New generation mineral fertilizers promoted by biologically active additives

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INTRODUCTION

The characteristics of innovative microbiologically enriched fertilizer products which have specific properties in stimulating the growth and yielding of crop plants were presented. The intensive research on development of environmentally friendly techniques for plant cultivation which would optimize fertilization process of cultivated plant has been carried out for many years. One of the fastest-growing and most promising fields of fertilizer industry is the use of fertilizers biologically enriched with additives that is with appropriately selected bacteria or fungi. Bacteria have a positive effect not only on soil environment, but they also stimulate the growth and development of plants directly and indirectly by increasing bioavailability of necessary nutrients. The microbiologically enhanced fertilizers supply micro and macro elements necessary for growth and life activity, whereas the presence of active microorganisms supports mechanism which improves soil fertility. They protect plants, improve and change the quality of soil ensuring the recovery of natural fertility and biological environment.

PROJECT DESCRIPTION

In the Łukasiewicz Research Network- New Chemical Syntheses Institute, the grant "Development of innovative technology of microbiologically enriched mineral fertilizers" Acronym BIO-FERTIL BIOSTRATEG3 / 347464/5 / NCBR / 2017 is being implemented. The aim of the project is to develop a technology for the production of innovative microbiologically enriched mineral fertilizers and to evaluate the effects of their application in plant cultivation as well as to evaluate the microbiological stimulation of soil fertility and productivity. The project is organized into 6 work packages: WP1 - Production technology of microbiologically enriched fertilizers, WP2 - Effectiveness of biofertilizers in improving bio-physico-chemical properties of degraded and agricultural soils, WP3 - Effect of biofertilizers on growth and yield of horticultural plants and on soil microbiology, WP4 - Effect of biofertilizers on growth and yield of arable crop plants and on improving soil fertility, WP5 - Assessment of the impact of biofertilizer use on water potential and macro- and microelement content in the soil and plants, WP6 - Preparation for implementation, dissemination and commercialization of research results and newly developed biofertilizers. (Fig. 1). The newly developed bio-fertilizers are created by combining simple fertilizers: nitrogen and phosphorus and complex fertilizers (NPK) with carriers and beneficial microorganisms with a biostimulating and protective effect. Specially designed carriers of beneficial microorganisms, devoid of harmful substances, enable the maintenance of high numbers and survival of beneficial microorganisms in bio-fertilizers. Useful microorganisms from the SYMBIO BANK of the Institute of Horticulture in Skierniewice and new species isolated from the rhizosphere of the studied plants were used for the microbiological enrichment of mineral fertilizers. SBL-INS in cooperation with the Institute of Horticulture and Grupa Azoty Zakłady Azotowe "Puławy" S.A. develops a technology for the production of batches of microbiologically enriched fertilizers necessary for field experiments. The batches of microbiologically enriched fertilizers for field trials were produced at INS on a semi-technical scale.

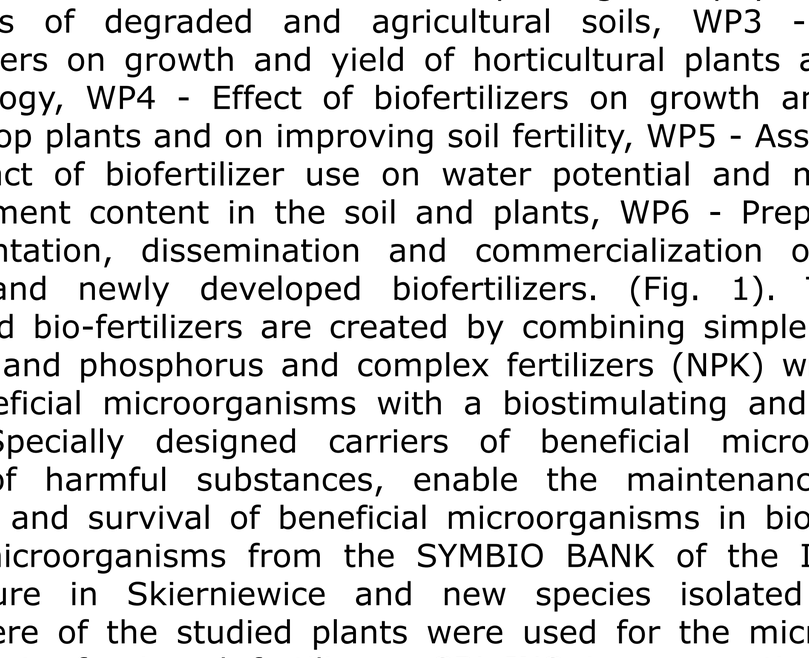

Fig. 1 Workpackages structure

TECHNOLOGY OF OBTAINING MICROBIOLOGICALLY ENRICHED FERTILIZERS

The technological scheme is shown in Fig. 2. The technology consists in coating fertilizers with a binder and microorganisms in the granulation drum. The main operations are: heating the granulate, its coating, cooling after coating. Polyethylene glycol PEG-4000 was selected as the binder material for the production of bio-fertilizers. It is a compound that has a number of advantages, such as: low melting point, low toxicity to humans and animals, harmless to microorganisms, high water solubility wide range of products with different melting points widespread availability in industrial quantities and low price.

Fig. 2 Installation 1/2 technical scale for the production of microbiologically enriched fertilizers

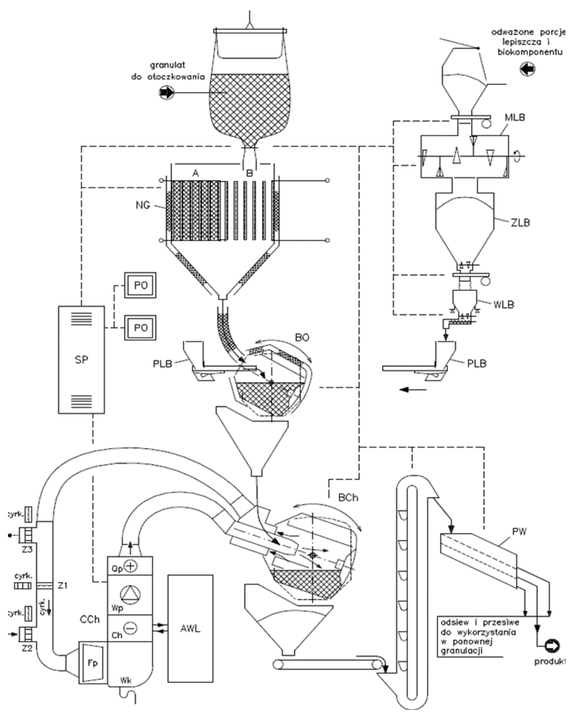

Fig. 3 Diagram of an installation for the production of microbiologically enriched fertilizers

Fig. 4 Results of field experiments - maize fertilized with fertilizer and microbially enriched fertilizer.

CONCLUSION

- The production of biofertilizers by the method of coating the mineral fertilizer granules with an external layer containing a neutral carrier seems to be the most appropriate direction for the production of this type of products.
- During the production process, it is advantageous to use low temperatures and to avoid using water as much as possible, because in the presence of moisture, especially at elevated temperatures, as during drying, rapid growth of live bacteria from their spore forms took place.
- It is also beneficial to physically separate the bacteria from the fertilizer granules, so that they are not exposed to high local concentrations of mineral salts formed during the dissolution of the fertilizer in the soil under the influence of moisture. Diversification of the dissolution rate of both these layers by creating a readily soluble outer coating containing microorganisms may favourably affect the effectiveness of the use of biofertilizers.
- In the further stage of research, the quality of the coatings should be improved by modifying their composition or production method, with particular emphasis on the high survival rate of microorganisms and physical properties of the final products.
- Moreover, the biofertilizer application on maize at field trials carried out in 2018-2020 show the positive effects on its production.

ACKNOWLEDGMENT

Grant financed by the National Center for Research and Development BIO-FERTIL BIOSTRATEG3 / 347464/5 / NCBR / 2017.