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# TECHNOLOGICAL SOLUTIONS WITH BIOLOGICAL CULTIVATION OF GREEN BEANS AT FIELD CONDITIONS

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***Abstract***

*The purpose of the study is to be determined the fertilization impact and the cultivation scheme on the biological manifestations and the productiveness of Bulgarian green beans varieties, which are cultivated as per the biological method in the region of the Thracian valley. The experiment is carried out during the period 2015-2017 in the test field of Institute as per vegetable crops Maritsa - Plovdiv, in strongly leached meadow-cinnamon soil after forerunner spinach (autumn planting). The spinach is cultivated in compliance with the principles of biological production. With three Bulgarian green beans varieties: Tangra, Pagane and Evros are tested two biological fertilizers: Emosan and Biosol, with two schemes of sowing (main with width of the row-crops 80 cm and additional one of 60 cm). Significant differences are determined in the productiveness of the studied green beans varieties, cultivated as per the biological method. The highest yield is obtained of variety Evros in comparison with the rest. With the main scheme of 80 cm under influence of the bioproducts brought in the yields vary from 14170.0 kg/ha (fertilized with Biosol) up to 15156.0 kg/ha (fertilization with Emosan), the increase is respectively by 17.8% and 26.0% in comparison with the control. Considerably higher yields for the three varieties are obtained with scheme of 60 cm. The effect is higher by the application of bioproducts with varieties Pagane and Evros - 23.3% and 20.3%, in comparison with the main scheme of 80 cm. The results are one-way for all the three varieties. The impact of the bioproducts brought in is expressed least with the variety Tangra - 14.6%, where the lowest yields are reported.*

***Key words****: biofertilizer, number of beans, organic production, Phaseolus vulgaris* L*, weight of beans, yield.*

## INTRODUCTION

Increased demand for organic production in the EU, where the market is unlimited (Yordanova, 2003) imposes the extension of the production and expansion of the range of vegetable crops grown in accordance with the standards of the biological method in Bulgaria rapidly. In the leading countries of Europe, the USA, Canada and Australia legal, managerial and technological systems of farming and marketing of organic products are operating and constantly improving (Willer & Lernoud, 2017; 2019). Organic farming is a production system that combines best environmental practices with the aim of producing safe food, preserving natural resources and obtaining stable yields (Boteva & Cholakov, 2010; Vlahova, 2012; Vlahova, 2013). The use of biofertilizers as an alternative to chemical fertilizers increases vegetative growth, yield and fruit quality in vegetable crops (Aly, 2002; Aitbayev et al., 2018; Poudel et al., 2002). Breeding programs are directed to development of hybrid varieties that are more resistant and suitable for organic production (Antonova, 2012; Nacheva et al., 2013; Todorova, 2013).

Many experiments related to organic farming are being conducted around the world. The green beans participate in the most experimental schemes included in crop rotation or independently (Venturini et al., 2005). With the development of organic production, the importance of bean crops is growing up. In Bulgaria, beans are a traditional food for the population and the conditions for growing are favourable in more part of the country. The short vegetation period and production of organic N from the bacteria found in plant roots, defines green beans as economically important vegetable crops used as cover crops and green fertilizers (Nakhone & Tabatabai, 2008). The bean a very good pre-culture in vegetable production (Panayotov, 2000; Cholakov et al., 2015), suitable for incorporation in a system of organic production which enriches the soil with nitrogen, releasing vegetative masses in quantities equal to

fertilizing with 30 t/ha. This crop is very appropriate for growing in organic vegetable farms (Karungi et al., 2006; Sharma & Chetani, 2017). The yields in organic farming of green beans are lower but the quality of the output is higher (Abubaker et al., 2007).

## MATERIALS AND METHODS

The experiment was carried out during the period 2015-2017 in the field of Maritsa Vegetable Crops Research Institute - Plovdiv in strongly leached meadow-cinnamon soil after forerunner spinach (autumn planting). The spinach is cultivated in compliance with the principles of the biological production. Two schemes of sowing are tested and two biological fertilizers: Emosan and Biosol, they were brought in separately and in combination with three Bulgarian determinant varieties green beans: Tangra, Pagane and Evros.

**Variants of the experiment**

**I. Main sowing scheme - with width of the row-crops 80 cm.**

1. Control - unfertilized;
2. Mineral fertilization - N80P100K100;
3. Fertilization with 1000 kg/ha Biosol - with single bringing in before the sowing;
4. Fertilization with Emosan - 200 L/ha* - bringing in two times: before the sowing 150 L/ ha and phase beginning of blossoming 50 L/ ha
5. Combined fertilization with Biosol - 800 kg/ha + Emosan - 100 L/ha *.

**II. Additional sowing scheme - with width of the row-crops 60 cm.**

The variants are the same as with the main scheme.

The experiment is set as per the method of the long plots, in 4 repetitions, with reported area 4 $m^2$. The quantity of the mineral fertilizers is determined on the basis of agrochemical analysis of the soil. Ammonium nitrate, granulated fertilizer triple superphosphate and potassium sulphate are used. The phosphorous and potassium fertilizers and half of the nitrogen fertilizer norm are brought in with the main processing of the soil, the feeding with the rest nitrogen is carried out in phase beginning of blossoming.

The sowing is carried out in the period 30.05-06.06. The cares during the vegetation are: drip system irrigations, conformed with the development phase of the plants; against the weeds - manual earthing ups and weeding; feeding with fertilizers as per scheme; plant-protection practices - with bioinsecticides and biofungicides which are allowed for usage.

***Materials***

**Variety Tangra –** It is created at Institute as per vegetable crops Maritsa - Plovdiv. The plants are low-stemmed, shrubby, with height 47-57 cm, very well covered with leaves, with a strong, upright stem. The variety has a short vegetation period 44-46 days from the germination up to technological maturity and can be cultivated as it is sown per stages from April until the second half of July. It has high biological potential for yield and with double manual harvestings it exceeds the yield of the varieties, which are sensitive to *Pseudomonas savastanoi* and the bean common mosaic. The beans are flat, green, upright, 1.2-1.3 cm wide and 10-13 cm long. It has good resistance to the causes of the *Pseudomonas savastanoi*, sclerotic rot, as well as to the bean weevil. It is less attacked by bean common mosaic (BCMV) and cucumber mosaic (CMV).

**Variety Pagane** - An early and high-yield variety, determinant variety garden beans. The plants are high, very well covered with leaves, with a strong, upright stem and many nodes. The blossoms are white and typical for the common beans; the racemes are situated in the leaves. It is resistible to the most important warehouse pests of the beans – the bean weevil (*Acanthoscelides obtectus* Say). It is appropriate for direct consumption, as well as for processing.

**Variety Evros** - It has high productiveness, it is vital and very well adapted to the agroclimatic conditions of the country. The plants are with determinant type of growth with 50-55 cm height, with a strong and upright stem and average big frutex. It has cylindrical, long (13-15 cm); straight, green beans without fiber exceptionally appropriate for frozen vegetable mixes, whole frozen beans and canning. The beans reach technological maturity for 50 days and preserve their good taste qualities and appearance for a long period of time, because of their slow maturing dynamics.

***Characteristic of bioproducts used in this experiment***

***Biosol*** (Sandoz GmbH) - A by-product of the production of penicillin, containing fumigant biomass (micelle). Contains: Dry matter – 95.60%; CaO -0.21%; Organic substance – 90.70%; MgO -0.05%; pH ($CaCl_2$) – 3.0; Cl – 0.04%; S – 1.80%; C: N = 5:1; B – 7.1 mg/kg; N (total) - 6-8%; Zn – 6.0 mg/kg; Phosphates ($P_2O_5$) – 0.5-1.5%; Fe – 10.1 mg/kg; Potassium ($K_2O$) – 0.5-1.5. Product is certified for organic production.

***Emosan*** **-** HemoZymNK (Arkobaleno, Italy) - Organic nitrogen fertilizer with long lasting effects on soil and plants. Contains total nitrogen (N) - 5%; organic nitrogen (N) - 5%; organic carbon (C) - 14%; protein - 34 p/p; humidity - 65 p/p; K - 0.4 p/p; P - 0.06 p/p, etc.; pH - 7.0-10.0. Product is certified for organic production

The experiment was set by the method of the long parcels in 4 replicates, with a reporting area of 4 $m^2$ and a scheme of sowing 80/30 cm. Highly leached cinnamon soil has a heavy mechanical composition with mineral nitrogen content (NH4 - N + NO3 - N) – 2.01 mg/100 g soil (determined by distillation); 18.2 mg $P_2O_5$ and 17.5 mg $K_2O$ per 100 g soil (determined by Egner River); soil response pH 6.8 in water (potentiometrically defined) with a humus content of 2.2% (by Thurin) (Tomov et al., 1999).

***Study Indicators:***

**1. Biometric Measurements**: Five plants were analyzed by replicates:

- ✓ Vegetative mass (leaves + stems) per plant (g);
- ✓ Weight and number of beans per plant (g);
- ✓ Weight of a bean (g).
- ✓ Number of beans

**2. Morphology of beans:** mass (g); length (cm) and width (cm) - an average of 10 peppers from repetition in technological maturity were analyzed.

**3. Yield** - Formed by standard beans of all harvests - kg/ha.

**4. Statistical data processing** - The treatment of the results obtained includes a Two-factor dispersion analysis and a Duncan's Multiple Range Test (Duncan, 1955; Lakin, 1990) comparative analysis performed with SPSS 12 for Windows.

## RESULTS AND DISCUSSIONS

The results of the biometric measurements show that with scheme 80 cm row-crop, the plants of variety Evros form the biggest fresh over-ground biomass (average 272.24 g/plant). The plants, which are fertilized with mineral fertilizers (354.89 g) have the biggest mass. The impact of the used bioproducts on the formed vegetative mass of the plants is more strongly expressed with Emosan fertilization, followed by the variant with combined application of Biosol and Emosan, where the biggest mass of the beans is reported (85.32 g and 79.01 g) as well as number of pods per plant (23.08 pcs. and 22.25 pcs.). The separate fertilization with Biosol on the vegetative manifestations is less expressed.

With variety Pagane the difference in the formed total biomass /leaves + stems + pods/ among the variants, fertilized with Biosol and the combined application of Biosol + Emosan are statistically unproven. Regarding the mass of the formed beans per plant, the fertilization with Emosan significantly exceeds the rest variants.

The mass of the beans per plant with the variant Tangra is bigger with the combined fertilization with Biosol + Emosan. The general tendency is preserved as for the rest varieties, but the impact of the biofertilizers is less expressed (Table 2).

By decrease of the feeding area with scheme of 60 cm between the rows are decreased the values of the leaf-stem mass and the mass of the beans, respectively by 27,7%, 25,8% and 25,1 %. (Table 3). The biggest vegetation mass again has variety Evros (213.22 g/plant), followed by variety Pagane (196.29 g/plant), as the differences are small and statistically insignificant. The effect is the strongest on this indicator with fertilization with Emosan, followed by the combined application of Biosol + Emosan. The results are one-way for the three varieties. Significant differences are not determined with both schemes of cultivation on the indicator – number of the beans.

The biometric measurements (Tables 1 and 2) show that the differences among the variants, fertilized with Emosan and combined application of Emosan and Biosol are not big, as they are more significant among the varieties.

Table 1. Biometric measurements for green beans, with a scheme of 80 cm

| Variant | Mass of plant, g | Mass of stems and leaves, g | Mass of peppers/ plant, g | Number of peppers | Length of plant, cm |
|---|---|---|---|---|---|
| Variety Evros | | | | | |
| Unfertilized | 204,18 c | 120,18 | 84,00 c | 21,33 b | 39,00 |
| NPK | 349,73 a | 203,16 | 146,58 a | 33,08 a | 46,17 |
| Biosol 100 kg/da | 235,26 b | 123,61 | 111,66 b | 20,67 b | 37,25 |
| Emosan 20 L /da | 325,94 a | 177,21 | 148,74 ab | 35,75 a | 41,42 |
| Biosol+ Emosan | 286,55 ab | 176,84 | 109,72 b | 26,92 b | 42,25 |
| average | 280,33 | 160,20 | 120,14 | 27,55 | 41,2 |
| Variety Pagane | | | | | |
| Unfertilized | 223,42 c | 121,69 | 101,73 c | 17,75 c | 40,42 |
| NPK | 348,33 a | 174,11 | 174,23 a | 26,92 a | 45,67 |
| Biosol 100 kg/da | 264,34 bc | 142,54 | 121,80 b | 19,42 b | 45,29 |
| Emosan 20 L /da | 310,06 a | 168,88 | 141,18 b | 25,83 a | 45,33 |
| Biosol+ Emosan | 283,48 ab | 165,54 | 117,93 cb | 19,75 b | 41,83 |
| average | 285,93 | 154,55 | 131,37 | 21,93 | 43,71 |
| Variety Tangra | | | | | |
| Unfertilized | 172,78 b | 122,01 | 50,77 b | 16,08 b | 45,42 |
| NPK | 239,40 a | 161,31 | 78,09 a | 19,83 ab | 47,96 |
| Biosol 100 kg/da | 172,78 b | 122,01 | 50,77 b | 16,08 b | 45,42 |
| Emosan 20 L /da | 231,17 a | 164,23 | 66,94 ab | 22,17 a | 45,54 |
| Biosol+ Emosan | 206,36 ab | 155,28 | 51,08 b | 17,67 b | 46,75 |
| average | 205,07 | 143,82 | 61,25 | 14,42 | 41,02 |

a, b, c - Duncan`s multiple range test ( p<0.05)

Table 2. Biometric measurements in green beans, in a scheme of 60 cm

| Variant | Mass of plant, кg | Mass of stems and leaves, кg | Mass of peppers/ plant, кg | Number of peppers | Length of plant, cm |
|---|---|---|---|---|---|
| Variety Evros | | | | | |
| Unfertilized | 157,33 c | 113,51 | 43,82 c | 14,83 c | 36,67 |
| NPK | 284,28 a | 201,36 | 82,92 a | 25,08 a | 42,92 |
| Biosol 100 kg/da | 198,04 b | 145,71 | 52,33 bc | 15,92 c | 39,67 |
| Emosan 20 L /da | 221,54 b | 160,90 | 75,25 ab | 17,75 b | 37,71 |
| Biosol+ Emosan | 204,89 bc | 121,24 | 62,40 b | 21,08 ab | 33,88 |
| average | 213,22 | 148,54 | 63,34 | 18,93 | 38,16 |
| Variety Pagane | | | | | |
| Unfertilized | 156,42 c | 101,86 | 54,56 c | 16,25 c | 46,04 |
| NPK | 233,50 a | 149,01 | 84,48 a | 27,17 a | 46,88 |
| Biosol 100 kg/da | 175,49 b | 115,60 | 59,89 b | 16,83 c | 45,22 |
| Emosan 20 L /da | 228,92 a | 147,79 | 81,14 a | 21,00 ab | 48,63 |
| Biosol+ Emosan | 187,14 b | 124,59 | 62,55 b | 19,08 b | 46,04 |
| average | 196,29 | 127,77 | 68,52 | 20,06 | 46,56 |
| Variety Tangra | | | | | |
| Unfertilized | 124,00 c | 94,60 | 29,41 c | 9,25 c | 42,17 |
| NPK | 195,83 a | 152,48 | 43,35 b | 15,08 ab | 48,75 |
| Biosol 100 kg/da | 160,35 b | 112,58 | 47,77 b | 14,00 b | 46,07 |
| Emosan 20 L /da | 186,51 ab | 129,39 | 57,12 a | 16,42 a | 45,50 |
| Biosol+ Emosan | 152,87 b | 98,81 | 54,06 ab | 11,92 bc | 38,13 |
| average | 163,91 | 117.57 | 46.34 | 13,33 | 44,12 |

a, b, c - Duncan`s multiple range test ( p<0.05)

Higher values of the studied beans indicators are determined with variety Pagane out of the morphological measurements. The plants with the biggest beans mass are the plants, which are fertilized with Emosan (9.38 g). The results are analogical and for the rest varieties (Table 3).

Table 3. Morphological measurements in green beans, in a scheme of 80 cm

| Variant | Mass of pepper, g | Length of pepper, cm | Width of pepper,cm |
|---|---|---|---|
| Variety Evros | | | |
| Unfertilized | 7,43 | 12,37 | 12,72 |
| NPK | 8,52 | 12,97 | 12,36 |
| Biosol 100 kg/da | 7,03 | 12,43 | 13,04 |
| Emosan 20 L /da | 8,03 | 12,90 | 13,01 |
| Biosol+ Emosan | 7,87 | 12,63 | 12,92 |
| average | 7,82 | 12,70 | 12,81 |
| Variety Pagane | | | |
| Unfertilized | 8,08 | 13,23 | 13,11 |
| NPK | 9,59 | 13,07 | 14,20 |
| Biosol 100 kg/da | 8,39 | 12,83 | 13,45 |
| Emosan 20 L /da | 9,38 | 13,67 | 13,71 |
| Biosol+ Emosan | 8,59 | 13,30 | 13,70 |
| average | 8,81 | 13,22 | 13,63 |
| Variety Tangra | | | |
| Unfertilized | 5,69 | 11,05 | 8,32 |
| NPK | 7,77 | 12,93 | 9,97 |
| Biosol 100 kg/da | 5,90 | 12,11 | 8,83 |
| Emosan 20 L /da | 6,92 | 12,00 | 9,44 |
| Biosol+ Emosan | 6,03 | 12,60 | 8,92 |
| average | 6,46 | 12,46 | 9,10 |

a, b, c - Duncan`s multiple range test ( p<0.05)

The impact of the sowing scheme on the parameters of the beans is well expressed after fertilization with Emosan. The results show that with the smaller row-crop the mass of the beans, their width and length decrease with the studied varieties. This, however, from technological point of view does not render impact on the final results of the production (Table 4).

Table 4. Morphological measurements in green beans, in a scheme of 60 cm

| Variant | Mass of pepper, g | Length of pepper, cm | Width of pepper, cm |
|---|---|---|---|
| Variety Evros | | | |
| Unfertilized | 7,02 | 12,09 | 12,58 |
| NPK | 8,14 | 12,47 | 13,25 |
| Biosol 100 kg/da | 7,34 | 12,73 | 12,65 |
| Emosan 20 L/da | 7,78 | 12,47 | 13,18 |
| Biosol+ Emosan | 7,62 | 13,00 | 13,10 |
| average | 7,58 | 12,55 | 12,95 |
| Variety Pagane | | | |
| Unfertilized | 7,29 | 12,73 | 12,76 |
| NPK | 8,89 | 13,33 | 13,70 |
| Biosol 100 kg/da | 7,66 | 12,05 | 12,94 |
| Emosan 20 L /da | 8,28 | 12,63 | 13,10 |
| Biosol+ Emosan | 8,09 | 12,65 | 13,01 |
| average | 8,04 | 12,68 | 13,14 |
| Variety Tangra | | | |
| Unfertilized | 5,55 | 11,37 | 9,41 |
| NPK | 5,83 | 11,33 | 8,78 |
| Biosol 100 kg/da | 5,92 | 11,47 | 8,52 |
| Emosan 20 L /da | 6,01 | 12,11 | 9,31 |
| Biosol+ Emosan | 5,27 | 11,37 | 8,00 |
| average | 5,72 | 11,53 | 8,80 |

Yields of the three varieties, registered with mineral fertilization, exceed the average of the bioproducts application as the increase is respectively 12.7% - for variety Evros; 10.8% - for variety Pagane and 8.2% - for variety Tangra.

The highest yields with bioproducts fertilization are reported with variety Evros in comparison with the rest varieties. The values among the variants with 80 cm row-crop vary from 14170.0 kg up to 15156.0 kg/ha. It is determined that the bioproducts increase the productiveness average by 21.5% in comparison with the unfertilized control. The obtained yields are with the highest values with fertilization with Emosan, followed by the variant with combined brining in of Biosol+Emosan as the increase in comparison with the control is respectively by 26.0% and 20.6%. The differences among the two variants are statistically proven (Table 5).

Significantly higher yields are reported with row-crop 60 cm, as the values vary from 16628.0 kg up to 18025.0 kg/ha. The increase of this indicator is average by 20.3%. The obtained results are not one-way with the main scheme of cultivation. The yields are the highest with the combined fertilization with Biosol and Emosan, followed by the separate bringing in of Emosan, but the differences among the two variants are small and unproven, respectively 22.1 and 24.2%. The effect of the brought in bioproducts with this scheme is by 24.2% higher than the main scheme.

The results are one-way with variety Pagane. With the main scheme of 80 cm under the impact of the bioproducts brought in the yields vary from 12130.0 kg/ha (fertilized with Biosol) up to 13317.0 kg/ha (fertilized with Emosan), the increase is respectively by 14.8 and 26.0 % in comparison with the control. Higher values for this indicator, average by 23.1%, are determined with the additional scheme of 60 cm.

The average effect of bioproducts included in the study is the highest with variety Pagane in comparison with the other varieties, expressed strongly with scheme of 60 cm row-crop - 23.3%, in comparison with the main scheme of 80 cm - 19.9%. In contrast to variety Evros, here the differences among the variants fertilized with Emosan and the combined bringing in of Biosol and Emosan are more considerable for both cultivation schemes.

The impact of the bioproducts brought in is less expressed with variety Tangra, where the lowest yields are reported. The tendency regarding the impact of the applied fertilization and the cultivation scheme is preserved, but the effect of the bioproducts in comparison with the unfertilized plants is less expressed - 14,5% (with scheme of 80 cm) and 14.6% (with scheme of 60 cm).

Table 5. Yields of green beans, kg/ha

| Variant | Yield 80 cm between the lines | % /K | Yield 60 cm between the lines | % /K | % toward s 60 cm |
|---|---|---|---|---|---|
| Variety Evros | | | | | |
| Unfertilized | 12020,8 c | 100 | 14510,5 c | 100 | 120,7 |
| NPK | 15550,9 a | 129,4 | 19560,8 a | 134,8 | 127,8 |
| Biosol 100 kg/da | 14170,0 b | 117,8 | 16620,8 bc | 114,6 | 120,3 |
| Emosan 20 L/da | 15156,0 ab | 126,0 | 17720,6 b | 122,1 | 125,0 |
| Biosol+ Emosan | 14500,2 b | 120,6 | 18025,0 b | 124,2 | 127,3 |
| effect | | 21,5 | | 20,3 | 24,2 |
| Variety Pagane | | | | | |
| Unfertilized | 10560,9 c | 100 | 12950,1 | 100 | 122,5 |
| NPK | 13990,5 a | 132,4 | 16630,3 a | 128,4 | 118,8 |
| Biosol 100 kg/da | 12130,0 b | 114,8 | 15000,3 b | 115,8 | 123,7 |
| Emosan 20 L/da | 13317,0 ab | 126,0 | 16150,4 ab | 124,7 | 121,3 |
| Biosol+ Emosan | 12560,8 b | 118,9 | 16730,8 b | 129,2 | 129,2 |
| effect | | 19,9 | | 23,3 | 23,1 |
| Variety Tangra | | | | | |
| Unfertilized | 9030,5 b | 100 | 11670,7 c | 100 | 120,2 |
| NPK | 10890,3 a | 120,6 | 14080,5 a | 120,6 | 123,3 |
| Biosol 100 kg/da | 9970,3 b | 110,4 | 12830,0 b | 109,9 | 118,6 |
| Emosan 20 L/da | 10370,5 ab | 114,8 | 13380,4 ab | 114,6 | 124,0 |
| Biosol+ Emosan | 10670,4 a | 118,1 | 13930,8 a | 119,4 | 126,6 |
| effect | | 14,5 | | 14,6 | 22,5 |

The yields level of the tested Bulgarian green beans varieties, in the conditions of biological production to the biggest degree depends on the variety peculiarities, and the technological elements - fertilization and cultivation scheme are with less impact (Table 6).

Table 6. Vatiation of the green beans yield under the influence of the fertilization and scheme of growing

| Factors | SS | df | F | P-value | F crit |
|---|---|---|---|---|---|
| **Variety** | 3615460 | 2 | 38,413 | 78,22*** | 3,885 |
| **Scheme** | 424151,2 | 1 | 9,013 | 9,18* | 4,747 |
| **AxB** | 17827,7 | 2 | 0,189 | 0,39 | 3,885 |
| **Casual** | 564719,4 | 12 | | 12,22 | |
| **Total** | 4622159 | 17 | | | |

## CONCLUSIONS

The sowing scheme impact on the parameters of the beans is well expressed after fertilization with Emosan. The plants of variety Pagane have the biggest mass of the beans. The mass of the beans, their width and length decrease with the less row-crop with the studied varieties. This, however, does not render impact on the final results of the production from technological point of view.

Yields from the three varieties, registered with mineral fertilization, exceed the average ones of the bioproducts application, as the increase is respectively 12.7% - for variety Evros; 10.8% - for variety Pagane and 8.2% - for variety Tangra.

With variety Evros are reported the highest yields with bioproducts fertilization in comparison with the rest varieties. The values among the variants with 80 cm row-crop vary from 14170.0 kg/ha (fertilized with Biosol) up to 15156.0 kg/ha (combined fertilization with Biosol and Emosan), the increase is respectively by 17.8 and 26.0% in comparison with the control. Considerably higher yields for the three varieties are obtained with row-crop 60 cm.

The effect of the bioproducts is the highest with variety Pagane, more expressed with scheme of 60 cm - 23.3%, in comparison with the main scheme of 80 cm - 19.9%. The results are one-way for all the three varieties.

Appropriate for biological cultivation are variety Evros, followed by variety Pagane, which have realized high yields with both sowing schemes. Variety Tangra has relatively lower productiveness, but can also be used for the making of organic products.

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