[1.]Maria Gabriela PÂRVU, [1.]Floarea BURNICHI, [1.]Lenuţa PANTAZI,
[1.]Florentina VASILE, [1.]Auraş NITA

RESEARCH ON THE INFLUENCE OF BIOLOGICAL TREATMENT WITH MIXED BACTERIAL PREPARATION APPLIED TO SEEDS, ON THE GROWTH AND DEVELOPMENT OF ORGANICALLY GROWN TOMATO PLANTS

[1.]Vegetable Research Vegetable Research and Development Station Buzau, ROMANIA

Abstract: Biological fertilization techniques are pertinent strategies for an efficient and rational use of agricultural resources with minimal generation of adverse environmental impacts that may affect water resources, ecosystems or the quality of human life. In addition, biological fertilizers provide a wide range of possibilities for the development of conservative agriculture (CA) in different geographic, economic, and cultural backgrounds. Treatments with mixed bacterial preparations or with *Trichoderma* spp., applied to seeds, can have a beneficial influence on the growth and development of organically grown vegetable species. In 2019, the VRDS Buzau, within the Complex Project PN-III-P1-1.2-PCCDI-2017-0301/Contract 28PCCDI/2018-"SEDMAGRO", carried out research activity with 4 variants: V1-control; V2-mixed bacterial preparation applied: A-for seeds; B-at planting, 2.5g granules at the base of the plant; V3-fungal preparation based on *Trichoderma sp.* applied to the seed; V4-with seedlings obtained from bacterialized seeds (V2), and no treatment at the time of planting. The experiment was carried out in the ecological polygon, on an area of 350m^2. The applied culture technology was unitary, also the treatments applied for the prevention and control of phytopathogens. The tomato variety used was BUZAU 1600 cultivar.

Keywords: bacterialized seeds, mixed bacterial granules, tomato growth&development, *Trichoderma sp.*

INTRODUCTION

Treatments with mixed bacterial preparations or with *Trichoderma* spp., applied to seeds, can have a beneficial influence on the growth and development of organically grown vegetable species, according to studies conducted over time, "all strains of *Trichoderma* spp. have been able to stimulate the growth parameters of the plants, in different degrees", (*Paica A., 2020*) both in the country and abroad, "the growth potential of the plants induced by the species of *Trichoderma* spp. can be 20% higher than the control" *(Baker R., 1988)*.

Trichoderma spp. is a saprophytic (non-pathogenic) fungus, among the strongest in the category of antagonistic microorganisms, characterized by a great capacity for adaptation and rapid growth *(Ceausescu et al, 1979; Jitareanu G., 1999)*. *Trichoderma* spp. introduced into the soil improves the health of plants and increases disease resistance without eliminating other beneficial microorganisms. *Trichoderma* also stimulates plant growth and the production of phytohormones. *(Sbîrciog, 2017)*.

Council of Agriculture (COA) held various seminars as well as workshops on the application of biofertilizers, so that farmers would have the opportunity to understand the effects of biofertilizers and are willing to use them *(Levandovschi at al., 2017)*.

Farmers were invited to inspect the growth of AMF, Rhizobial or PSB inoculated crops in the fields and were encouraged to participate in workshops after viewing the successful outcomes of using biofertilizers.

The application of inorganic chemical fertilizers was thus significantly reduced to 30-50% *(Aggani S. L., 2013; Raja, 2013)*.

Biological fertilization techniques are pertinent strategies for an efficient and rational use of agricultural resources with minimal generation of adverse environmental impacts that may affect water resources, ecosystems or the quality of human life. In addition, biological fertilizers provide a wide range of possibilities for the development of conservative agriculture (CA) in different geographic, economic, and cultural backgrounds *(Carvajal-Muñoz&Carmona-Garcia, 2016)*.

In order to support farmers in these fields, new organic products have appeared on the Romanian market meant to be used in the agro-zoo-veterinary field: biofertilizers, silage agents, probiotics and immunomodulators *(Toader G. et al, 2019)*.

MATERIALS AND METHODS

During the second stage of the SIMPLANT project, the biological material used for the establishment of the experimental plot was represented by the tomato variety BUZAU 1600.

Characterization of the biological material: The BUZAU 1600 tomato variety was approved in 1977, being one of the most important creations of the Vegetable Research and Development Station Buzau. It is a semi-late variety (120-130 days), with undetermined growth, high vigor, tolerant to the attack of the main pathogens of tomatoes. The fruits are spherical, weighing 180-200 g, the average height of the fruit is 6.6 cm, the average diameter of the fruit is 7.7 cm, the number of seminal lodges is 5-6 and the color of the fruit is uniformly red at maturity (without green cover). The tomato

variety BUZAU 1600 can be grown in the open field (in a palisade system), in all areas of the country favorable for tomato cultivation.

The batch of tomatoes established on 20.05.2019 was organized in four experimental variants and the arrangement of the experiment was in randomized blocks, with 4 variants and 3 repetitions each. The surface of a rehearsal was 7.5 m^2:

- Variant 1 - was the control variant, tomato variety BUZAU 1600, without biostimulation;
- Variant 2 - was the variant in which biological treatment with mixed bacterial preparation was applied, created and inoculated by ICDPP Bucharest, applied in two stages (seed and planting), to the BUZAU 1600 tomato variety;
- Variant 3 - was the variant in which biological treatment was applied to the seed with fungal preparation based on *Trichoderma* spp., created and inoculated by ICDPP Bucharest, for the tomato variety BUZAU 1600;
- Variant 4 - was established with seedlings obtained from bacterialized seeds (V2), but to which the mixed bacterial biopreparation was not applied at the time of planting.

The land preparation started in the autumn of 2018 when the works for the chopping of the previous culture and the leveling of the land were executed. In the spring of 2019, the land was prepared with the cultivator and modeled on 140 cm (94 cm at the canopy) furrows.

The production of the seedling was done in the greenhouse multiplier. The seedling was produced by sowing in a germination bed. The sowing was performed on 01.04.2019 in 3 (three) variants. The culture started to emerge on 09.04.2019. The seedling was transplanted on April 22, 2019, in alveolar pallets, using sterile peat as substrate.

The care works applied to the seedling were: directing the vegetation factors at the optimal level for the growth and development of the seedlings. The ventilation of the space plays a very important role in the prevention of diseases, knowing that high atmospheric humidity favors the appearance of diseases in this culture environment, rational irrigation and the application of treatments to prevent and combat diseases and pests with ecological substances.

Before ten days planting the seedling in the field, it was hardened by gradually lowering the humidity, temperature and progressive aeration of the seedling production space.

RESULTS

Biometric measurements were performed on the seedling before the culture was established. As can be seen in table no. 1, following the measurements, differences were found between the 3 variants in terms of seedling height and root development:

- V2 - tall seedling, with well-developed root, with an average number of leaves;
- V3 - seedling with a more vigorous growth, lower seedling height, very well developed root, and an average number of leaves.

Tabel 1. Differences were found between the 3 variants in terms of seedling

No. Var.	Height plant cm	Root length /cm	G.M.V. Root /g	G.M.U Root /g	Height stem /g
V1	28,6	8,63	1,11	0,07	18,3
V2	35,5	13,1	0,55	0,04	24,1
V3	25,5	12,4	0,87	0,06	15,7
No. Var.	**G.M.V Stem / g**	**G.M.U Stem/ /g**	**No. leaves**	**G.M.V leaves /g**	**G.M.U leaves /g**
V1	2,4	0,1	6,4	2,9	0,2
V2	2,9	0,1	6,1	2,9	0,2
V3	2,0	0,1	5,6	2,5	0,2

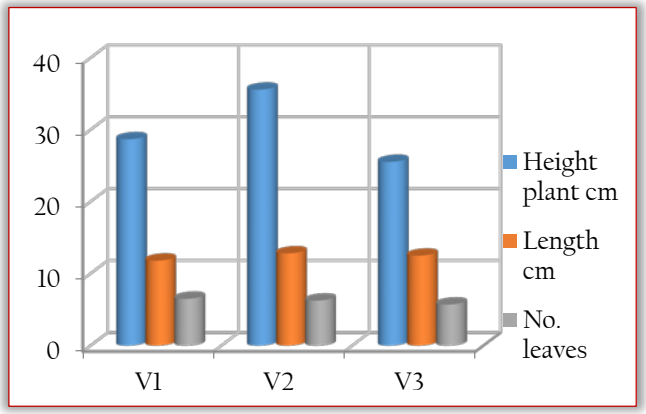

Figure 1. Differences between biometric determinations to V1, V2, V3

Figure 2. Trichoderma spp., created and inoculated by ICDPP Bucharest

Establishment of the culture: the planting of the seedling was done manually, on 20.05.2019, the planting distances were 70 cm between rows and 35 cm between plants / row, setting up 1,500 plants / solarium, the experimental variants were placed and the mixed bacterial preparation was applied to the base of the plant (2.5 g granules / plant) at V2 (photo no. 1)

Immediately after planting, the crop was irrigated by the installed drip system (photo no. 2). After 3 days from planting, the gaps were filled, manually, with seedlings of the same variants and of the same age as the one initially used. During this stage of the project were followed the growth and development of plants, under the influence of seed treatment as well as tolerance to the appearance of phytopathogens and the evolution of pathogens in tomato culture BUZAU 1600.

The experiment took place against natural infections. After the establishment of the culture and the filling of the gaps, the care works applied to the tomato culture were the general works, the irrigation of the culture being carried out whenever it was necessary (Figure 3).

Figure 3. Detail of the infinite culture

After 14 days from planting, the palisade and shoots removal were carried out. Manual weeding was done 4-5 times to destroy weeds and loosen the soil. Shoot removal was repeated periodically at about 14 days. Given the location of the experiment (in the ecological polygon), the treatments for preventing and combating phytopathogens and pests were also ecological. After 7 days from planting, the first pest that appeared in the tomato crop Buzau 1600 was the common red mite (*Tetranichus urticae*), which has a very aggressive attack on plants.

The treatments administered at its signalling were Laser, applied in a dose of 0.05% and Metab, in a dose of 0.25% (it was microactivated with the Nutryaction product). These products have managed to reduce the degree of attack of this pest until it is completely stopped. The treatment based on Bordeaux Juice was applied on 05.07.2019 in a dose of 0.5%, when signalling the appearance of the phytopathogenic agent *Phytophthora infestans* (tomato blight).

On 17.07.2019, the biological insecticide based on *Beauveria bassiana* was applied in a dose of 15 ml/m^2, when signalling the occurrence of the pest *Tuta absoluta* (tomato moth). On the same day, an organic fertilizer based on NPK (from SIRIO ORGANIC) was incorporated.

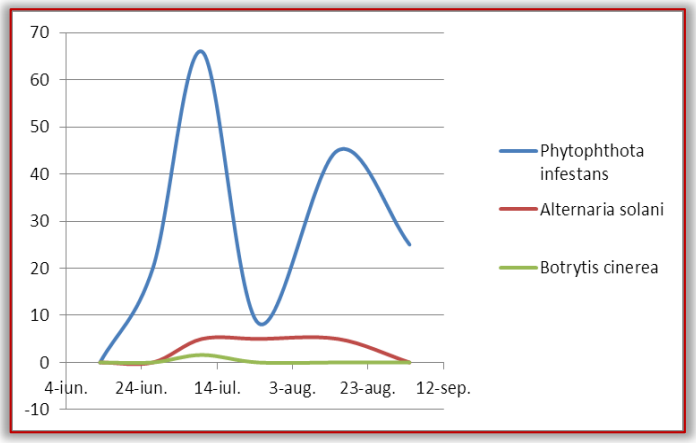

Figure 4. Evolution of phytopathogenic agents in the Buzau 1600 tomato crop in the ecological crop (%)

During the vegetation period, ecological products based on microorganisms, biological insecticide based on *Beauveria bassiana* from the project leader, the Research and Development Institute for Plant Protection Bucharest, Bordeaux Juice and Laser were administered.

The determination and monitoring of the attack of pathogens and pests was performed by means of indicators of frequency, intensity and degree of attack. For this purpose, dynamic observations were made, every 10 days, on the frequency of the attack (F%) and the intensity of the attack (I%), on the background of natural infestation. The degree of attack (GA%) was calculated with the obtained data. Biometric determinations were performed at 15 days, on each repetition being retained for observations and determinations 5 (five) plants.

In figure no.4 shows the evolution of the three phytopathogenic agents, *Phytophthora infestans* having a stronger degree of attack than the other pathogens. By administering Actiseed and Clonotri organic products, this disease has been greatly diminished, until it is completely stopped. The highest number of pests were *Tuta absoluta* and *Aphys gossypii*. Under the action of applied bioinsecticides, they were reduced to total cessation (Figure 5).

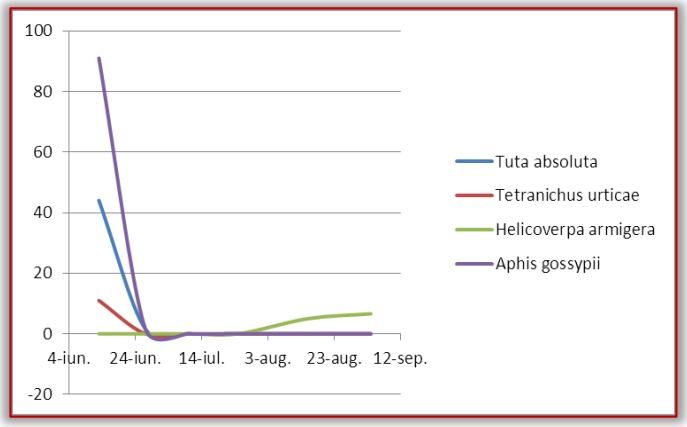

Figure 5. Evolution of pests in tomato crop Buzau 1600 planted in the ecological polygon (%)

Regarding the growth and development of plants, based on the results of biometric measurements and phenological observations, the following conclusions were reached: After the establishment of the culture, the plants developed normally, with small differences between the experimental variants in terms of average plant height, noting V3 (which used seeds with biological treatment based on *Trichoderma* sp).

Regarding the number of leaves per plant, it is found that V2 (the variant with bacterized seeds to which the mixed bacterial preparation was applied at the time of planting) had a richer foliar growth compared to the other variants. Regarding the number of inflorescences on the plant, it is observed that V4 (without the application of the mixed bacterial preparation at planting) has better results, but due to the high temperatures in July and August, the 3rd and 4th order inflorescences aborted in 75%, the 5th order inflorescences aborted in 50%, which greatly influenced the production (Figure 5).

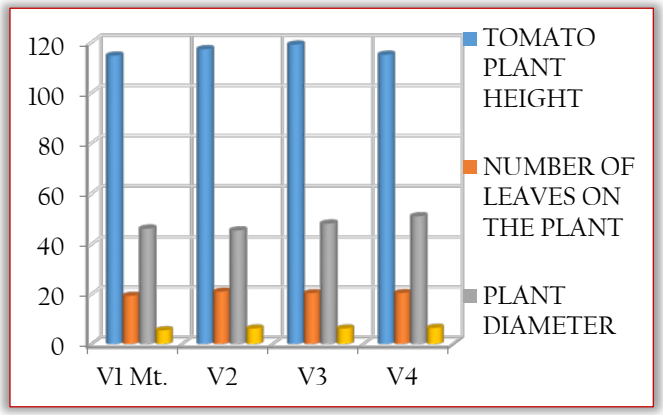

Figure 6. Growth and development of tomato plants Buzau 1600, SIMPLANT project

The fruit productions obtained on each variant following the harvests performed are presented in Figure 6.

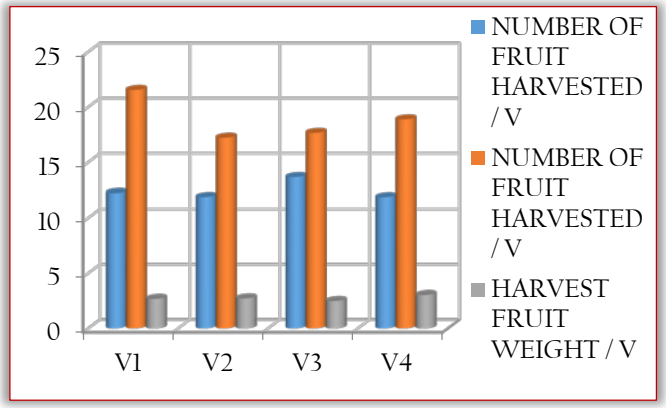

Figure 7. Productions obtained for the Buzau 1600 tomato variety

The harvests were carried out on 12.08.2019 (first harvest), 29.08.2019 (second harvest) and on 12.09.2019 the last harvest was made in the tomato crop, Buzau 1600 variety. The production was much diminished due to abortion of flowers formed between June 20 and August 30. Very high temperatures and atmospheric drought resulted in a 45% loss of production. The first 2 (two) inflorescences normally bore fruit on average 3 fruits / inflorescence, on the third inflorescence the abortion phenomenon occurred and on average 1 fruit / inflorescence was harvested (Figure 7).

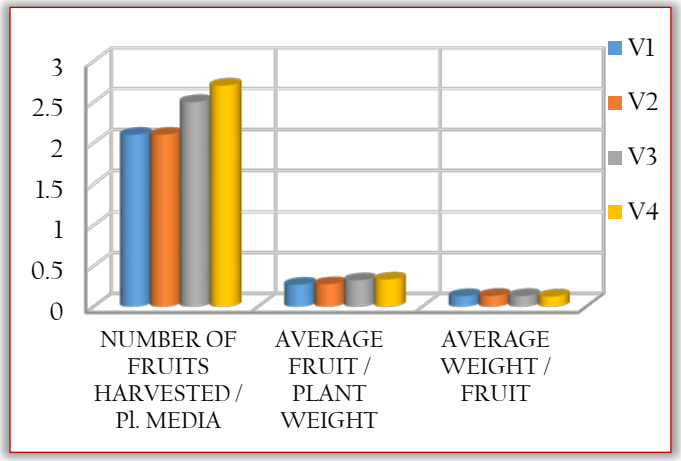

Figure 8. Presentation of the variation of the number of fruits / plant and of the average weight of the tomato fruits, Buzau 1600 variety

CONCLUSIONS

The fourth and fifth floors were 70% aborted, and the fruits formed were small, uncharacteristic of the variety. In the sixth floor the formed fruits reached the consumption maturity on average 3 fruits/inflorescence, but the average weight of the fruit was 85 g. In these conditions the variant with the most fruits harvested on the plant was V4. Regarding the average weight of the fruits, there were no significant differences between the 4 experimental variants, the main reason being the stressful climatic conditions in the summer months.

So, based on the main growth, development and productivity indices followed in the experiment, the degree of utility of the bacterial biopreparation applied to both seed and planting (V2) and of the fungal preparation based on *Trichoderma* sp. (V3) compared to the control (V1) without applied biostimulation treatment, the conclusions of the experience are the following:

- In the seedling phase the experimental variant V3 was distinguished by strong plant vigor, short internodes, strongly developed root, compared to V2 where the seedling was tall, with long internodes;
- After the establishment of the culture in the ecological polygon, the plants had a uniform growth and development, without big differences between the 4 experimental variants.
- Climatic factors, especially high temperature and atmospheric drought have caused significant losses in fruit production. In these conditions, regarding the production obtained on the plant and the number of harvested fruits, Variant V4 was highlighted.
- The applied culture technology was of unitary and general character, the treatments applied for the prevention and control of phytopathogenic agents also had a general and unitary character (it was not necessary to apply different treatments on variants).

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Note:

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Life Technological Platform", in Bucharest, ROMANIA, 30 October, 2020

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Faculty of Engineering Hunedoara,
5, Revolutiei, 331128, Hunedoara, ROMANIA
http://acta.fih.upt.ro