# RESULTS ON THE USE OF BACTERIAL BIOPREPARATIONS (BIOLOGICAL FERTILIZERS) IN AGRICULTURAL CROPS IN RESEARCH AND DEVELOPMENT STATIONS FOR AGRICULTURE, ROMANIA

**George TOADER[1], Viorica CHIURCIU[1], Nistor MAIEREAN[1], Valentina FILIP[1], Cristian-Ionut FLOAREA[1], Petru SEVCIUC[1], Floarea BURNICHI[2], Cătălin-Ionuț ENEA[3], Leonard ILIE[4]**

e-mail: george.toader@romvac.ro

**Abstract**

The development and use of strategies for organic fertilization of agricultural crops will lead to a decomposition of insoluble elements in the soil structure, which will lead to an increase in the number of soluble mineral elements in the soil structure, which will lead to significant plant growth and of agricultural production. Soil pollution with chemical elements has led to an increase in pH from a basic / neutral to an acid one. Soil acidification causes a decrease in agricultural production, a decrease in plant resistance to certain pests of soil structure, but especially soil pollution, groundwater with certain chemical elements found in the structure of fertilizers. Thus, following the research carried out within the research-development stations for agriculture in Romania, it was proved that the lots fertilized with biological fertilizer had a much higher production than the lots fertilized chemically.

**Key words**: bacterial biopreparations, biological protection and fertilization, ecological fertilization technologies

In order to support the growth and development of plants, the soil must be able to provide the plants with the mineral elements they need, in equal quantities so as to ensure the harmonious growth and development of the crop plants. The soil structure contains a highly developed bacterial fauna that has the role of ensuring the decomposition of insoluble elements into soluble elements as well as accelerating the process of decomposition of plant debris on the soil surface and its interior (Chandler D *et al*, 2010; Larkin and Hansen A., 2010).

The production of biological fertilizers that contain live bacterial cultures is an innovation for agriculture. The role of bacteria in bacterial biopreparations used as biological fertilizers is to recolonize the bacterial fauna of the soil, providing the nutrients that plants need in their growth and development and in the processes in soil structure (fixing atmospheric nitrogen in the soil, decomposition of insoluble elements in soluble elements, decomposition of plant residues in the soil, etc.) (Toncea I. *et al*, 2012; Voloșciuc L , 2009a).

Another aspect related to the use of bacterial biopreparations in agriculture is the impact that these bacteria have on pests in the soil structure and on the surface of plants. As a result of their activity, the bacteria eliminate a series of enzymes and phytohormones that have the role of fighting certain pests in agricultural crops. (Aggani S.L., 2013). Tests on maize have shown that the effect of inoculating the seed material in a solution of bacterial biopreparations has led to a halt to the attack of the pest *Tanymecus dilaticollis*. This is an important step in the biological control of pests resistant to chemical components in plant protection substances as well as those in the composition of chemical fertilizers (Toader G. *et al*, 2019). The ecological imbalance of the soil is characterized by the decrease of the activity of bacteria in the soil fauna (useful soil fauna), the use in large doses of these products will lead to soil acidification, decreased fertility, increased pest resistance and side effects. on the human or animal body (Chiurciu C *et al*, 2019).

In order to replace chemical fertilizers, agricultural researchers with the help of soil fertilizers and plant protection products have managed to restore the structure of the soil, its recolonization with beneficial bacteria and the decomposition of insoluble mineral elements into

[1] Romvac Company S.A. Voluntari, Ilfov
[2] Vegetable Research and Development Station, Buzău
[3] Agricultural Research and Development Station (ARDS), Suceava
[4] University of Agricultural Sciences and Veterinary Medicine, Bucharest

soluble components, easily assimilated by plants. These plant fertilization products have allowed the development of new technologies in the field of agriculture, green technologies, environmentally friendly and new technologies for fertilizing agricultural crops with these organic fertilization products (Voloșciuc L., 2009b).

## MATERIAL ŞI METHOD

The product Rom-Agrobiofertil NP was used as research material. The product represents a set of three living bacterial cultures: *Azospirillum lipoferum*, *Azotobacter chroococcum* and *Bacillus megaterium*. The three living bacterial cultures have their own role in the agricultural soil system (useful soil fauna) these bacteria accelerating the process of decomposition of residues and the release of insoluble comos from the soil structure into soluble compounds, easily assimilated by plants. The research methods were applied within the Research-Development Stations for Agriculture in Romania, namely S.C.D.L Buzău, S.C.D.L Bacău and S.C.D.A Suceava.

## RESULTS AND DISCUSSIONS

**1. Buzău Vegetable Research and Development Station.**

Following the tests of the bacterial biopreparation Rom-Agrobiofertil NP on some cultures within the resort, the following results were obtained:

**1.1. Cabbage crop, "de Buzău" variety:** within the resort, the Rom-Agrobiofertil NP product was tested on the cabbage crop. Different batches were made: control batch (chemical fertilizer-V1) (*figure 1*) and biological fertilizer batch-V2 *(figure 2*) (Rom-Agrobiofertil NP product). Numerous differences were identified between the two lots as follows (*figure 3*) and (*table 1*):

Tabelul 1

**Biometric data: seed culture of cabbage "De Buzău"**

| Lots | No shoots | Length siliques | No medium / plant siliceous | No seeds / syllable | Average seed / plant | | Average seed production kg / ha | Sales price / kg | Total value of seeds / lei |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | No seeds / plant | g/pl | | | |
| V1- Witness | 21 | 6.25 | 209 | 24 | 2021 | 8.31 | 422.46 | 500 | 211.230 |
| V2 - Rom-Agrobiofertil NP | 23 | 7.80 | 424 | 29 | 6564 | 44.4 | 1171.76 | 500 | 585.880 |
| Growth (%) | 9.52 % | 24.8 % | 102.87 % | 20.83 % | 224.79 % | 434.3 % | 177.4 % | 0.0 % | 177.36 % |

Figure 1 **Culture of cabbage witness lot**

Figure 2 **Culture of cabbage "De Buzău"- organic fertilized lot**

Figure 3 **Differences between the control group (fertilized) and the biological fertilized group (Rom-Agrobiofertil NP)**

Following the testing of the bacterial biopreparation Rom-Agrobiofertil NP in parallel with a chemical fertilizer, it was proved that in the cabbage culture, the production of the biologically fertilized lot was much higher than the production of the chemically fertilized lot. Thus, the percentage of production of the biologically fertilized lot compared to the chemically fertilized lot was between 224.79% (number of seeds per plant) and 177.4% (production of seed material per ha). Also, the profit increased by 177.36%.

**1.2. Tomato culture, "Florina 44" variety**

Within S.C.D.L Buzău, tests were also performed on tomato crops. Chemical fertilization products in parallel with biological fertilizer were used in the culture. The results obtained in the biologically fertilized batch were much more significant than the results obtained in the chemical batch (*table 2*).

Following the testing of the bacterial biopreparation Rom-Agrobiofertil NP in parallel with a chemical fertilizer, it was proved that in the tomato crop, the production of the biologically fertilized lot was much higher than the production of the chemically fertilized lot. Thus, the percentage of production of the biologically fertilized lot compared to the chemically fertilized lot was between 79.97% (total fruit production per kg), 69.27% (total production per ha) and 39.96% (total number of fruits per plant).

**2. Bacău Vegetable Research and Development Station.**

**2.1. Bean and corn cultures.**

Within S.C.D.L Bacău, tests were performed on bean and sweet corn crops. Chemical fertilization products in parallel with biological fertilizer were used in the culture. The results obtained in the biologically fertilized batch were much more significant than the results obtained in the chemical batch (*table 3*).

**3. Suceava Agricultural Research and Development Station**

**3.1. Rapeseed / phelium (lolium) crop.**

Within S.C.D.A Suceava, tests were performed on rapeseed and phelium (lawn) crops. Chemical fertilization products in parallel with biological fertilizer were used in the culture.

Table 2

**Tomato culture. "Florina 44".**

| Lots | No of Ripe fruit/pl | Ripe fruit weight/pl (kg) | No. of green fruits/pl | Weight of green fruits/pl (kg) | Total fruit/plant production (kg) | Total no. fruit/plant | Total production t/ha |
|---|---|---|---|---|---|---|---|
| V1- Witness | 11.2 | 0.802 | 14.2 | 1.06 | 1.862 | 25.4 | 78.3 |
| V2 - Rom-Agrobiofertil NP | 13.3 | 1.251 | 22.25 | 2.1 | 3.351 | 35.55 | 132.6 |
| Growth (%) | 15.78 % | 35.89 % | 36.17 % | 49.52 % | 79.97 % | 39.96 % | 69.27 % |

Table 3

**Bean and corn cultures**

| Lots | Bean “Auria Bacăului” | Corn “Dulce de Bacău” |
|---|---|---|
| V1- Witness | 1058 | 7896 |
| V2 - Rom-Agrobiofertil NP | 1219 | 8760 |
| Growth (%) | 15.22 % | 10.94 % |
| Production surplus | 161 kg/ ha | 864 kg/ ha |

The results obtained in the biologically fertilized batch were much more significant than the results obtained in the chemical batch (*table 4*).

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Table 4

**Rape and lolium cultures**

| Lot | Rape | Lolium |
|---|---|---|
| V1- Chemically fertilized | 3260 kg/ha | 240 kg/ha |
| V2 - Rom-Agrobiofertil NP | 3680 kg/ha | 310 kg/ha |
| Production surplus | 420 kg/ ha | 70 kg/ ha |
| Growth (%) | 12.88 % | 29.16 % |

cultures mentioned above, the productions of the biologically fertilized lots were much higher than the productions of the chemically fertilized lots. Thus, the percentage of production of the biologically fertilized lot compared to the chemically fertilized lot was 12.88% (rapeseed crop) and 29.16% (phelium crop).

These increases in agricultural production have shown that the application of an organic fertilizer leads to an increase in agricultural production in relation to the products obtained from a chemically fertilized lot. Another important aspect is the action of biological fertilizer on the soil (useful bacterial fauna as well as the amount of mineral elements in the soil).

Following the application of this fertilizer on the soil, it was proved that the bacterial activity in the composition of the biological fertilizer solubilized insoluble compounds in the soil structure into soluble compounds, which led to the enrichment of the soil with mineral elements easily assimilated by plants (*table 5*).

Numerous differences as well as fluctuations in the increase and decrease of the main mineral microelements were identified between the lots arranged in the field.

Thus, from *table 5* it can be seen that the pH shows a slight increase (+3.53%). Another element is given by the decrease of humus (-8%). The decrease of organic matter in the biologically fertilized lot is due to the bacterial activity in the soil because these bacteria have an important role in the decomposition of complex compounds in the soil structure (chelated compounds).

This decomposition is a process by which insoluble compounds are converted into soluble compounds, easily assimilated by plants. The fact that on the biologically fertilized soil the amount of humus and oeganic matter has decreased, this phenomenon can be explained by growing plants and obtaining high yields.

The activity of soil bacteria has led to the recolonization of soil bacterial fauna. This recolonization brought with it a decomposition of insoluble elements in the soil. Their conversion gave the plants the essential elements they needed in their growth and development both as a plant itself but especially as a production.

A large increase in agricultural production in the biologically fertilized lot was due to the increase in the elements that the plants needed. The higher the amount of mineral elements in the soil, the higher the plants and the higher the production.

These aspects make the use of fertilizers based on bacterial cultures beneficial to be the "right choice" in agriculture, these fertilizers being compatible with the development and sustainable agriculture of agricultural crops. The present paper aims to present the effects of the action of biofertilizers on the crops to which this product was applied. From the obtained biometric data, a significant difference can be observed between the two batches, which denotes the benefits of using these types of biological fertilizers. Also, the action of these biofertilizers on the soil and, implicitly on the agricultural crops, can be observed from the differences recorded in the total

production. A large production represents a surplus for the farmer, this aspect being equivalent to a greater profit for it.

Biofertilizers are organic products, they are environmentally friendly so that they do not affect the surrounding flora or fauna.

Table 5

**Fluctuation elements identified soil analysis**

| Growth | Tests performed | | | | |
|---|---|---|---|---|---|
| | pH | Humus | Nt | $P_{AL}$ | $K_{AL}$ |
| | unit.pH | % | % | mg/kg | mg/kg |
| Lot treated vs untreated (field) | **3.53 %** | **-7.79%** | **4.67%** | **59.49 %** | **14.04 %** |
| Untreated vs. treated lot (field) | **-3.41 %** | **8.45 %** | **-4.46 %** | **-37.30 %** | **-12.31 %** |
| Treated vs. untreated lot (solar) | **0.62 %** | **-3.61 %** | **-4.32 %** | **10.64 %** | **8.96 %** |
| Untreated vs. treated lot (solar) | **-0.62 %** | **3.75 %** | **4.52 %** | **-9.62 %** | **-8.22 %** |

## CONCLUSIONS

Following the application of the organic fertilizer product Rom-Agrobiofertil NP on certain lots, in parallel with a chemical fertilizer it was proved that between the two lots were identified differences related to the height of the plants and their actual production.

Thus, the bacterial activity in the soil structure led to the acceleration of the process of decomposition of complex compounds in the soil structure as well as the solubilization of insoluble compounds in the soil into soluble compounds essential for the growth and development of crop plants. Another important aspect is the increase of the productions registered at the biological batches.

The application of biological fertilizer on the lots established within the research and development stations led to the appearance of internal processes in the soil structure. Following the mapping of the soil, it was demonstrated that the bacterial activity in the soil led to the decomposition of insoluble mineral elements in the soil into soluble elements easily assimilated by plants. The "abundance" of mineral elements in the soil structure led to the stimulation of the growth of crop plants so that the plants showed a significant increase in both height, plant material and production itself.

The most important aspect in the use of biofertilizers is the ecological soil as well as the significant reduction of environmental pollution and the improvement of the conditions in the soil structure. These innovative technologies (biofertilizers) represent a contribution in obtaining large yields, in enriching the soil with the necessary elements for the growth and development of plants but especially in recolonizing the bacterial fauna of the soil.

Another important aspect regarding the use of these products is the provision of the important elements (nitrogen, phosphorus, potassium) necessary for the growth and development of plants. These products do not pose a threat to the health of humans and animals so biofertilizers can be applied in any culture.

Based on the present article, we can say that following the application of these organic products in relation to chemical fertilizers, the biometric yields and determinations were much higher compared to the chemical batch - biological batch vs. chemical batch. Following the analyzes carried out within the ICPA Bucharest in the lots where the biofertilizer was used Rom-Agrobiofertil NP was found a decrease of the complex compounds in the soil structure, an ecology of it but especially an increase of the soil fauna. Another important aspect is the increase of the soil loosening, loosening which allows a better aeration, a bigger water retention but especially a much faster facilitation of the energy exchange between soil-plant-environment.

The use of these products in the agricultural field represents a new innovation, a new technology and the fact that farmers are beginning to use these technologies proves that in the future agriculture will become sustainable, agriculture that will ensure large, healthy, products that will not affect human health and of animals.

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## REFERENCES

**Agganni S.L. 2013 -** *Development of Biofertilizers and its Future Perspective.* Sch. Acad. J. Pharm., 2 (4): 327-332

**Chandler D., Greaves J., Prince G., Tatchell M., Bailey A**. **2012** - *Biopesticides: Pest Management and Regulation.* CABI, 2010. 256 p.

**Toader G., Chiurciu C., Chiurciu V, Burnichi F., Petre C., Chițonu P., Maierean N., Ilie L., 2019** - *Research on the action of rom-agrobiofertil np biofertilizer on agricultural crops.* In: Scientific Papers. Series A. Agronomy, Vol. LXII, No. 1, 2019. ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785.

**Toader G., Chiurciu C., Chiurciu V, Burnichi F., Petre C., Chițonu, P., Maierean N., Ilie L., Bora C., Păunescu G., 2019 -** *Research on the action of fertilizers based on bacterial cultures on some agricultural crops in Romania.* In: Agroprint timișoara: Lucrări Ştiinţifice, seria I, VOL.XXI (2). ISSN print 1453-1410; ISSN online 2069-2307.

**Toncea I., Enuţă S., Ioniţă Niţu Georgeta, Alexandrescu Daniela, Toncea V. A. 2012 -** *Manual de Agricultură Ecologică.* Cluj-Napoca, 2012. 360 p.

**Volоșciuc L.T., 2009a** - *Biotehnologia producerii şi aplicării preparatelor baculovirale în agricultura ecologică. Chişinău: Mediul ambiant*. Chișinău, 262 p.

**Volоșciuc L.T., 2009b** - *Probleme ecologice în agricultură*. Chişinău, 264 p.

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