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# RESEARCH ON THE USE OF BACTERIAL BIOPREPARATIONS IN AGRICULTURAL CROPS OF VEGETABLES

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***Key words**: Azospirillium lipoferum, Bacillus megaterium, Biofertilisers, Azotobacter chroococcum, Rom-Agrobiofertil NP*

## INTRODUCTION

The role of this article is to bring to the awareness of farmers the novelty of sustainable production systems, environmentally friendly, systems that gold the role to stop the pollution of agricultural crops as well as to convert certain agri-food waste into products intended for their use in different fields. activity. The purpose of this paper is to present and use the latest innovative technologies in the agricultural field and to replace the traditional pollutants (chemical fertilizers), so that the farmers can reach a much greater potential in relation to the registered productions.

The role of the farmer is to obtain additional profit with innovative technologies and minimal investments. At the same time, it places great emphasis on what you get, namely on plant or animal foods. In the developed countries, there is a great emphasis on sustainable development, development that involves certain technologies of plant and animal production, technologies that have the role of reducing the pollution of the environment, of ecologizing the soil and, implicitly of obtaining a big production compared to fertilizers or conventional chemicals (Patel et al., 2016).

The diversification of chemical fertilizers, their application methods and techniques for maintaining agricultural crops have led to a significant increase in environmental pollution. Thus, the excessive use of chemical fertilizers and of some old agro-zoo-veterinary technologies have caused a deterioration of the soil structure, its pollution but especially a deterioration of the soil structure as well as of both vegetable and animal production.

In order to protect the environment and the agri-food health and safety of humans and animals, the company Romvac Company S.A has developed a series of innovative technologies with the help of the farmer have obtained certain ecological products for their use in the agro-zoo-veterinary field (Sbîrciog et al., 2017).

Biofertilizers are organic products that have in their composition bacterial, fungal, or certain fungi beneficial to the soil and the environment. These products have the role of recolonizing the fauna of the soil but above all to ensure micro and macro elements of the soil structure. At the same time, the role of these products is to ensure a greater growth of plants, of plant production but especially of producing certain phytohormones (by the bacteria in its composition) in order to protect the plants from certain pests.

Biofertilizers, being in liquid form, can be applied both on the ground and in the form of autoinoculation (seed immersion) or in leaf form. After the application of these products, the microorganisms begin to do their activity so that it will lead to a growth of plants and, implicitly, of agricultural production (Sunita et al., 2018).

Rom-Agrobiofertil NP is a fertilizer based on three bacterial strains: *Azospirillium lipoferum, Azotobacter chroococcum* and *Bacillus megaterium*. Each bacterium has its own role as well as action on soil and crops.

Thus, *Azotobacter chroococcum* has the role of capturing atmospheric nitrogen on the basis of certain resources and exchanges of energy between the soil and the environment, fixing in the soil. In addition to this role, this bacterium also has the role of metabolizing phosphates in the soil, assimilating root exudates, and counteracting certain plant-damaging bacteria, existing bacteria in the soil (Levandovschi et al., 2017).

*Azospirillium lipoferum* has the role of metabolizing organic matter from soil to nutrients assimilable by plants (metabolism of cellulose, hemicellulose, lignin etc.).

At the same time, as azotobacter, azospirillium is designed to capture nitrogen in the atmosphere and to place it in the soil.

Under certain environmental and soil conditions, Azospirillum can positively influence plant growth, crop yields and N-content of the plant.

This plant stimulatory effect exerted by Azospirillum has been attributed to several mechanisms, including biological nitrogen fixation and auxin production (Steenhoudt et al., 2000).

The mode of action of Azospirillum is most probably composed of multiple mechanism. The increased use of the various biological process in soil will decisively contribute to make agriculture more productive with less harm to the environment (Attilla et al., 2010).

The last bacterium of the biofertilizator, *Bacillus megaterium*, plays a role in the decomposition of soil detriment, the solubility of insoluble phosphates from the soil into soluble phosphates, but also produces certain organic acids necessary for the growth and development of plants (lactic acid, glutamic acid etc.) and enzymes and minerals the role of acting as growth incentives for plants and agricultural production (Sbîrciog et al., 2017).

The use of these products has led to much higher yields compared to the chemically fertilized lots, but especially to the decomposition of certain complex compounds in soil structure, compounds made of phosphorus, potassium, copper or other macro-elements necessary for plant growth and development.

The use of these bacteria have the role of ensuring a supply of mineral substances necessary for the growth and development of plants as well as on soil ecological processes (Patel et al., 2016).

The research carried out on the soil within the ICPA Bucharest has proved the effectiveness of bacterial biopreparations - biofertilizers. Thus, after the concomitant application below the dose recommended by the producers, during two years it was found that certain complex compounds in its structure as well as certain microbiological processes were improved but especially these compounds were broken.

The resulting microelements were used to the maximum by the plants, which resulted in a significant growth of elements necessary for the growth and development of the plants.

## MATERIALS AND METHODS

The first research on biofertilizers of Romvac Company S.A. was carried out at a research farm in agriculture, namely Research and Development Station in Vegetables Bunzău, Research and Development Station in Vegetables Bacău and Research and Development Station in Agriculture Suceava. Within this resort, alongside Romvac collaborators Dr. Ing. Maria CĂLIN (Scientific Secretary of SSC Bacău), Dr. Biol. Floarea Burnichi (Scientific Secretary of SSC Buzău) and Dr.Ing. Cătălin Ionuț ENEA (Scientific Secretary of SSC Suceava) established the crops to which the Rom-Agrobiofertil NP biofertilizer was applied.

Thus, in May 2018 in agreement with the researchers from Research and Development Station in Vegetables Bacău established the agricultural crops to which the biofertilizer was applied Rom-Agrobiofertil NP, on the „climbing beans - Auria Bacăului", „Sweet corn – Deliciosul de Bacău" and „ Miruna garden beans".

The first tranche of Rom-Agrobiofertil NP was 5 l/ha (3 bacterial cultures x 5 = 15 l/ha) for each crop.

In April 2018 in agreement with the researchers from Research and Development Station in Vegetables Buzău, we established the agricultural crops to which the biofertilizer was applied Rom-Agrobiofertil NP on the seed cabbage „ by Buzău". The first tranche of this biofertilizator was administered at a dose of 5 l/ha (3 bacterial cultures x 5 = 15 l/ha) for each crop.

In 2018, at Research and Development Station in Agriculture Suceava it was tested the biofertilizer Rom-Agrobiofertil NP on rape and lolium culture (Rom-Agrobiofertil NP biofertilizer was administered on 5 l/ha 3 bacterial cultures x 5 = 15 l/ha dose) for each crop.

## RESULTS AND DISCUSSIONS

At he Research and Development Station in Agriculture Bacău, for each culture, it was used technological record of the culture was made, as follows:

1. Climbing beans - „**Auria Bacăului**": date of sowing - 09.05.2018. Fertilizer application phase 1 - May 16, 2018 V. treated with Rom-Agrobiofertil NP. Palisse 23.05.2018

Application Fertilizer phase ll - 07/28/2018 V treated with Rom-Agrobiofertil NP. Chemical fertilization 125 kg / ha NPK 15:15:15 + 125 kg / ha NH4NO3. 3 manual slips.

2. **„Sweet corn – Deliciosul de Bacău":** Date of sowing - 02.05.2018

Fertilizer application phase 1 - May 16, 2018 V. treated Rom-Agrobiofertil NP. Application Fertilizer phase ll - 07/28/2018 V treated Rom-Agrobiofertil NP. Chemical fertilization 150 kg / ha NPK 15:15:15 + 150 kg / ha NH4NO3.

3. **„ Miruna garden beans":** Date of sowing - 02.05.2018. Fertilizer application phase 1 - May 16, 2018 V. treated Rom-Agrobiofertil NP. Application Fertilizer phase ll - 07/28/2018 V treated Rom-Agrobiofertil NP. Chemical fertilization 100 kg / ha NPK 15:15:15 + 100 kg / ha NH4NO3. There was made a mechanical straw and two manual straws.

Following the quantitative determination of the production between the two lots (chemical fertilized vs. biological fertilized), we obtained the following results (Table 1).

Table 1. Biometric data recorded in autumn at garden beans ans sweet corn

| Lot | Garden beans „Miruna” | Sweet corn „dulce de Bacău” |
|---|---|---|
| Chemically fertilized | 1058 | 7896 |
| Biologically fertilized with Rom-Agrobiofertil NP | 1219 | 8760 |
| Lot differences kg / ha | 161 kg/ ha | 864 kg/ ha |
| Growth (%) | 15,22 % | 10,94 % |

The second research on biofertilizers of Romvac Company S.A. was made in agreement with the researchers from Research and Development Station in Lecumiculture Buzău established the agricultural crops to which the biofertilizer was applied Rom-Agrobiofertil NP on the seed cabbage „ by Buzău”.

Main features of cabbage seed „by Buzău”: The seedlings are green or purple-green. When planting, the seedling has 40 days. The height of the plant is 55-60 cm. The diameter of the rosette (with high leaves) is between 90-100 cm. The leaf is medium (27-29 cm). Base leaves: 30-35 cm high. Long petiole: 12-15 cm, with 1-3 arms. The leaf has a greenish-blue color. Shape: elongated (basal leaves) and rounded to middle leaves (upper part of rosette).

The edges of the tongue: wavy, slightly bent environments. Surface of the tongue: slightly highlighted. Diameter of cabbage head: average variation with variation limits between 23-25 cm. Head height: average variability, with limits between 17-19 cm. The shape index is between 0.7-0.9, with globular head shapes. The weight of the head varies between 2.0-3.5 kg. The head is full, covered with leaves. Position of the rosette after head formation: does not cover the head. Outer cochlea: 4-6 cm. Inner cochlea (average): 5.0-6.5 cm (Table 3).

Leaf color: yellow-white. The leaves inside the head are fine and thin. Variety: semi-late. Vegetation period: 135-140 days. Planting-maturity interval: 95-100 days. Potential: 70-80 tons / ha.

This variety of cabbage is cultivated in all parts of the country, in southern areas it is cultivated in successive culture. "Buzau" variety shows good resistance to pathogen attack. The growing period of this variety is: at maturity (130 days) 14.06-20.10 and planting - maturity (95 days) 18.07-20.10. Production destination (Table 4): a well-known and well-known variety for fine leaves, very well-suited for fresh consumption or preserved by marinating (from the leaves of this variety, from the 1950s to the 1960s, traditional sausages are prepared). Experimental variants: $V_1$ - Unfertilized (Control - Table 2, Figure 1) and $V_2$ - Rom-Agrobiofertil NP 5 l/ha (3 x 5 = 15 l - Table 2, Figures 1, 2 and 3).

Table 2. Scheme of treatment for autumn cabbage culture "by Buzău"

| Scheme of cultivation of cabbage seedlings in the field | | | | | |
|---|---|---|---|---|---|
| No. treat. | Date of application of the treatment | Applied product type | Name bacterial strain | Approved dose | The dose used |
| 1 | 4/25/2018 | Organic fertilizer<br>Organic fertilizer<br>Organic fertilizer | *Azospirillum lipoferum*<br>*Azotobacter chroococcum*<br>*Bacillus megaterium* | 5.0 l/ha<br>5.0 l/ha<br>5.0 l/ha | 5.0 l/ha<br>5.0 l/ha<br>5.0 l/ha |

Table 3. Biometric data recorded in autumn cabbage seed crop "by Buzău"

| Variant | No. of the main shells | Average length of silicone | No. of silicone / plant media | No. seed / silica medium | Average seed / plant | |
|---|---|---|---|---|---|---|
| | | | | | Nr. seeds / plant | g/pl |
| $V_1$ - Control | 21 | 6.25 | 209 | 24 | 2021 | 8.31 |
| $V_2$ - Rom-Agrobiofertil NP 5 l/ha x 3 = 15 l/ ha | 23 | 7.80 | 424 | 29 | 6564 | 44.4 |
| Growth like $V_1$ Control (%) | 9.52% | 24.8% | 102.87% | 20.83% | 224.79% | 434.3% |

Table 4. Seed production at Autumn Cabbage semicircle "by Buzau" variety, kg/ha

| Variant | Average seed yield kg/ha | Selling price/kg | Total value of the seeds lei | MMB g | Number of seeds/1 g |
|---|---|---|---|---|---|
| $V_1$ - Control | 422.46 | 500 | 211230 | 4.11 | 243.0 |
| $V_2$ - Rom-Agrobiofertil NP 5 l/ha | 1171.76 | 500 | 585880 | 6.76 | 147.8 |
| Growth like $V_1$ Control (%) | 177.4% | | 177.36% | 64.5% | -39.17% |

Figure 1. Semi-cabbage crop, "by Buzău" variety - control batch

Figure 2. Semi-sweet cabbage crop, "by Buzău" variety - fertilized with Rom-Agrobiofertil NP

Figure 3. Semi-sweet cabbage crop, "by Buzău" variety - differences between control and variant fertilized with Rom-Agrobiofertil NP

**Results obtained into the Research and Development Station in Agriculture Suceava**

Within the Research-Development Station in Suceava Agriculture, the Rom-Agrobiofertil NP biofertilizer on an area of 2 ha. Within the resort a delimitation of the batches of rapeseed and lolium crops was carried out as follows: 2 ha control batch, 2 ha chemical fertilized lot and 2 ha biological fertilized batch, both for rape and lolium cultures.

The year 2018 started against the background of a mild winter with average positive air temperatures ($1,8^0$C in January and $1,7^0$C in February), but also with rainfall that exceeded the multiannual amount for these months. The coldest month was March ($5^0$C average temperature), with absolute minimums of $-16,9^0$C and two episodes of snow days, which exceeded 40 cm.

The amount of precipitation in March was 151.2mm compared to 38.02mm the multiannual amount. Since April, the air temperature has increased a lot ($17,8^0$C average temperature) with highs of $32,9^0$C and with very little rainfall (17mm). This month the average air temperature exceeded the multi-year average for April with $7^0$C.

The increase of the air temperature due to the lack of precipitation has led to a very fast phenophase development, thus in many plant species the process of flower fertilization was affected. During the vegetation, determinations were made on the waist of the plant, the number of shoots per plant, the number of knots per plant, and at harvest were made determinations on production (the production was weighed on each variant and related to the surface unit Table 5).

Also, following the biological fertilization with the product Rom-Agrobiofertil NP, in the lolium culture very good results were obtained both as production and especially as growth. Thus, in the following figures we can observe significant growths of the plants from the lolium culture, the differences being visible between the chemically fertilized and the biological fertilized lot (Figures 4 and 5).

Table 5. Seed production at rape and lolium variety, kg/ha at the Research and Development Station in Agriculture Suceava

| Lot | Rape | Lolium |
|---|---|---|
| **Chemical fertilized lot** | 3260 kg/ha | 240 kg/ha |
| **Organic fertilized lot Rom-Agrobiofertil NP** | **3680 kg/ha** | **310 kg/ha** |
| **Lot differences kg / ha** | 420 kg/ ha | 70 kg/ ha |
| **Growth (%)** | **12,88 %** | **29,16 %** |

Figure 4. Lolium seed variety - fertilized with chemical fertiliser

Figure 5. Lolium seed variety - fertilized with biological fertiliser Rom-Agrobiofertil

## CONCLUSIONS

All of the cultures responds positively to the action of bacteria in the bio-fertilizer content of Rom-Agrobiofertil NP.

**Cabbage production**

The recorded production (production increase) is very high (177.4%), from 422.5 kg/ha to 1171.8 kg/ha. The increase in length of silicve with approx. 24.8% against the non-fertilized $V_1$ control. Increasing the number of silicas per plant to $V_2$ by 102.9% compared to $V_1$. The increase in the number of seeds on silicone in variant $V_2$ by 20.8%.

Increase of the number of seeds per plant at the variant fertilized with Rom-Agrobiofertil NP by 224.79% against the control. Increase of the weight and average seed quantity per plant, from 8.3 g/plant to $V_1$ Control to 44.4 g/plant in variant fertilized with Rom-Agrobiofertil NP. It is recommended to resume the experiment for its long-term validation. It is necessary to repeat the experiments in order to validate the results obtained and to diversify them by introducing into study other vegetable species, in order to improve the applied crop technologies and to increase the economic efficiency of the crops.

**Miruna garden beans**

It presents a positive response to Rom-Agrobiofertil NP biofertilizers. The productivity between biological fertilisation lot increase by approx. 161 kg/ ha against the chemical fertiliser. Also, the productivity between the chemical fertilised lod and biological fertilised lot was growth with 15,22 %.

Also, the plants showed a significant increase in their height, the number of leaves, the inflorescences, the fruits on the plant as well as the number of branches, which led to a significant increase of the biological fertilized lot, compared to the chemical fertilized lot.

**Sweet corn – Deliciosul de Bacău**

It presents a positive response to Rom-Agrobiofertil NP biofertilizers. The productivity between biological fertilisation lot increase by approx. 864 kg/ ha ha against the chemical fertiliser. Also, the productivity between the chemical fertilised lod and biological fertilised lot was growth with 10.96 %.

**Rape production**

Rape culture responded well to the Rom-Agrobiofertil NP biofertilizer. The plants in the batch treated with this biofertilizer showed an increase in the waist, an increase in the vegetal mass, and an inflorescence richer than the control group. The recorded production was different because three potato varieties were planted.

The productivity between biological fertilisation lot increase by approx. 420 kg/ ha against the chemical fertiliser. Also, the productivity between the chemical fertilised lod and biological fertilised lot was growth with 12.88 %.

**Lolium production**

Lolium culture responded well to the Rom-Agrobiofertil NP biofertilizer. The plants in the batch treated with this biofertilizer showed an increase in the waist, an increase in the vegetal mass, and an inflorescence richer than the control group. The recorded production was different because three potato varieties were planted.

The productivity between biological fertilisation lot increase by approx. 70 kg/ ha against the chemical fertiliser. Also, the productivity between the chemical fertilised lod and biological fertilised lot was growth with 29.16%

## ABSTRACT

This paper has the role to promote certain sustainable production systems, diversified and balanced, in order to prevent pollution of agricultural crops, the environment, the conversion of agri-food waste (whey) into veterinary medical products as well as the implementation of green, non-polluting technologies in the agricultural sector. The purpose of this work is to present and use the newest innovative technologies into the agricultural field and replace the traditional polluting products (chemical fertilizers), so that the farmers can reaches a much greater potential over the recorded productions.


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