New soil improvement products for reducing the pollution of soils and waters and revitalizing the soil ecosystem

The Layman’s Report

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Beneficiaries:
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For more information, see:
http://biorewit.inhort.pl/index.html

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Background and aims of the project BIOREWIT

Agriculture, by using environmental resources in the production process, is perceived as one of the main sources of environmental pollution. Intensive agricultural production is associated with a wide use of many manufactured inputs such as mineral fertilizers and pesticides. Excessive intensification of agriculture, based on agrochemical products, which eliminates organic fertilizers from production, with a concurrent increase in the number of cultivation treatments, has led in many developed countries of the EU to significant pollution and degradation of the natural environment. A threat to the natural environment is also posed by intensive greenhouse production, based on the widespread cultivation of soilless crops, concentrated in relatively small areas. Excess fertilizer solutions from these crops are discharged outside, directly into the soil or drainage water, and the growing medium is mineral wool that does not undergo natural decomposition. After the completion of cultivation, it becomes a waste material difficult to utilize, and is disposed of in landfills. The aim of the project BIOREWIT is to counteract the adverse impact of agriculture on the environment by reducing the pollution of the soil and groundwater, and by revitalizing the soil ecosystem. This objective will be achieved by the introduction into horticultural production of a new generation of organic fertilizers and non-woven materials, and biodegradable growing substrates for soilless greenhouse production, as well as by using organic matter from spent greenhouse substrates for fertilizing fields, and fertilizer runoff from greenhouses for the production of organo-mineral fertilizers for field-grown crops.

Threats to soils and waters

Degradation of the soil ecosystem manifests itself in the deterioration of physical and chemical properties of the soil, decrease in organic matter and humus contents, acidification and biological impoverishment, and a greater risk of soil mass loss as a result of erosion caused by wind and water. The lowering of the levels of organic matter and humus in the soil is contributed to by the reduction in the amount of crop residues left in the field, omission of organic fertilization, increase in the mineralization of organic matter due to intensive soil cultivation and aeration, and the decomposition of humus caused by the use of physiologically acidic fertilizers and reduction in the activity of soil microflora under the influence of mineral fertilization. The consequence of the decreasing amounts of organic matter in the soil has been the increased leaching of mineral components into the deeper layers of the soil, and then into the groundwater, watercourses, lakes and rivers, which contributes to eutrophication and depletion of the oxygen supply, thus adversely affecting the flora and fauna in water reservoirs. In many European countries there has been an observable increase in the pollution of the groundwater and rivers with nitrogen and phosphorus. Acidification of the soil disrupts the proper uptake of nutrients by plants, reduces the availability of calcium, magnesium and potassium, releases from the sorption complex harmful components, such as aluminium, and increases the mobility and availability to plants of heavy metals (lead, cadmium, mercury, chromium, arsenic). Acidified soils are considered to be chemically degraded, in which beneficial microorganisms and bacteria die.
Project objectives

The aim of the project BIOREWIT was to develop technologies for the production of modern soil eco-activators for horticultural field crops, and soilless substrates for greenhouse production, and to apply them in practice in order to reduce soil and water pollution and revitalize the soil system. The implementation of the project included:

1. Development of technologies for the production and use in horticultural crops of the following soil eco-activators:

- Pelleted organic fertilizers of plant origin (from the biomass of leguminous plants) and of plant-animal origin (from the biomass of legumes and waste raw fleece) that can be used at any time during the growing season and on any vegetable species
- Biodegradable organic fleece for horticultural crops, whose production is based on the use of waste raw materials from the textile industry, enriched with plant biomass rich in nitrogen
- Organic growing substrates for greenhouse crops, utilizing waste raw materials from the textile industry, that help to reduce greenhouse production on non-biodegradable mineral wool substrates
- Organo-mineral fertilizers from waste raw plant materials (straw, flax shives, sawdust) subjected to impregnation with low-concentration drainage water from greenhouse crops
- Organo-mineral fertilizers from waste raw plant materials (straw, flax shives, sawdust) subjected to impregnation with low-concentration nitric acid and pH neutralization with aqueous ammonia

Products and technologies used

- Production of pelleted organic fertilizers
- Production of biodegradable fleece
- Production of substrates for greenhouse crops
2. **Design and construction of prototype equipment and installations for the production of innovative soil eco-activators:**

- a line for the production of pelleted organic fertilizers, including the drying of the raw material, grinding, treatment, mixing, wetting and pelletizing.
- a line for the production of consolidated flat non-woven products, including bulk delivery of the raw material, combing, stacking, charging with powdery raw plant material, needle punch consolidation, and calendering (pressing)
- automated unit for the production of cultivation mats for soilless greenhouse crops, including pretreatment of the textile raw material and other components, weighing and mixing of the raw materials, forming a layer and slicing it, packaging individual mats in plastic foil
- equipment for processing used growing substrates into organic fertilizer, including the removal of foil from mats, breaking up and loosening the substrate, packaging
- installations and equipment for the production of organo-mineral fertilizers by impregnating organic matter (straw, flax shives, sawdust) with low-concentration drainage water from soilless crops. The installation includes the preparation of the basic raw material (breaking up, defibering, fractionation, and drying) and impregnating (soaking) it with drainage water
- installations and equipment for the production of organo-mineral fertilizers by impregnating waste raw plant materials (straw, flax shives, sawdust) with low-concentration nitric acid. The installation includes preparation of the basic raw material (breaking up, defibering, fractionation, and drying) and impregnating (soaking) it with nitric acid, and neutralizing the fertilizer pH with aqueous ammonia.
PRODUCTS OF THE PROJECT BIOREWIT – SOIL ECO-ACTIVATORS

The project has developed a number of environmentally friendly products, called soil eco-activators, and relevant production technologies that utilize organic waste raw materials generated by the textile industry and dried organic matter from nitrogen-rich leguminous plants.

❖ PELLETED ORGANIC FERTILIZERS

Suitable for all types of horticultural production (organic, integrated, home gardens and allotments); can be used for growing vegetables, flowers, ornamental shrubs, orchards, berry plantations, and lawns. These fertilizers are safe to crops, people and animals, easy to use for pre-plant applications and top dressing. They improve soil fertility and increase the activity of beneficial soil microflora, releasing nutrients gradually, in a balanced way.

- **Ekofert K** and **Ekofert L** (plant-derived fertilizers) – produced from suitably treated plant biomass of red clover and alfalfa harvested during the plant development stage, which guarantees a high nutrient content
- **Fertilan K** and **Fertilan L** (plant- and animal-derived fertilizers) – produced from biomass of leguminous plants (clover or alfalfa), enriched with the addition of waste raw fleece; fertilizers with an elevated nitrogen content.

❖ ORGANO-MINERAL FERTILIZERS

The production of new organo-mineral fertilizers is based on the utilization of organic waste from greenhouse production, agriculture and the timber industry. These are fertilizers with a loose structure, environmentally friendly, inherently biodegradable.

- **FertiVeg** – produced from used BIOPOT organic substrate, after the end of the growing season in greenhouse production; fertilizer of high nitrogen content
- **Agrofert S-DW** – obtained by impregnating straw with drainage water from soilless greenhouse production
- **Agrofert S-N** – obtained by impregnating straw with a solution of nitric acid and aqueous ammonia to neutralize the pH
BIODEGRADABLE ORGANIC AGROFLEECE

- **Covelana K** and **Covelana L**
  Produced from organic waste raw materials of the textile industry, enriched during the technological process with nitrogen-rich plant material (dried clover or alfalfa)

GROWING SUBSTRATE - BIOPOT

Biodegradable organic substrate for soilless greenhouse cultivation. Made from waste sheep wool and cotton with the addition of brown coal, defibered sawdust and flax shives. Retains good physical and chemical properties throughout the period of cultivation and is an alternative to mineral rockwool. Environmentally friendly – no problems with utilization after the completion of cultivation.

Certificates and patents obtained for eco-activators:

**Certificates**
- Quality label “Gwarantowana jakość” (Quality guaranteed) for the fertilizers Fertilan K and Fertilan L, the substrate BIOPOT, and the fleece products Covelana K and Covelana L
- Quality mark ‘Q’ for Fertilan K and Fertilan L, the substrate BIOPOT, and the agrofleece products Covelana K and Covelana L
- Symbol confirming the suitability of the product for organic production for the fertilizers Ekofert K and Ekofert L
- Ecological label – “Eko-znak” (Eco-label) for the fertilizers Ekofert K and Ekofert L.

**Patents**
- for the substrate BIOPOT – Patent No. 213622
- for the biodegradable fleece Covelana – Patent No. 215009
Certificates:

- Quality label
  “Gwarantowana jakość”
  (Quality guaranteed)
- Suitability for organic production
- Quality mark “Q”
- Ecological label – “Eko-znak”

**PROTOTYPE EQUIPMENT FOR THE PRODUCTION OF ECO-ACTIVATORS**

- Technological line for the production of pelleted organic fertilizers – used for the production of Ekofert and Fertilan
- Technological line for the production of fertilizer from used biodegradable greenhouse substrates (FertiVeg)
- Technological lines for the production of loose organo-mineral fertilizers (Agrofert S-DW and Agrofert S-N)
- Technological line for the production of biodegradable substrate for soilless cultivation in greenhouses
- Technological line for the production of biodegradable organic fleece (Covelana)

**IMPLEMENTATION OF THE PRODUCTS DEVELOPED UNDER THE PROJECT BIOREWIT**

Industrial-scale production of biodegradable substrates for soilless cultivation of plants in greenhouses, biodegradable fleece and organic fertilizers was undertaken by the companies Golab S.A. and Poltops Sp. z o.o. headquartered in Żagań, ulica Dworcowa 45. These companies are engaged in the production and sale of finished and semi-finished products from wool. The production process generates a lot of waste wool, which can be used to produce biodegradable substrates and biodegradable non-woven fabrics, as well as additions to organic fertilizers, enriching them with nitrogen. The company Golab S.A. applied to the Institute of Horticulture for the sale of Patent No. 213622 ‘Multi-layer growing substrate and equipment for forming a multi-layer growing substrate’, while the company Poltops Sp. z o.o. purchased Patent No. 215009 ‘Biodegradable fleece for use in agrotechnology’. On the basis of the agreement between the parties, the PCBC certificates for the products developed under the project were transferred to these companies. Recently, the two companies have purchased production machines, and requested the Ministry of Agriculture and Rural Development to authorize the organic fertilizers and biodegradable fleece products for sale.
While being implemented, the project Biorewit was promoted among a wide circle of recipients. The background and objectives of its activities were presented, as well as production and environmental benefits resulting from the use of the newly developed soil eco-activators.

- A website was created and updated regularly: www.biorewit.inhort.pl/index.htm

- The effectiveness of the eco-activators was tested in experiments conducted at the Institute of Horticulture and Demonstration Organic Farm in Chwałowice. The results obtained were used for perfecting the technologies used to produce them.

- The results of the activities being conducted were presented at training sessions and demonstrations for manufacturers, agricultural advisors, and students of agricultural universities.

- The results of the work in progress were presented at conferences and domestic (Skierneiwce, Warszawa, Gołuchów, Kielce, Bydgoszcz, Puszczykowo) and foreign (Athens, Ghent, Zagreb, Nuremberg, Nitra) trade fairs.

- A number of scientific and popular-science publications, training materials, leaflets and posters were prepared and published. The results of the project were also systematically presented in electronic form as multimedia presentations and videos. A few interviews to the press were also given.

Dissemination of project achievements

- Presentation of the results on the Biorewit and EcoWeb websites

- Training sessions, demonstrations, meetings with stakeholders

- Presentation of the results at conferences and trade fairs

- Training and information materials, brochures

- Demonstration of experiments conducted at the Institute of Horticulture and Demonstration Organic Farm in Chwałowice
**Benefits to the natural environment**

- Reduction in the pollution of soil, groundwater and watercourses with mineral components of agricultural origin as a result of the gradual replacement of synthetic mineral fertilizers with organic eco-activators.
- Reduction in the emissions to the environment of unused mineral components with drainage waters from soilless greenhouse cultivation and the consequent significant reduction in the eutrophication of groundwater, watercourses, lakes and rivers.
- Constant enrichment of the soil with organic matter and increase in organic carbon in the soil as a result of using the innovative soil eco-activators produced from plant or plant-animal organic matter, including:
  - organic fertilizers (a- from the biomass of legumes, b- from plant biomass and waste raw fleece)
  - organo-mineral fertilizers (a- from used biodegradable substrates from soilless cultivation, b- from waste plant biomass, enriched with greenhouse runoff, c- from waste plant biomass, impregnated with nitric acid and aqueous ammonia)
  - organic, biodegradable fleece for soil mulching.
- Increase in soil water holding capacity by 30% resulting from the use of soil eco-activators and doubling of the period in which soil moisture losses reach a critical level for plants.
- Increased share of small-seed legumes in the crop structure, valuable to the environment and the soil ecosystem, resulting from their use as raw material for the production of pelleted organic fertilizers.
- Reduction in the amounts of used non-biodegradable mineral wool substrates disposed of in landfills.
- Improvement in the quality of food as a result of eliminating the risk of over-fertilization of crop plants with nitrogen and accumulation of harmful nitrates in agricultural produce.