ABSTRACT

Keywords: *electromagnetic field, electromagnetic monitoring, apple rootstock, rooting stimulation, thermal imagers*

Thesis entitled "***Study of physiological processes apple species using electromagnetic monitoring systems***" describes the conduct of complex experiments that have been identified, proposed, designed, developed and used this type of systems.

The aim of the thesis is to identify, propose, design, develop and deploy systems for monitoring physiological processes characteristic of the different stages of plant development in apple species in areas defined spectrum electromagnetic field observation and data collection or analysis and their interpretation of the evolution of these physiological processes caused by the influence of external factors of electromagnetic nature and/or environment.

The experimental results and technological base (mainly electronics) conceived, produced and used in the experiments during doctoral studies emphasizes the importance and usefulness of electromagnetic fields in our relationship with representatives of apple species. Electromagnetic fields affect the quality of our information and observation submitted subject. In this interaction nature (magnetic or electric), the frequency or intensity of field use, are key sizes. Observations are made daily related natural visible and its surroundings area: infrared and ultraviolet are extremely tempting.

The doctoral thesis "*Study of physiological processes apple species using electromagnetic monitoring systems*" is divided into six chapters, followed by bibliography and a number of 3 annexes.

Each chapter presents application monitoring physiological processes using electromagnetic fields, with features related to either band of the electromagnetic spectrum in which to work in monitoring physiological process be supervised either by the nature of the stimuli used.

Chapter II aims to monitor growth and fruiting of apple varieties by stills taken regularly visible and processed using appropriate software.

The biological material consisted of five varieties of apple with two repetitions each: Luna, generous, Topaz, Goldrush and Fujion.

The method consisted in taking regular frames for each of the 10 trees studied, image processing with specialized software for mechanical design and manufacturing CAD-CAM for drawing data processing and interpretation.

The results highlighted using statistical methods (regression, correlation coefficient, determination coefficient, analysis of variance unifactorial and variance multifactorial) shows the evolution laws processes geometric growth while diameters, sections and volumes for each of the trees and varieties subject monitoring. A highly significant correlation was found between increased fruit diameter and standard trunk diameter 100 cm above the ground, causing conclusions on the use of measuring the level of the trunk at a height of 100 cm for characterization of growth indices. A film of seasonal evolution is achieved using a process Morphism.

Using electromagnetic field monitoring leads naturally to the question of the degree of influence the subject being observation. Schumann frequency is a strong bond benchmark by which they exert on metabolism beings on planet earth: its lack of an environment to produce serious disturbances, initially observed in space missions. But her presence at an intensity of 10 or 100 times the natural magnetic field determines?

For this question attempt to obtain a response by monitoring the magnetic field measurement techniques using magnetic field induction in the extremely low frequency (3-300) Hz. To study the effect of the magnetic field imposed the problem of generating a uniform magnetic field as a defined volume of samples subjected to maintaining the experience of having controllable and stable frequency and intensity over time. The result of this research is presented in Chapters III and V.

Chapter III covers monitoring of apple rootstock cuttings rooting in the frames alternating magnetic field periodically taken in the visible and processed using appropriate software. The biological material used was to a group of 4 rootstock apple rootstocks consisting of CG16, CG13, M9 and B9. Experimental equipment used was designed and built specifically for this type of stimulation.

The method consisted in taking regular frames for each of the 120 apple rootstock, distributed into 3 groups differentiated by the magnetic field to which they were exposed. They have been used extensively by 0 mt, 0.5 mt and 4.0 mt, for an electromagnetic field having a frequency of 10 Hz.

Image processing was conducted both by specialized software for mechanical design and manufacturing CAD-CAM data for drawing and conversion programs Winmorph morphic type.

The results highlighted using statistical methods and analysis of variance unifactorial multifactorial variance shows that:

- Influences rootstock very significant changes in the number of roots: the best of the lot is tested rootstock B9 (VD), followed in order rootstocks CG16 (VA), M9 (VC), CG13 (VB);

- Very significantly influence the magnetic field strength; the order is V2 (4.0 mT), V1 (0.5 mT), V0 (0.0 mT);
- Interaction affects significantly distinct: CG16 couples (VAxV1), M9 (VCxV2), B9 (VD xV2), CG16 (VAxV2), B9 (VDxV1), M9 (VCxV1).

The results after 90 days of continuous testing were worth the effort: some cuttings primordial density increased compared to control samples up to 300%.

Chapter IV aims electromagnetic monitoring rooting in cuttings dry apple rootstock on a technology platform with basal heating.

The biological material consisted of different rootstock varieties. The technical platform was built specifically. The method used was based on the technology and equipment sold by the company FLIR being used 640SC and software FLIR FLIR room QUICK PITCH 1.2. The results show that infrared monitoring method used in biological research, our application as proof. Infrared photographs taken and processed b / w and color containing detailed information on thermal field of rootstock studied temperature set points assessed precisely observer. The monitoring results are remarkable, but the lack of air cooling system in experimental space temperatures reversed, causing the plant compromised. Electromagnetic method proposed monitoring revealed the experimental results and the evolution of plants under environmental data.

Chapter V aims to monitor rooting green apple rootstock in the frames alternating magnetic field periodically taken in the visible and processed using appropriate software. The biological material used was to a group of 10 apple rootstocks CG11, CG23, CG16, CG41, B9, M9, M26, and M106. Experimental equipment used was designed and built specifically for this type of stimulation. A magnetic generator in a digital component-based design ensures high precision and good stability signal 3-300 Hz frequency band, with a field strength of up to 10 mT. The application of electromagnetic fields was done by systems of Helmholtz coils and Maxwell plane type, designed and built for magnetic field strengths more than 100 times the natural.

The method consisted in taking periodic frames of apple rootstock, distributed into 3 groups differentiated by the magnetic field to which they were exposed. They have been used extensively to 0 mT, 0.5 mT and 4 mT, electromagnetic field having a frequency of 10 Hz. Image processing was performed by specialized software for mechanical design and manufacturing CAD-CAM (SolidWorks).

The results proved apparatus and method ability to achieve the objective of monitoring the process of rooting cuttings green apple rootstocks in the frames alternating magnetic field periodically taken in the visible and processed using appropriate software. The experiment

conducted in hot summer conditions had a dramatic end and disappearance of plants after prolonged exposure to temperatures close to 50 ° C, the method of acquisition and interpretation of experimental data showing it.

Chapter VI presents original contributions made by way interdisciplinary approach to the subjects of the experiments monitored by electromagnetic means, combining the use of the measuring parameters stimuli spectral range electromagnetic fields of extremely low frequency in the visible and infrared using photographic equipment and use of software in the field of mechanics (SolidWorks) or specialized (ANOVA) for analysis and interpretation of monitoring results.

Another original contribution is the realization of electronic equipment that enabled the generation of magnetic field extremely low frequency as a stimulus on the rooting of cuttings Apple and constitute a technological basis for the development of complex experiments on the evolution of plants in all stages of development from the stage of germination. The great value of this contribution has been confirmed by the jury awarding the International Exhibition of Inventions PROINVENT 2015 patent application relating to electromagnetic stimulation of plant rooting cuttings and method of use.

The thesis contains 231 pages, 141 figures and 46 tables.

Recovery of experience and information obtained in this research was realized by publishing articles (accepted for publication), among which:

1. Velcea M, Mihailescu B., 2014 Minilab for evaluating the influence of electromagnetic field over "in vitro cultures". IEEE 20th International Symposium for Design and Technology in Electronic Packaging (SIITME) 978-1-4799-6962-3, IEEE 227, Bucharest, Romania.
2. Velcea M, Ganea I., 2014. The experimental structure for Investigation of Influencing factors in plant biotechnology. ISB-INMA Bucharest, pp. 605-610.
3. Velcea M. Stan F., Peticilă A., 2015 Rooting stimulation of apple rootstocks uniform electromagnetic field Using year. International Conference Agriculture for Life, Life for Agriculture, Veterinary Medicine Bucharest.
4. Mihailescu B., M. and Plotog Velcea I., 2015 Comparative assessment of Maxwell and Helmholtz coils for magnetic field biotechnological applications. 21th IEEE International Symposium for Design and Technology in Electronic Packaging (accepted for publication)

Another 14 works of the author are published in the Web of Science.

There have been published so far 21 other books and 23 articles in the ”List of works” published with the author/coauthor Marian Velcea.

The general conclusions:

1. Experimental facilities have been designed and made especially for this study; they were functioning at the proposed ability to achieve outstanding results (i.e. a primordial density increase for some cuttings have increased compared to control samples up to 300%, according to chapter II). Originality plant cuttings rooting stimulation was assessed by awarding appropriate application of the invention.

2. The method developed and tested in each of the experiments described and performed has shown the ability to solve specific objectives magnetic fields monitoring of physiological processes apple species. Development of aerial photographs matrix method by replacing the 3D data obtained by scanning with the laser beam may be a refining step thereof immediately.

Continued research is a requirement of the current trend assessment ever increasing interference field and extended the artificial components with biological structures, chances of finding practical solutions to possible adverse economic interaction.