Economic advantages of using bacterial biopreparations in agricultural crops

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ECONOMIC ADVANTAGES OF USING BACTERIAL BIOPREPARATIONS IN AGRICULTURAL CROPS

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Summary: *The ecological, genetic, biological approach proposed by agricultural specialists in order to protect plants and crops has a role in reducing the impact of pests through the process of selection and improvement of genetic resources in the processes of planting, development and introduction of biological means to combat pests in agricultural ecosystems. The strategies proposed by the specialists in the agricultural field aim not at the total extermination of the pests from the agricultural crops but at keeping the pest populations at the optimal damage threshold. The most important advantages of these biological processes are those of the evolutionary stability of the crop systems, the ecological stabilization of the pest and crop populations as well as the assurance of a superior quality of the resulting agricultural products.The present paper aims to present the main advantages of using bacterial biopreparations in agricultural ecosystems (research conducted in agricultural research stations in Romania), reducing soil pollution, environmental crops, use of alternative fertilization and cultivation technologies as well as obtaining additional, ecological productions.The aim of this paper is to present the economic advantages of using bacterial biopreparations in agricultural research and development stations, reducing costs in agriculture and the processes that these bacterial biopreparations have on the agricultural ecosystem, the environment and humans and animals.*

Keywords: *bacterial biopreparations, bioinsecticide, green fertilization technologies, economic advantages*

JEL classification: Q56, Q12, Q57.

INTRODUCTION

Every year the quality of the soil and their fertilization decreases due to the excessive use of chemical fertilizers, in increasing doses. Excessive use of chemical fertilizers has led to changes in soil structure and processes, for which the crop ecosystem suffers. A first negative aspect is the acidification of the soil. Through this negative process the pH of the soil becomes acidic fact for which the physiological systems of the plants do not adapt, the plant suffers from certain deficiencies of mineral elements and gradually, as a result of acidification of the soil, the plants dry out. Another negative aspect is the serious impact of the attack of harmful organisms that manifests itself in agricultural ecosystems, organisms that can be so different species of pests, weeds, pathogens in a proportion of approx. 30-35%. Crop losses per agricultural calendar year exceed about 60% (for all cultivated species). In order to reduce these issues, farmers need to use certain technologies so as to avoid crop losses.

MATERIAL AND METHOD

In order to prove the advantages of bacterial biopreparations, certain live bacterial cultures such as *Azotobacter chroococcum, Azospirillum lipoferum, Bacillus megaterium* and *Bacillus thuringiensis* (figures 1, 2, 3 and 4) were used for research in the research and development stations for agriculture in Romania. Following the use of bacterial biopreparations, the pedo-climatic parameters of the ecosystem within the agricultural crops, the biometric data of the crops to which bacterial biopreparations were applied, the production differences between the biologically and chemically fertilized lots and the quality of the soil, plants were followed. and agricultural products obtained. On the lots, major differences were identified both in terms of quantity of agricultural production but especially in terms of quality (soil, plant, production).

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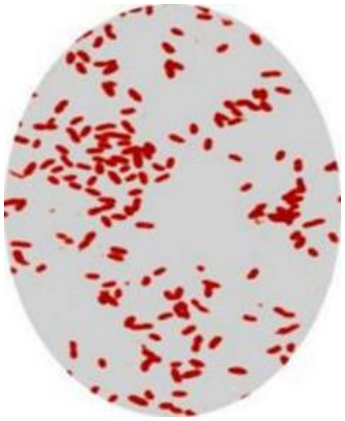

Figure 1- *Azotobacter chroococcum*

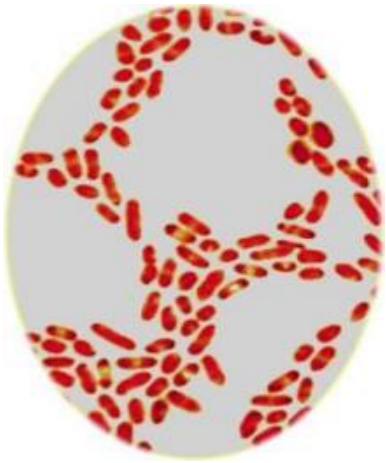

Figure 2- *Azospirillum lipoferum*

Figure 3- *Bacillus megaterium*

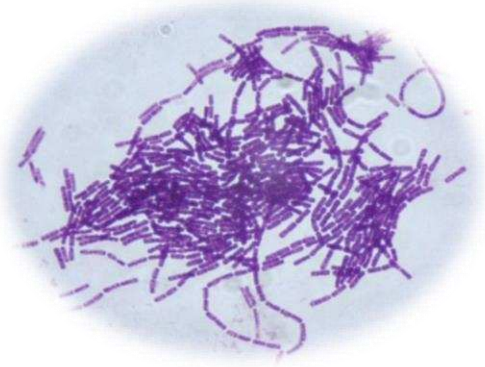

Figure 4- *Bacillus thuringiensis*

RESULTS AND DISCUSSIONS

From an optimo-economic point of view, the use of bacterial biopreparations in agricultural crops has the direct effect of increasing agricultural production by stimulating the growth and development of plants so that the yields of biologically fertilized lots will be higher than chemically fertilized lots. From the economic point of view (of the profit) for the crops tested within the research-development stations for agriculture we have the following optimo-economic situations:

1. Buzau Vegetable Research and Development Station (table 1, 2 and 3):

Table 1. "Buzău" seed cabbage cultivation

Lots	**Average seed production kg / ha**	**Sale price / kg**	**Seed price / ha**	**MMB g**	**No seeds / 1 g**
V1 – Fertilized control	422.46	300	126738	4.11	243
V2 - Rom-Agrobiofertil NP	1171.76	300	351528	6.76	147.8
Growth (%)	**177.37**	**0.00**	**177.37**	**64.48**	**-39.18**

Lot	**Total value of seeds / lei**
V1 – Fertilized control	126,738.00
V2 - Rom-Agrobiofertil NP	351,528.00
Growth (%)	**177.37**
Profit	**224,790**

Table 2. Tomato cultivation "Buzau 1600"

Lots	**No fruit / plant**	**Fruit weight (g)**	**Total seed production (kg / ha)**	**Price kg of seeds**	**Profit lei**
V1 – Fertilized control	8.4	123.9	550	1000	550000
V2 - Rom-Agrobiofertil NP	10.6	137.9	897	1000	897000
Growth (%)	**26.20%**	**11.29%**	**63.09%**	**0.00%**	**63.09%**

Lots	**Total value of seeds / lei**
V1 – Fertilized control	550,000.00
V2 - Rom-Agrobiofertil NP	897,000.00
Growth (%)	**63.09**
Profit	**347,000**

Table 3. Tomato culture "Florina 44"

Lots	**Green fruit weight / pl (kg)**	**Total fruit / plant production (kg)**	**Total number of fruits / plant**	**Total production t / ha**	**Seed quantity kg / ha**	**Profit (900 lei/kg)**
V1 – Fertilized control	1.06	1,862	25.4	78.3	1117	1005300
V2 - Rom-Agrobiofertil NP	2.1	3,351	35.55	132.6	1739	1565100
Growth (%)	**49.52%**	**79.97%**	**39.96%**	**69.27%**	**55.68**	**55.68**

Lots	**Total value of seeds / lei**
V1 – Fertilized control	1,005,300.00
V2 - Rom-Agrobiofertil NP	1,565,100.00
Growth (%)	**55.68**
Profit	**559,800**

2. Bacău Vegetable Research and Development Station (table 4):

Table 4. Corn culture ..sweet from Bacău ”/ beans“ Auria Bacăului ”

Lots	Corn ..dulce de Bacău”	Price/ kg	Profit/lei	Bean ..auria Bacăului”	Price/ kg	Profit/lei
V1 – Fertilized control	7896	50	394800	1058	100	105800
V2 - Rom-Agrobiofertil NP	8760	50	438000	1219	100	121900
Differences lots kg / ha	864 kg/ ha	0	**43200**	161 kg/ ha	0	**16100**
Growth (%)	**10.94%**	0	**10.94**	**15.22%**	0	**15.22**

Lots	**Total value of seeds / sweet corn**	**Total value of seeds / lei of golden bean beans**
V1 – Fertilized control	394,800.00	105800
V2 - Rom-Agrobiofertil NP	438,000.00	121900
Growth (%)	**10.94**	**15.22**
Profit	**43,200**	**16,100**

3. Suceava Agricultural Research-Development Station (table 5):

Table 5. Rapeseed and phleum cultivation

Lots	Rape (kg/ha)	Phelium (kg/ha)
Chemical fertilized lot (complex 16:16:16)	3260	240
Organic fertilized lot (Rom-Agrobiofertil NP)	3680	310
Growth (%)	12.88 %	29.17 %
Lot differences kg / ha	420 kg	70 kg

The economic advantages of bacterial biopreparations, compared to a chemically fertilized lot, are the sustainability of plants through the processes of decomposition of insoluble elements in the soil structure into soluble elements, easily assimilated by plants. Thus, increasing the level of soil elements leads to a significant growth of plants. A high growth of plants denotes their development by the number of shoots. A number of shoots will lead to a much larger number of inflorescences, which will lead to a larger number of fruits than a chemically fertilized lot. A higher number of fruits per plant denotes a higher amount of fruit per hectare and, implicitly, a higher total production in the organic lot compared to a chemically fertilized lot.

Direct economic advantage

Bacterial biopreparations have many more advantages over fertilizers or fertilizers and plant protection products based on chemical compounds. But the biggest advantage of using bacterial products is their economic part. From a series of comparisons by chemicals with similar action as a biological fertilizer (bacterial biopreparation) their biggest advantage is the PRICE. Thus, from table 6 we can identify a number of differences in the price of chemicals compared to bacterial biopreparations.

Table 6. Competitive advantage chemical fertilizer vs biological fertilizer (price)

Type of fertilization product	Culture of	Dose / ha	Presentation form	Total ha (bags / bottles)	Bag / bottle price (lei)	Total cost/ ha	Cost: Chemical fertilizer vs biological fertilizer/ ha	Cost: Biological fertilizer vs chemical fertilizer ha
Chemical Fertilizer (Complex 16:16:16)	Rape	300	Bag x 50 kg	6	85	510	**11.57**	**-10.37**
NPK-20-20-0	Barley and triticale	300	Bag x 50 kg	6	92	552	**20.76**	**-17.19**
NPK-15-15-15		400	Bag x 50 kg	8	95	760	**66.26**	**-39.85**
NPK-15-15-15	Corn	500	Bag x 50 kg	10	95	950	**107.83**	**-51.88**
NPK-22-10-10+B+Zn		300	Bag x 50 kg	6	80	480	**5.01**	**-4.77**
NPK-20-20-0		400	Bag x 50 kg	8	92	736	**61.01**	**-37.89**
NPK-15-15-15	Sunflower	500	Bag x 50 kg	10	95	950	**107.83**	**-51.88**
NPK-20-20-0		350	Bag x 50 kg	7	92	644	**40.89**	**-29.02**
Organic Fertilizer (Rom-Agrobiofertil NP)	All crops	15	Bottle x 10 l	3	152.37	**457.11**	0	0

In terms of (direct) economic advantage, bacterial biopreparations have a much lower price than conventional chemical fertilizers. Referring to the activity that bacteria have on the soil, we can say that to achieve or achieve the same bacterial processes in the soil, farmers must use certain products that have the same role (more or less) as chemical fertilizers. . Thus, in order to reduce costs in agriculture, specialists propose the use of these bacteria. The production of enzymes, acids, hormones by them play an important role in the agricultural ecosystem. In order to achieve the same performance with chemicals, farmers should invest a much larger amount but without knowing if they will get a higher production or, implicitly, an additional profit.

Another aspect related to the direct advantage (from an economic point of view) of fertilizers based on bacterial cultures is the application technologies. Bacterial biopreparations are recommended to be applied in the form of two treatments regardless of their form (liquid or powder). The fact that the farmer will make two treatments (one in soil preparation and one in spring) will reduce both the cost per fuel, the cost of labor, the cost of consumables (spare parts) for machinery but especially the compaction of soil by technical equipment. This aspect represents for farmers a decrease of costs by up to approx. 35% of the total expenses from the own farm.

Another economic advantage of using bacterial biopreparations in agricultural ecosystems is the surplus of mineral elements that they provide to crops. Through the activity and processes carried out in the soil structure (decomposition, solubilization, permeability, phytopathological protection, plant growth, seed material stimulation, seedling material stimulation, etc.) bacteria provide all the elements that plants need in their growth and development. As a result of these processes, farmers reduce the costs of applying phytosanitary treatments or soil, plant improvers or products to stimulate the growth and development of seed / planting material. The fact that oil benefits from a surplus of mineral elements without the application of chemical technologies represents a cost savings of about 40% for farmers.

Another aspect directly related to the reduction of the cost and the optimo-economic advantage of microorganisms is the enrichment of the soil with nitrogen. The fact that nitrogen, along with phosphorus and potassium are the basic elements of plant growth and development, with the help of bacteria farmers reduce the costs of both the purchase of nitrogen-based fertilizers but especially by reducing intervention on soil and crops. The fact that nitrogen-fixing bacteria in these biopreparations fix atmospheric nitrogen in the soil through certain processes, automatically farmers will have an economic benefit, the amounts needed to purchase nitrogen-based fertilizers can be used for other purchases or investments.

Indirect economic advantage

The use of bacterial biopreparations in agricultural crops aims to obtain much higher yields than chemically fertilized crops, a significant increase in mineral elements in the soil and greening soils containing large amounts of insoluble complex compounds by solubilizing them by bacteria used. From an economic point of view, bacterial biopreparations have much greater advantages over conventional chemical fertilizers as follows:

1. Bacterial biopreparations have the role of producing hormones, vitamins, growth stimulants that have a role in the growth and yield processes of plants. The use of combinations of bacteria and their application in agricultural ecosystems have the role of reducing the application of chemical fertilizers or chemical compounds in the form of stimulants, growth hormones, etc.

2. The use of microorganisms in agricultural ecosystems is a competitive, complex process, the bacteria used having a role in extra and intra-cellular communication to plants through certain compounds produced by the microorganism and plants so as to process the processes of consumption of mineral nutrients in the soil. to the roots of plants.

3. Production of bioactive factors: root exudates, vitamins, amino acids

3.1. Root exudates are produced exclusively by plant roots and the interaction with the activity of microorganisms in the soil structure. They represent chemical compounds based on organic acids and sugar, polyamines. These exudates have the role of stimulating root growth, increasing the activity of soil microorganisms and the production of certain types of acids such as lactic, succinic, malic, oxalic, amides, etc.

3.2. Amino acids. Compared to a chemical fertilizer, bacterial preparations have the advantage of producing certain amino acids with an important role in plant growth, stimulation of seed material (germination), stimulation of plant fruiting and (all in an ecological system based on bacterial activity in the soil and their interaction with plant roots). Among the most important acids

produced by the activity of bacterial biopreparations we mention: glutamic acid, succinic, lactic, oxalic, butyric acid, etc.

3.3. The production of growth promoters (compared to chemical fertilizers, the advantages of using bacterial biopreparations, from an economic point of view is to reduce costs. The use of microorganism products compared to a chemical fertilizer has the advantage of producing formulations with the same bacteria, in order to apply a growth stimulant or certain enzymes necessary for the growth and development of plants, farmers have to buy, in addition to chemical fertilizers and other products, which is an additional cost).

4. Production of phytohormones (phytohormones produced by the microorganism have a role in plant respiration processes, essential plant processes - photosynthesis / chemosynthesis - plant metabolism, acceleration of plant root absorption system, influence of seed germination, plant growth, height inflorescence and increasing the number of fruits per plant).

5. Production of metabolites (metabolites are biological components produced by bacteria or plants that play a role in stopping certain pests or diseases in that crop. Using a fungicidal product would mean an additional cost for the farmer).

6. Enzyme release (process by which bacterial activity based on certain enzymes and soil-bacterium-plant processes produces enzymes. In conventional crops farmers use in addition to the recommended dose of fertilizer per hectare and other products in order to produce or induce certain enzymes necessary for growth and plant development).

7. The production of antibiotics (certain species of bacteria such as Bacillus spp. have a role in the production of phenazine antibiotics, which have the role of balancing the nutrient reserves of the soil, induces a resistance of the root to certain diseases and pests, contributes to antagonistic activity against certain phytopathogens).

8.

CONCLUSIONS

The use of bacterial biopreparations in agricultural ecosystems has the role of stimulating plant growth, restoring soils affected by excessive use of chemical fertilizers, decomposition of complex compounds in soil structure, conferring insoluble matter in the soil into soluble matter, supporting the production and fruiting of plants and , amino acids with an important role in protecting plant roots and plants themselves from certain diseases or certain specific pests. The fact that bacteria lead to the activation of many processes in the soil structure, which are able to produce enzymes, proteins, acids and even the solubilization of insoluble compounds in the soil into soluble compounds, is a significant cost reduction for farmers. Purchasing products that have the same role as the processes and activity of soil microorganisms is an additional cost for a farmer, a cost that is constantly growing. The fact that farmers want to obtain large yields in order to obtain much higher profits, they will use a large amount of chemical fertilizers, in increasing quantities / doses.

By using bacteria beneficial to the soil and agricultural ecosystems, farmers reduce the costs of related chemicals because bacterial activity in organic fertilizers or bioinsecticides, biofungicides used will lead to greening (primarily) the soil, to stimulate planting material (the farmer will have to I buy a chemical = additional cost), crop plants or, implicitly, agricultural production, the farmer will have to focus on these bacterial components.

The microorganisms proposed by agricultural specialists have the role of balancing the soil balance, to ensure the nutrients that plants need in their processes and to ensure a greening of the soil by breaking down complex compounds in the soil. The fact that the farmer uses a scarification technology (plowing between 30-70 cm) so as to bring to the surface the harpoon (resulting from the compaction of the soil and the leaching of complex compounds) for him will represent an additional cost. The use of microorganisms will lead to loosening of the soil, to the decomposition of complex

compounds in the soil as well as to the destruction of the harp and obtaining a loose soil, malleable and with a much higher permeability.

Approx. 65% of Eastern Europe's agricultural land suffers from compaction. This phenomenon will lead to production losses between 15% and 35%. As a result, the farmer, with additional costs can obtain either a production enough to bring him a certain profit but also a loss caused by these aspects. Referring to this aspect, we can say that a farmer who has about 1000 ha of land cultivated with corn, wheat and soybeans the losses would be very high (table 7 and 8).

Table 7. Soil compaction- production affected

Culture of	**Harvest tons / ha**	**€/ tone**	**Profit/ha**	**Loss per harvest per 1000 ha**		
				15%	**25%**	**35%**
Grain	5	€ 150	€ 750	€ 113	€ 188	€ 263
Corn	7	€ 140	€ 980	€ 147	€ 245	€ 343
Soya	2.2	€ 330	€ 726	€ 109	€ 182	€ 254

Table 8. Soil compaction-yield reduction

Culture of	**Harvest tons / ha**	**€/ tone**	**Profit/ha**	**Loss per harvest per 1000 ha**		
				15%	**25%**	**35%**
Grain	5000	€ 150	€ 750	€ 113,000	€ 188,000	€ 263,000
Corn	7000	€ 140	€ 980	€ 147,000	€ 245,000	€ 343,000
Soya	2200	€ 330	€ 726	€ 109,000	€ 182,000	€ 254,000

As a result, the use of bacterial cultures has the role of restoring the soil structure, stimulating the seed material in the soil, stimulating the planting material or seedlings in the respective agricultural ecosystem, decomposing complex compounds into soluble forms, easily assimilated by plants. These processes carried out by soil bacteria lead to increased farm yield processes, reduced costs, increased production and, consequently, a large increase in income. Thus, microorganisms used in agricultural crops have a beneficial role both for the ecosystem itself, but especially for the "pockets" of farmers, in their "fight to reduce costs."

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