

HABILITATION THESIS

Contribution to the recent research advances in plant stress physiology

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HABILITATION THESIS

ABSTRACT

This thesis summarizes the research activity of the candidate after defending the PhD Thesis at Babes-Bolyai University, confirmed by The Ministry of Education, on the basis of Order no. 000536, dated 15.02.1996.

The research activity and achievements presented here are in the field of plant stress physiology, continuing and diversifying with new subjects, the topic of the PhD Thesis.

It should be mentioned that the activity of the candidate in the field of plant stress physiology (26 years of research in this field), from the beginning, from October 1988, until the defending of PhD Thesis, and for the post-thesis period, is in line with the fields of research of Babes-Bolyai University.

The new subjects of research in the post-thesis period can be related to the following aspects:

- Changes in macronutrient uptake induced by interactions between metals; sub-optimal supply of nitrogen and phosphorus affecting metabolism of phosphorus, starch, glucose and fructose content, growth and nitrate distribution in the plant organs.
- Assessment of metal toxicity using plant water status and yield components (harvest index, grain yield and biomass) as stress indicators, and assessment of remediating efficiency of maize used for phytoremediation of polymetal-contaminated soils;
- Evaluation of the stress of the vegetation in mining areas (Rosia Montana), considering soil characteristics related to pH and heavy metal load and development of new models of environmental monitoring, combining satellite remote sensing, and aerial lightweight measurements with the ground sampling.
- Effects of shielded magnetic fields and microgravity on the main physiological processes of plants: cell viability, nitrogen accumulation, growth, germination rate, and photosynthesis.
- Cellular ultrastructure and biochemical changes produced by shielded magnetic field:

microtubules distribution, dispersal of amyloplasts, assimilatory pigments protein content, and nitrogenase activity.

The main achievements and results are presented in detail in Chapter (II.1): *Scientific, professional and academic achievements*. More than 35 papers have been published in this direction.

In what concerns the future research and development plans of the candidate, related to the fields presented above, the following two topics will continue or will be developed.

The first research topic consists of:

- Developing an automated module for plant cultivation technologies compatible with currently developed rack-like prototypes based on plants, consisting of water and nutrient management system, a lighting system, combining a variety of monochromatic lights, specifically tailored to plant requirements, adapted to different plant species in different stages of the life cycle that may provide an optimum growth, a cooling system needed for the thermal stabilization of the module and for the management of gases, monitoring and preventing contamination of the module and of the harvested plants.
- Miniaturization through development of module components and measurement technologies concerning temperature, radiation, gas concentration and humidity.
- Selection of robust plant varieties having high nutritional values, exhibiting high yields, high resistance and short life cycle.

Developed technologies will be on-ground preparatory activity for future space exploration providing an advanced process control through the design and validation of automated equipments for adjusting the quality of nutrient solutions, lightening, cooling system, and warning in case of biological stress or anytime when the operational stability of the module is affected.

The second research topic is related to the effects of microgravity on biological structures, intending to test the following hypotheses: (1) microgravity is perceived by cells as a stress factor which alters metabolic pathways and lowers the energy pools; (2) extracellular ATP serves as a stress related signal molecule in plant cells.

Contributions from the research on ATP and pyrophosphate as the main energetic molecules of plant cells, more particularly on their link with membrane-bound marker enzymes (V-ATPase and P-ATPase) and methods for identification of enzymes involved in carbohydrate metabolism, on phosphate group transfer and enzymes which serve as sensitive indicators of the presence of toxic compounds in biological samples will be integrated.

A short description of topic has been done in Chapter (II-2): *Scientific, professional and academic future development prospects.*