K_{52.}$ Two of the organic fertilizers were applied vegetational through fertigation: Hydrolysed plant proteins and Hemozim. The organic fertilizers were used in the recommended norms – not vegetative and vegetative (four times – from the beginning of fruit formation every other 15 days). The foliar spray was performed twice with an interval of 10 days, starting three weeks after planting. **Agrobiosol** is an organic fertilizer - granulated biomass without additives from conventional materials. Dry matter content - 95.6%; Organic substance - 90.7%; PH ($CaCl_2$) -3; Humidity - 4%; N (total) - 6-8%; Phosphates (P_2O_5) - 0.5-1.5%; Potassium (K_2O) 0.5-1.5%; C: N 6: 1; CaO 0.21%; MgO 0.05%; Cl 0.04%; S 1.80%; Zn 6.0 mg / kg; Fe 101 mg/kg; B 7.1 mg/kg; Other trace elements and vitamins. **Orgamax** is a soil, organic - humic fertilizer made from carefully selected and processed lignites. It is organic in origin and is clean of pathogens and heavy metals. This improves the chemical properties of the soil (cation exchange capacity), which makes more nutrients in the soil accessible to plants, creating better conditions for their assimilation. Suitable for the greenhouse, vegetable production. It contains a guaranteed composition of 1% organic nitrogen N; 30% total organic matter (17.4% organic hydrocarbon); 7% humic substances; 8% sulfur (SO_3); 1% iron (Fe); 5-6 pH; 17% c / N ratio; 8% max. Moisture. **Eurobio P 26 N -** for an organic fertilizer containing P, CaO and a patented N-pro complex. Phosphorus feed increases over time; Calcium neutralizes the soil pH and creates a micro-medium, facilitating the absorption of all micro- and macro elements from the soil; Improving soil pH, Eurobi activates the bacterial flora and stimulates the mineralization process primarily on nitrogen. The patented N-Pro complex facilitates the easier mineralization of organic matter in the soil, making nitrogen a form of nitrate, nitrite, and ammonia available to plants. **Naturally NPK 8-8-6** contains org. Nitrogen 8%; P_2O_5 - 8%; K_2O - 6%; MgO - 2%; Org. Biocarbon - 30. It is a high-quality organic fertilizer, both in terms of used raw materials and its exceptionally low humidity level. In this way, continuous and prolonged infusion of nitrogen is ensured, thus providing the nutrients of the plants throughout the cultivation cycle. Avoid overtaking the nitrogen level, leading to a strong growth plant and weakening plants. It is used in the form of pellets with sizes ranging from 3-4 mm in diameter and 8-10 mm length and humidity not higher than 10%. The pellets thus obtained are excellently suited for spreading with all types of fertilizer spreaders, and after their landfall, they are rapidly disintegrating because they absorb up to 4 times more water than their own weight. **Lumbrycompost -** California Worm Organic Fertilizer. Biohumus is a product that is the result of the life span of Red Californian worms (Lumbricus rubellus and Eisenia foetida), which feeds on organic residues. Once processed by the worm's organism, these raw materials change extremely favorably. Worm faeces are high in humus. Contains a large number of beneficial bacteria and other microorganisms, many biologically active plant stimulants, vitamins, amino acids and antibiotics added to it during the digestive process of the worm. The presence of nitrogen, phosphorus, potassium, magnesium, calcium and other useful elements is much higher than the richest land. It is not irrelevant that nutrients are encased in a water-soluble membrane, which means they are gradually released according to the needs of the plants. Absorption is also more complete. The exclusive value in bio-humus is the humic acid, as it is a major reservoir of nutrients in the soil. They are involved in the formation of water-resistant aggregates and improve the water-air regime of soils, something too important for high yields. **Biochumus** is easy to apply. It has a lasting impact. To its great advantages, it is there other effects: not burning plants, no unpleasant odor. Crops fertilized with biohumus fertilizers grow faster, yields are earlier and significantly higher. When applying biohumus, you also take care of the soil because this fertilizer retains the necessary moisture but also provides soil drainage. Excess water is squeezed, which in turn means that the plants do not heat up, saving water. Biohumus not pollutes with weed seeds and other harmful ingredients, because it does not contain them but protects the soil against parasites and diseases too. **Osmo Bio Garden 6-5-7 (+4)** is organic granulated fertilizer for general use in the feeding of greenhouse plants from March to September. The product of OSMO ORGANICS BELGIUM. Provides fast food and does not burn plants. The special composition of first-class raw materials guarantees a period of slow release of 3 to 6 months and maintains the soil structure in good condition. It is suitable for organic production. **Hemosim** $N_5P_3K_6$ is a liquid fermentation blood containing C: N = 3.8 and Fe: 5 ppm. It is applied at a dose: 8-10 l/da. **Vuksal Macromix**is Suspension Mineral Leaf Fertilizer. Content: N 16%; P_2O_5 16%; K_2O 12%; B 0.02%; 0.05%; Fe 0.1%; Mn 0.05%; Mo 0.001%; From 0.05%. Cationic microelements (iron, copper, manganese, and zinc) have chelated (EDTA).

There is a well-balanced ratio of NPK. Improves growth and improves quality. It prevents the occurrence of chronic and acute nutrient deficiency in critical moments. Increases resistance to stressful conditions. It regulates the pH of the work solution, and superheating ensures rapid absorption of trace elements. It is applied at a dose of 500 ml/da. **HP** is are hydrolysates of plant and yeast proteins with 30% dry matter. It is applied by fourfold fetal phase feeding onset of fruit production for 15 days at a dose: 8-10 l/da. **BIOFA** is a natural extract of brown algae, an anti-stress factor, and a nutritional supplement. Contains: dry matter 10.89%, pH 7.4, organic carbon - 26.0%, total nitrogen (N) - 0.20%, total phosphates (P_2O_5) - 0.011%, total potassium (K_2O), Total Sulfur (S) - 0.24%. Microelements in ppm: Cu - 0.81; Zn - 4.10; B - 8.7; Mn - 0.43; Fe - 4.18; MO - 0.03. It is applied at a dose of 0.5%. **Alga 600** is a biological leaf fertilizer. Contains: N - 0.5 - 0.8%, P_2O_5 - 1%, K_2O - 17 - 19%, Mg - 0.04%, Ca - 0.60 ~ 1.80%, S - 1.0%, Fe - 45 ppm, I - - 2.3-3.2%, Alginic acids> 10-12%, OR (organic substance) - 55 - 65%, PGR enzymes (plant hormones) Organic substances contained in Alga 600 are formulations of an organic fertilizer that acts as a fast -digesting complex food.Advantages of Alga 600: Compensates for lack of macro and trace elements, L-amino acids together with Nitrogen (N) and Potassium (K), promotes protein synthesis, Increases the resistance of the plant to drying and freezing, Increases the multiplicity of treated Seeds, activates photosynthesis and absorption of nutrients, stimulates cell division and formation of larger fruit, increases the vitamin content, the hardness and the possibility of storing. Improved anti-inflammatory forces against stress and diseases, acts against repelling insects. Increasing the quantity and quality of oil in oilseed crops. It has a positive impact on the quality and quantity of yields. It is applied at a dose of 500 g / ha.**Soft Garden ++** is a leaf fertilizer containing N-5%, P_2O_5-4%, K_2O-3%, Cu> 0.02%, Zn> 0.01%, Chitosan> 2.6%, OM> 14% 5 Activates the immune system against stress Factors, favors plant growth in treated plants, Provides deficiency of Cu and Zn, increase quality and yields. It is applied after transplanting 2 times per season in a dose of 1250 ml/ha.The plants were grown from seedlings in a heatable steel-glasshouse with period for sowing – the first ten days of January and planting in the third ten days of March. The field experiment was setup in 4 repetitions with 14 plants in each repetition. The following planting scheme was applied: 40+85+70+85+40 X 42.5 cm with 28000 plants/ha and nutritional area per plant of 3400 cm^2. The plants formed with one stem, the tops were pruned 50 days before the last harvesting. The productivity of the plants was determined as:early yield – up to the fifth pick - kg/da; total yield – up to the end of vegetation - kg/da. Do is leaf diagnosis, the samples from plant material were analyzed after wet incineration Kjeldahl. Nitrogen was determined by distillation of an aliquot of mineralization apparatus Parnas-Wagner; phosphorus - colorimetrically by the same mineralization a molybdate-vanadate assay (BDS 11374/86 Feed combined, protein concentrates and raw materials for these Rules for sampling and assay methods for C09); potassium - by flame photometry in the aliquot of the same mineralization Kjeldahl. Analysis of variance was performed on all variants. The changes in the soil and the plants were determined through **agrichemical analysis** of the soil - samples were taken prior to the performance of the experiment and the end of vegetation. The ammonium and nitrate forms of N were determined – by distillation; assimilable P_2O_5– calorimetrically; assimilable K_2O – by flame photometry, pH (BDS, 2002; GOST, 93).Data from the experiment treated with module ANOVA criterion for assessing differences LSD and method of Duncan bundled applications SPSS.

RESULTS AND DISCUSSION

1. Agrichemical analysis of the soil

To establish the effect of the studied fertilizers on the agrichemical characteristics of the soil, analyses were conducted at the beginning of the vegetation in 2012 (Table 1) and the end of the vegetation of 2012 and 2013 (Table 1). On pH, no significant change in values is observed, the soil is neutral to slightly alkaline, and this trend persists over both years in all variants (Table 1). The change of several tenths is explained by the fact that the pH is most unstable as an indicator for values close to neutral (Arinushkins, 1970).

Minerals soil content (N, P_2O_5, K_2O) in the soil is directly related to pH values (Table 2). Particularly pronounced hydromorphism results from the high mineralized waters, with the tendency that in most of the variants the reduction in salt content in the second year compared with the first is probably due to the underwater dynamics and on the other. The impact of applied fertilizers. Options with higher soil salt values in the second year compared with the former may be attributed to the natural increase in background salt concentration at a relatively high level of groundwater combined with the lack of filtration flow. The results obtained on BDS EN 13038: 2011 1201-Soil Improvement and Growth Soil Environments - Determination of Electrical Conductivity.

The Ca and Mg content is high and increases in the second year compared to the first as their confidence is insignificant and is due to the lower groundwater level at the time of soil sampling.

The results obtained are in line with the statements made by Mazaeva, Neugodova, and Hawvanska (Palaveev, 1970).

Table 1. Chemical properties of the soil 2012-2013

Variants	**pH (KCl)**		**Salts µs/cm**	
	2012	**2013**	**2012**	**2013**
Before planting 2012				
	7.77		477.13	
At the end of the vegetation 2012-2013				
1. N_{44}:P_8:K_{52}	7.6	7.6	613	388
2. N_{44}:P_8:K_{52}+Wuksal	7.6	7.6	860	371
3. Evrobio+Osmo+Biofa	7.5	7.4	636	615
4. Orgamax+Osmo+Biofa	7.5	7.4	622	313
5. Agrobiosol+Osmo+Biofa	7.5	7.6	566	612
6. Naturale+Osmo+ Biofa	7.6	7.6	683	354
7. Lumbrikompost+Osmo+Alga	7.7	7.7	414	423
8. Evrobio+Hemozim+Biofa	7.4	7.4	579	432
9. Orgamax+Hemozim+Biofa	7.5	7.5	301	431
10. Agrobiosol+Hemozim+Biofa	7.6	7.5	370	486
11. Naturale+Hemozim+Biofa	7.6	7.7	375	359
12. Evrobio+Lumbrikompost+HP+Softgard	7.6	7.7	545	395
13. Orgamax+LK+HP+Softgard;	7.6	7.7	360	444
14. Agrobiosol+LK+HP+Softgard	7.6	7.6	455	274
15. Naturale+LK+HP+Softgard	7.6	7.5	433	296
Legend: LK-Lumbrikompost**; HP-**Hydrolysed proteins				

2. Fertilization of the plants and necessity of nutritional substances

2. 1. Leaf diagnostics

The results of the leaf analysis show that in the first bunch there is a good reserve of nitrogen corresponding to the norm, a very good reserve of phosphorus, and the potassium is the norm (Table 3). In the second and third bunch, the good rate of the reserve is only that of the phosphorus, as with the nitrogen, the highest values are found in the first leaf under bunch 2 in variant 1 and the first leaf under bunch 3 in variant 4. Potassium is with the highest rates in the first leaf under bunch 2 of variant 12 and in the first leaf under bunch 3 of variant 11. In all the examined variants the contents of nitrogen and potassium in the second and third bunch are under the optimal one, which gives a reason to recommend nutrition with nitrogen and potassium organic fertilizer during vegetation.

2.2. Economic productivity. The results obtained show an advantage of the mineral fertilization compared to the organic regarding early yield (Table 4). The existing understanding of the slower effect of organic fertilizers and the need for appropriate conditions to activate microbiological processes in soil explains the more slowly maturation and consequently the lower outcomes regarding early-ness.

The early yield of the $N_{44}P_8K_{52}$ mineral fertilization variant exceeds organic fertilization options from 9.10% to 49.13%.

Table 2. Reserve of nutritional substances in the soil, years of 2012-2013

Variants	N_NH$_4$ mg/1000g		N_NO$_3$ mg/1000g		N_min mg/1000g		mg/100g P_2O_5		mg/100g K_2O		meq/100g Ca+Mg	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Before planting 2012												
	11.93		71.79		83.72		101.41		60,88		23,80	
At the end of the vegetation 2012-2013												
1. N_{44}:P_8:K_{52}	5.77	10.10	31.75	28.87	37.52	38.97	96.59	153.16	44.14	60.46	27.36	30.35
2. N_{44}:P_8:K_{52}+Wuksal	2.89	8.66	20.21	20.21	23.09	28.87	90.79	154.03	48.5	64.29	26.87	29.10
3. Evrobio+Osmo+Biofa	2.89	14.43	34.64	75.05	37.52	89.48	106.16	167.37	48.6	56.89	33.58	36.82
4. Orgamax+Osmo+Biofa	2.89	8.66	31.75	54.84	34.64	63.50	110.37	148.81	50.6	58.16	33.33	36.07
5. Agrobiosol+Osmo+Biofa	2.89	8.66	28.87	57.73	31.75	66.39	108.63	164.47	32.6	49.49	25.87	26.12
6. Naturale+Osmo+ Biofa	5.77	10.10	49.07	34.64	54.84	44.74	109.79	164.18	32.7	45.66	24.63	28.11
7. Lumbrikompost+Osmo+Alga	8.66	11.55	43.3	23.09	51.96	34.64	110.51	171.43	33.02	40.94	22.14	26.37
8. Evrobio+Hemozim+Biofa	5.77	2.89	43.3	46.18	49.07	49.07	110.8	173.46	44.2	54.06	33.83	37.81
9. Orgamax+Hemozim+Biofa	5.77	2.89	31.75	23.09	37.52	25.98	102.25	150.84	34.5	50.31	29.6	35.82
10. Agrobiosol+Hemozim+Biofa	8.66	11.55	51.96	36.08	60.62	47.63	106.6	166.50	32.7	42.50	29.35	29.35
11. Naturale+Hemozim+Biofa	4.33	5.77	17.32	37.52	21.65	43.30	103.55	164.47	31.85	46.25	22.64	26.37
12. Evrobio+Lumbrikompost+HP+Softgard	4.33	5.77	40.41	20.21	44.74	25.98	111.82	159.54	33.6	42.19	23.13	26.37
13. Orgamax+LK+HP+Softgard	2.89	11.55	11.55	23.09	14.43	34.64	107.61	154.32	32.7	42.19	25.37	26.12
14. Agrobiosol+LK+HP+Softgard	5.77	8.66	14.43	25.98	20.21	34.64	130.67	197.24	35.7	56.88	24.63	25.87
15. Naturale+LK+HP+Softgard	2.89	2.89	14.43	20.21	17.32	23.09	184.48	194.34	33.7	45.00	25.62	26.62

Legend: LK - Lumbrikompost; HP - Hydrolysed proteins

The average yield for the period is significantly influenced by the fertilizers tested. High yield after fertilization is found in variants 7, 12, 13, 14 and 15.

The same variants have no statistically proven differences with the control ($N_{44}P_8K_{52}$). These combinations of organic fertilizers provide the necessary nutrients to produce yields that are substantially indistinguishable from the control.

All bio-fertilized variants have proven differences on the second control, which is of a higher value. The multiple-term comparative analysis shows that the group of variants - from 12 to 15 no significant differences between them, as with both controls.

During the experimental period, the organic production with the application of organic fertilizers does not lead to a significant decrease in the total yield as part of the variants are equal to the control ($N_{44}P_8K5_2$) one, while others even exceed it.

Some of the tested variants (3, 7, 9, 12, 13, 14 and 15) significantly outweigh the control ($N_{44}P_8K5_2$). This ascertainment contradicts the imposed understanding that organic production may lead to a decrease in the yield.

In a two-year experience with conventional and organic tomato production, Pascale noted that in the second experimental year the market yield of conventional production significantly exceeds the organic yield. Fertilizing N to 200 kg/ha-1 increases yield and improves fruit quality (Pascale et al., 2004).

In an economic analysis of organically grown tomatoes, it is agreed upon net profit per square and net profit per kg $ 1.5 and 0.2. According to the results of economic analysis, the net profit per square and net profit per kg are $ 5.1 and 0.2 for organic greenhouse tomatoes (Engindeniz, S. H. Tüzel, 2003).

The explanation of the results obtained by us may be searched in the improved formulations of the organic fertilizers we used as well as in the following stimulation of the active microbiological processes in the soil.

The more intensive scheme of root nutrition, combined with leaf feeding up applied by us, help for this.

Tringovska points out that soil application of humans and biofuels stimulates growth. The total yield increased by 19-21% for soil application and by 13-14% for the foliar application of the biator and humominic fertilizer [14].

The increase in total yield is due to the increase in the average fruit weight from 14 to 50 g per fruit. The early yield and number of fruits of a plant are affected by fertilization applied (Tringovska, I., 2012).

A part of the other variants with organic fertilization (4, 6, 8 and 11) is very close in value to the mineral fertilizing variant $N_{44}P_8K_{52}$. Despite the lower rates in these variants, the obtained yield is satisfactory with organic production, having in mind the opportunity for the realization of a higher price.

The statistical difference between most of the examined variants and the control ($N_{44}P_8K5_2$) one is proved.

From this group, variant 13 (Orgamax + LK + HP + Softgard) has the highest yield of 15168.1 kg/da, also this variant also has the lowest value of the standard error.

Therefore, variant 13 stands out from all tested variants and shows resistance in the conditions in which it is grown.

Regarding the second control, variations with variants 3, 6, 9 and 10 are insignificant. Substantial differences in the cost of the tested variants were obtained in variants 5, 7, 12, 13, 14 and 15.

Again, variant 13 was distinguished from the others with the highest yield when comparing the variants with the second control.

Multipurpose benchmarking shows that both tested controls have significant differences versus option 12, 13, 14 and 15. Additionally, the two controls have significant differences with variants 3, 5, 7 and 9, with variations at the expense of the variants.

From this group, option 9 has the lowest value of the standard error (156.7) of all tested variants without the controls. For this variant we can conclude that it has the most sustainable yield under organic fertilization.

Table 3. Contents of N%, P_2O_5% and K_2O% in the leaves per phases, year of 2012

	1 leaf under bunch 1			1 leaf under bunch 2			1 leaf under bunch 3		
Variants	N%	P_2O_5%	K_2O%	N%	P_2O_5%	K_2O%	N%	P_2O_5%	K_2O%
	Norm								
	4-5	0.4-0.5	4-5	4-5	0.4-0.5	4-5	3.5-4.5	0.35-0.45	3.5-4.5
1. N_{44}:P_8:K_{52}	4.45	1.88	2.88	4.09	1.73	2.73	2.89	1.15	2.18
2. N_{44}:P_8:K_{52}+Wuksal	4.14	1.56	2.67	3.89	1.22	2.56	2.51	1.16	1.99
3. Evrobio+Osmo+Biofa	4.53	1.81	2.56	3.42	1.52	2.16	2.83	1.35	2.32
4. Orgamax+Osmo+Biofa	5.24	2.17	2.54	3.58	1.33	2.54	2.99	1.22	2.43
5. Agrobiosol+Osmo+Biofa	3.20	2.45	2.65	3.31	1.47	2.77	2.93	1.26	2.48
6. Naturale+Osmo+ Biofa	4.97	2.01	2.76	2.91	1.25	2.64	2.28	1.11	2.17
7. Lumbrikompost+Osmo+Alga	6.00	3.23	2.68	3.20	1.57	2.76	2.82	1.2	1.76
8. Evrobio+Hemozim+Biofa	3.84	2.05	2.74	2.86	1.38	2.66	2.46	1.2	2.49
9. Orgamax+Hemozim+Biofa	4.58	2.68	2.73	3.07	1.35	2.58	2.84	1.21	2.05
10. Agrobiosol+Hemozim+Biofa	4.73	2.83	2.86	3.09	1.46	2.51	2.85	1.36	2.33
11. Naturale+Hemozim+Biofa	5.09	2.06	2.83	3.82	1.35	2.58	2.98	1.26	2.61
12. Evrobio+Lumbrikompost+HP+Softgard	5.01	1.72	2.58	3.88	1.45	2.82	2.97	1.28	2.24
13. Orgamax+LK+HP+Softgard	4.56	1.83	2.65	3.61	1.42	2.52	2.83	1.16	2.13
14. Agrobiosol+LK+HP+Softgard	4.48	3.36	2.69	3.77	1.37	2.56	2.70	1.16	2.22
15. Naturale+LK+HP+Softgard	4.43	2.51	2.80	3.61	1.44	2.71	2.86	1.26	2.34

Table 4. Influence of organic fertilization on the yield of tomatoes, years of 2012-2013, kg/da

Variants	Tomatoes early yield - 2012-2013				Tomatoes total yield - 2012-2013			
	Comparative evaluation with LSD (control option 1)	Comparative evaluation with LSD (control option 2)	Comparative assessment method Duncan	Standard error	Comparative evaluation with LSD (control option 1)	Comparative evaluation with LSD (control option 2)	Comparative assessment method Duncan	Standard error
1. N_{44}:P_8:K_{52}	***2984.6***	2984.6 n.s.	2984.6 ab	379.5	***11692.1***	11692.1 n.s.	11692.1 fgh	130,4
2. N_{44}:P_8:K_{52}+Wuksal	3493.0 n.s	***3493.0***	3493.0 a	378.7	12261.5 n.s.	***12261.5***	12261.5 efg	135,2
3. Evrobio+Osmo+Biofa	2003.1 *	2003.1 ***	2003.1 cdef	230.9	12670.8 ***	12670.8 n.s.	12670.8 de	228,4
4. Orgamax+Osmo+Biofa	1962.4 *	1962.4 ***	1962.4 cdef	240.5	10428.1 ***	10428.1 ***	10428.1 i	317,5
5. Agrobiosol+Osmo+Biofa	1665.6 *	1665.6 ***	1665.6 ef	148.4	13527.2 ***	13527.2 ***	13527.2 c	245,8
6. Naturale+Osmo+ Biofa	1977.5 *	1977.5 ***	1977.5 cdef	174.1	11548.1 n.s.	11548.1 n.s.	11548.1 gh	172,1
7. Lumbrikompost+Osmo+Alga	2082.8 *	2082.8 ***	2082.8 cdef	296.7	13860.9 ***	13860.9 ***	13860.9 bc	344,6
8. Evrobio+Hemozim+Biofa	1738.6 **	1738.6 ***	1738.6 def	86.8	9562.8 ***	9562.8 ***	9562.8 j	259,1
9. Orgamax+Hemozim+Biofa	1518.4 ***	1518.4 ***	1518.4 f	106.2	12447.7 **	12447.7 n.s.	12447.7 def	156,7
10. Agrobiosol+Hemozim+Biofa	1618.7 ***	1618.7 ***	1618.7 ef	150.3	11891.1 n.s.	11891.1 n.s.	11891.1 efgh	161,1
11. Naturale+Hemozim+Biofa	2283.0 n.s	2283.0 **	2283.0 bcdef	393.7	11116.2 n.s.	11116.2 **	11116.2 hi	254,4
12. Evrobio+Lumbrikompost+HP+Softgard;	2629.5 n.s	2629.5 *	2629.5 bcd	366.6	14677.1 ***	14677.1 ***	14677.1 a	365,2
13. Orgamax+LK+HP+Softgard;	2378.9 n.s	2378.9 **	2378.9 bcdef	180.5	15168.1 ***	15168.1 ***	15168.1 a	230,0
14. Agrobiosol+LK+HP+Softgard	2515.6 n.s	2515.6 *	2515.6 bcde	385.9	14436.0 ***	14436.0 ***	14436.0 ab	365,7
15. Naturale+LK+HP+Softgard	2713.2 n.s	2713.2 *	2713.2 abc	311.4	13109.3 ***	13109.3 *	13109.3 cd	306,0

* warranted the differences between the criterion LSD at the error α = 0.05
** warranted the differences between the criterion LSD at the error α = 0.01
*** warranted the differences between the criterion LSD at the error α = 0.001
n.s. the difference is insignificant to control
a, b, c………….. degree of proof by the method of Duncan Error α=0.05

CONCLUSIONS

1. At pH, no significant change in values resulted from applied organic fertilization. In the first experimental year, the highest total salt values were observed for the Naturale + Osmo + Biofa - 683 variant and the second for the Evrobio + Osmo + Biofa - 615 variant.

2. By foliar diagnostics, the highest values of macroelements in the third cluster were studied for the fertilizer variant with Orgamax + Osmo + Biofa (2.99), for the phosphate in the fertilizer variant with Agrobiosol + Hemozim + Biofa (1.36) and for the potassium in the fertilizer variant with Naturale + Hemozim + Biofa (2.61).

3. Of the tested organic fertilizer variants, the highest early yield was obtained with Naturale + LK + HP + Softgard - 2713.2 kg/da and the total yield was highest at fertilization with Orgamax + Lumbrikompost + Hydrolysed proteins + Softgard, respectively - 15168.1 kg/da**.**

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