

As a result of ever-increasing human pressure on the environment, many areas around the world are endangered by pollution; some have even been declared environmental disaster zones. In many countries ways and means are being sought not only to prevent the contamination of the environment and of food, but also to restore degraded land. The factor mainly responsible for the degradation of the environment, and soils in particular, is the 'progress of civilisation' (industry, transport, agriculture based on artificial fertilisers and pesticides) as well as the irrational management of environmental resources and waste products. All of this has led to:

- a deterioration in landscape quality,
- the pollution of ground and surface waters,
- a reduction in soil fertility.

Moreover, heavy metal levels have risen in most farming areas, which has caused the quality of food products and human health to deteriorate. That is why the recultivation of degraded land is taking on greater significance, and consumers and farmers in developed countries are increasingly interested in organic farming methods, which aim to eliminate harmful chemicals. The development of new technologies and investigations into the efficacy of existing technologies for reclaiming degraded land have been in progress all over the world for many years now. But traditional land restoration technologies are both expensive and time-consuming; in addition, they often require the application of other chemicals that are usually far from neutral towards either the abiotic environment or living organisms. The search therefore continues for more effective and economic technologies. One of these is **phytoremediation**, in which specially selected plants, capable of accumulating large quantities of heavy metals, are cultivated on degraded land, rendering these contaminants harmless.

The results of investigations into the bioactive compounds contained in white cabbage, carried out at the Faculty of Chemistry (Gdańsk University of Technology), have encouraged our partners in the AGROBIOKAP project to develop a technology for utilising white cabbage as a plant suitable for the phytoremediation of degraded land and for biofumigation. The overriding objectives of the project – to encourage the development of organic farming, to optimise the restoration of degraded land and to reduce the intensity of human pressure – are thereby being pursued.

The project tasks have been allocated to the partners on the basis of their experience gained so far within AGROBIOKAP and are as follows:

Gdańsk University of Technology

- analytical research to ascertain the effect of the conditions under which cabbages are grown on their content of bioactive compounds and their bioaccumulation of heavy metals,
- statistical workup of measurement results,
- development of methods for managing the wastes generated by the production of the biopreparation.

Institute of Industrial Chemistry

- development of a technology for obtaining the biopreparation in accordance with industrial requirements.

Agricultural University

- development of a research programme to examine the physiology of cabbage grown under different conditions,
- development of a cabbage cultivation technology.

The research tasks will seek to assess the possibilities of utilising cabbage as a hyperaccumulator in phytoremediation and as a starting material for manufacturing a product for the biofumigation of agricultural and horticultural crops.

To evaluate the phytoextractional properties of cabbage, three types of crop will be used:

- **A control crop in a phytotron**, where the soil will be deliberately contaminated with known amounts of heavy metals (cadmium and zinc) in order to achieve the concentrations typical of moderate and high soil pollution levels,
- **Cultivation in areas** subject to different levels of human pressure, where cabbage will be grown under controlled conditions from seedlings obtained from a known, reliable source,
- **Plantations**, where cabbage has been grown for several years; these are natural models of experimental plots, which can supply information on the efficacy of the phytoremediation of typical fields.

Cabbages will be harvested and soil samples collected from all three crop types in order to assess heavy metal levels. This part of the project aims to evaluate the usefulness of cabbage for the phytoremediation of soils with elevated metal levels, for example, for preparing land to be given over to organic farming and for the restoration of degraded land. This will enable the right conditions for guaranteeing an appropriate plant biomass increment to be established.

The second part of the project will involve investigating the usefulness of cabbage as a raw material for the production of a **biopreparation** that could serve to biofumigate the soil, and to develop an efficient, environmentally friendly technology for obtaining it on an industrial scale in such a way as to maximise the biomass from harvested cabbages.

Sorption techniques will be used to obtain a biopreparation of a suitable chemical composition, and the raw material will be the juices obtained from cabbages harvested from land that is undergoing phytoremediation to remove heavy metals from the soil. The development of the technology for producing this biopreparation will go hand in hand with a detailed assessment of its quality. First of all, its ability to resist or kill soil microorganisms causing certain plant diseases, which could significantly affect its quality, will be evaluated. Then, it will be tested with respect to the contents of environmental contaminants, like heavy metals, nitrates (III and V), and organic compounds (PAHs and PCBs), so that the technological parameters will guarantee the complete removal of harmful substances from the biopreparation. Analytical studies will also be carried out to determine the content of bioactive substances from among the decomposition products of glucosinolates and antioxidants in the plant raw material and the biopreparation, the composition and content of which will affect the biological activity of the biopreparation. Moreover, the toxicity of increasing amounts of the biopreparation to human cells will be assessed in cultures; this may be a measure of the content of bioactive substances, but on the other hand, it may supply information on the possible harmfulness of the biopreparation to human health, which would enable appropriate recommendations to be formulated for its users.



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INNOVATIVE ECONOMY
NATIONAL COHESION STRATEGY

EUROPEAN UNION
EUROPEAN REGIONAL
DEVELOPMENT FUND



The exploitation of white cabbage for phytoremediation and biofumigation of soils (AGROBIOKAP)

Priority axis:

1. Research and development of novel technologies

Action:

1.3. Support for R+D projects carried out by scientific institutions on behalf of industrial companies

Sub-action:

1.3.1. Development projects

No. of project:

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