Acronym: BIOSOYCOAT

Project title: Development of innovative biodegradable soybean seed coating based on biopolymers from renewable raw materials for better tolerance of plants to adverse environmental conditions

Funding: National Centre for Research and Development, programme BIOSTRATEG

Project number: BIOSTRATEG3/346390/4/NCBR/2017

Duration of the project: from 2017-04-01 to 2020-06-30

Project coordinator: dr inż. Ewa Kopania

Coordinator institution: Łukasiewicz Research Network - Institute of Biopolymers and Chemical Fibres

Partner institutions: Institute of Soil Science and Plant Cultivation – State Research Institute (IUNG-PIB), University of Rzeszów, Naukowo Badawcze Centrum Rozwoju Soi AgeSoya Sp. z o.o.

Principal investigator at IUNG-PIB: dr Grażyna Korbecka-Glinka

Description of the results of the project:

The aim of the project was to develop biodegradable and environmentally friendly seed coating based on renewable biopolymer compositions, protecting soybean seeds against adverse weather conditions. Low temperature of the soil affects the sown seeds by extending the germination process thereby making the seedlings more vulnerable to infections by soil-borne pathogenic fungi. Therefore, this project aimed at developing a seed coating which would show a high mechanical integrity in low temperatures and prevent beginning of the germination process in unfavourable conditions.

Several two-layer compositions were prepared using polymers or mixtures of polymers with vaxes. These compositions contained natural polymers from the group of polysaccharides with high bioactivity. The compositions selected for soybean seed coating showed suitable chemical, physical and rheological properties and also the desired thermal performance. Applying them on the seeds has led to obtaining homogenous seed coatings with a thickness of 3-5µm. The protective effect of the seed coatings was verified by germination tests of the coated and uncoated seeds in the controlled conditions. It was also confirmed that the selected coatings are biodegradable in a process of microbiological decomposition in soil environment. In addition, life cycle assessment (LCA) was performed for the developed seed coatings.

The effectiveness of the new seed coatings was verified in the field experiments in which emergence, growth dynamics of plants and occurrence of plant diseases were monitored. Initially, these experiments included seven soybean cultivars provided by “AgeSoya” company (cultivars: Annushka, Atlanta, Lajma, Madlen, Mavka, Smuglyanka, Violetta) and three versions of seed coatings. Then, in a large-scale field experiment, cultivar Annushka and the most effective version of seed coating was used. In this experiment, effect of seed coating was compared for organic and conventional farming system. The conclusion of this experiment was that the seed coating contributes to higher emergence and yield in both farming systems. Project implementation is carried out by „AgeSoya” company and it will be done by launching the production and sale of the coated soybean seeds.

The outcomes of Biosoycoat project include also data on resistance of soybean cultivars and breeding lines which was assessed in inoculation tests with fungal pathogens. Moreover, in the field experiments, monitoring of pests and diseases was performed. In addition, a comparison of the influence of different, commercially available bacterial inoculants on soybean yield was studied. These research tasks provided data for scientific publications and agricultural practice.

Patent

Patent no. 242700 granted by the Patent Office of the Republic of Poland for invention entitled “The method of preparation of the protective coating on soybean seeds”

Selected publications:

Olszak-Przybyś, H.; Korbecka-Glinka, G.; Patkowska, E. 2023. Identification and pathogenicity of *Fusarium* isolated from soybean in Poland. Pathogens. 12, 1162. https://doi.org/10.3390/pathogens12091162

Jarecki W. 2021. Soybean Response to Seed Coating with Chitosan + Alginate/PEG and/or Inoculation. Agronomy. 11(9): 1737. https://doi.org/10.3390/agronomy11091737

Jarecki W., Wietecha J. 2021. Effect of seed coating on the yield of soybean *Glycine max* (L.) Merr. Plant, Soil and Environment. 67(8): 468–473. https://doi.org/10.17221/246/2021-PSE

Olszak-Przybyś, H.; Korbecka-Glinka, G.; Czubacka, A.; Patkowska, E. 2021. Identification of fungi inhabiting underground plant parts of soybean [*Glycine max* (L.) Merrill] in two developmental stages Acta Scientiarum Polonorum Hortorum Cultus 20 (5): 139-149. https://doi.org/10.24326/asphc.2021.5.13

Korbecka-Glinka, G.; Wiśniewska-Wrona, M.; Kopania, E. 2021. The use of natural polymers for treatments enhancing sowing material. POLIMERY. 66, 11-20 (in Polish, abstract in English). https://doi.org/10.14314/polimery.2021.1.2

Jarecki, W. 2020. Reaction of soybean [*Glycine max* (L.) Merr.] to seed inoculation with *Bradyrhizobium japonicum* bacteria. Plant, Soil and Environment. 66, 242-247. https://doi.org/10.17221/201/2020-pse

Jarecki, W.; Buczek, J.; Jańczak-Pieniążek, M. 2020. Soybean (*Glycine max* (L.) Merr.) response to commercial inoculation with *Bradyrhizobium japonicum*. Applied Ecology and Environmental Research. 18, 6713-6724. https://doi.org/10.15666/aeer/1805_67136724

Jarecki, W.; Bobrecka-Jamro, D. 2019. Influence of seed inoculation with commercial bacterial inoculants (*Bradyrhizobium japonicum*) on growth and yield of soybean. Legume Research. 42(5), 688-693. https://doi.org/10.18805/lr-485

Wiśniewska-Wrona, M.; Pałys, B.; Jagodzińska, S.; Korbecka-Glinka, G.; Czubacka, A.; Skomra, U.; Doroszewska, T.; Monich, R.; Koba, L.; Skórka M.; Bobrecka-Jamro, D.; Jarecki, W. 2019. Opracowanie innowacyjnej otoczki nasion soi w celu zwiększenia tolerancji roślin na niekorzystne warunki środowiskowe. Biuletyn Instytutu Hodowli i Aklimatyzacji Roślin. 285, 179-180. https://doi.org/10.37317/biul-2019-0000

Jarecki, W.; Bobrecka-Jamro, D.; Monich, R.; Kopania E.; Korbecka-Glinka G. 2019. Porównanie przebiegu wegetacji roślin oraz wielkość i jakość plonu nasion wybranych odmian soi. Biuletyn Instytutu Hodowli i Aklimatyzacji Roślin. 285, 59-60. https://doi.org/10.37317/biul-2019-0000

Awards and distinctions:

Special award from Macao Innovation and Invention Association (MIIA) , HRVATSKI SALON INOVACIJA INTERNATIONAL INVENTION SHOW Zagreb, Croatia, November, 2020

Golden medal for invention “Method of preparation of the protective cover on soybean seeds” received on International Invention Show INOVA CORATIA in November 2020.

CERTIFICATE of Achievement - Gold Award awarded by E-INNOVATE Virtual Innovation Fair, Poland