

INTEGRATED SYSTEM FOR OBTAINING EXTRACTS ACTING AS BIOFERTILIZERS / FOLIAR BIOINSECTICIDES IN ORGANIC FARMING

Iulian VOICEA¹, Valentin VLĂDUȚ¹, Mihai MATACHE¹, Cătălin PERSU¹, Dan CUJBESCU¹, Nicoleta UNGUREANU²

¹ INMA Bucharest, voicea_iulian@yahoo

² University "POLITEHNICA" Bucharest

Abstract: The EXT BIO equipment (experimental model) for obtaining organic biofertilizers / bioinsecticides works on the principle of extracting bioactive substances under the action of variable hydrostatic pressure in the extraction vessel, with control of solvent temperature. In order to optimally control the extraction process it is used a microPLC with graphic interface, through which you the working parameters can be programmed. Hydrostatic pressure in the extraction chamber is obtained by means of a pneumatic cylinder supplied with compressed air by a compressor which is part of the integrated extraction system. All components are mounted on a frame consisting of V profiles.

Keywords: EXT BIO, bioactive substances, hydrostatic pressure, extraction.

1. Introduction

Global energy crisis and sharp price rises of raw materials led to a determined passage to the production and use of some types of fertilizers and insecticides which are less industrially processed, with reduced energy consumption, of liquid type. Countries practicing an intensive farming had the trend that still exists, of strong growth in the share of liquid fertilizers at the expense of solid, energy-intensive ones. The extension on a larger scale of fertilization by liquid fertilizers was determined by their technical and economic benefits, [1]. Using liquid fertilizers allows full mechanization and automation of all operations of transport, storage, handling and management, eliminating losses almost completely, while ensuring a high degree of uniformity in the application and a close supervision of recommended doses, [2].

Worldwide, a new and strong requirement appeared, which was turned into a real movement in the U.E. to obtain food products through clean, non-polluting technologies, without chemicals. Product quality is assessed taking into consideration several characteristics, the most important being the physical, chemical and technological ones. Organic farming puts a special emphasis on hygienic, ecological and biological quality of the obtained products, [3].

Organic farming promotes the sustainable production systems, diversified and balanced, in order to prevent the pollution of crop and environment. Organic production in crops, without the use of harmful traditional products, knows a special concern for some decades in economically developed countries. The interest in organic products and production is also growing in our country, [4]. Unfortunately, areas cultivated in ecological conditions in our country are still very low. In order to expand the organic farming system in Romania, were established national legal regulations on the production, processing and capitalization of organic agri-food products, in line with international standards in this regard. Among these, are included: Government Emergency Ordinance no. 34/2000, respectively Law no. 38/2001; Government Decision. no. 917/2001 for approval of the methodological norms for the application of these regulations (including annexes to the methodological norms) etc, [5].

Crop technologies are developed in the spirit of these regulations, economically efficient and non-polluting, preventing environmental deterioration and maintaining the fundamental resources of agriculture. It is recommended to place crop rotation on plots converted to organic farming, to the best precursory, some which also improve soil fertility (such as leguminous plants and green manure), to use only fertilizers allowed in organic farming, the so-called *biofertilizers*, and to

exclude all pesticides that pollute the crops and environment through the use of *bioinsecticides* of vegetable nature, [6]. Thus, in the context of practicing an organic farming, is prohibited the use of chemical fertilizers to improve production quality. The use of *biofertilizers* is an environmentally friendly alternative to the classic one, that can lead to the obtaining of high productivity organic crops. Applying these biofertilizers can be done foliarly, with very high absorption coefficient by the plants. Foliar fertilization consists in applying any fertilizing substance in liquid form on the leaves. Fertilizing elements in this case are in solution, soluble, and thus very accesible to plants. This is in contrast with the application of fertilizers (in solid form) on the soil, and which are usually applied in granulated, dry form. They need to be dissolved, either by irrigation or by watering after a rain, to be available to the plants by the root system. In other words, it should be dissolved in soil solution to be accessible to plants, [7].

2. Chapter 1

The EXTBIO experimental model for obtaining organic fertilizers / insecticides (Fig. 1) comprises in the following subassemblies: frame; extraction container; compressor; system for monitoring and control of the extraction process; recirculation pump and solenoid valves; double-piston cylinder; distributor, controler and pneumatic filter; shell heater with thermostat; Pt100 resistance thermometer; pressure transducer; container for solvent loading and container for unloading the finished product.



Fig. 1. Experimental model for obtaining organic fertilizers / insecticides, EXTBIO

The system of monitoring and control of the extraction process (Fig. 5) consists of the following components: microPLC AL 2 – 14 MR – D with extension of analog outputs AL2-2DA, interface module RS232 AL2-GSM-CAB and signal adapter Pt100 AL2-2PT-ADP, operating terminal GT1050 – QBBD with GT01-C10R4-8P connection cable, 24Vcc power supply in switching type PSU 50, bipolar safety C32, Omron relays block, metal box, safety button, rail, metal transom, Φ 1.5 mm – 20 ml supply cable, 3x1.5 mm – 10 ml supply cable. The system of monitoring and control receives information from the Pt100 temperature sensor, pressure sensor and graphical interface with the user represented by operating terminal and send commands to the execution elements of the integrated extraction system: solenoid valves, circulation pump, double-piston cylinder, compressor, pressure controller and heating jacket.

The program installed in PLC allows the control of the following components: compressor, heating jacket, recirculation pumps, solenoid valves, pneumatic distributor, pressure controller. The reference values of the working parameters can be set by the user using the operating terminal.

The equipment consists of the following circuits:

1. pneumatic circuit: from the compressor to the pneumatic cylinder.
2. hydraulic circuit: from the filling container, to the extraction container, the unloading container and the hydraulic cylinder.
3. electrical circuit: for compressor drive, PLC, the terminal for operating the pneumatic distributor, pressure controler and heating mantle.

Double-piston cylinder, with piston diameter of mm, stroke 125 mm and maximum working pressure of 10 bar is presented in Figure 2.

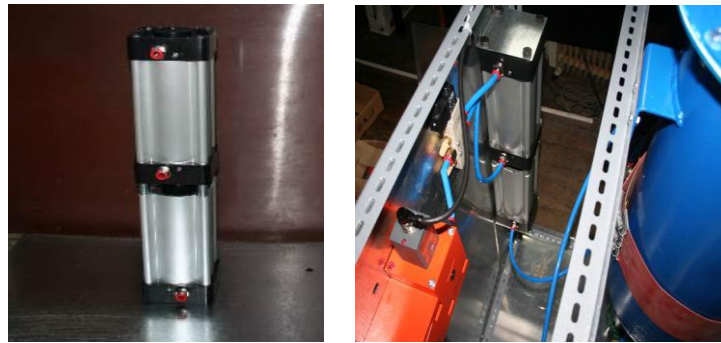


Fig. 2. Double-piston cylinder

The cylinder is equipped with double piston and is included in two circuits: pneumatic and hydraulic circuits of the EXT BIO integrated extraction system. Thus, the force obtained by the compressed air provided from the compressor at an adjustable pressure acting on the piston 1 is converted to the hydrostatic pressure by means of piston 2 of the cylinder that is placed in connection with the extraction container.

The Metal Work **pneumatic distributor**, type 702002110, with maximum working pressure of 10 bar, coil voltage 24 Vcc, Metal Work **pneumatic controller and filter** (maximum working pressure 11 bar, maximum working temperature 50°C) are presented in Figure 3.



Fig. 3. Pneumatic distributor, pneumatic controller and filter Metal Work

3. Equations, Figures, Graphs and Tables

The EXT BIO experimental model for obtaining extracts with active principles, having the role of organic foliar fertilizer / insecticide, with application in organic farming is an efficient system for the extraction of active constituents in plants, herbs, fruits, flowers, leaves, fruits, bulbs, seeds, bark, roots, stems, of aromatic, culinary, medicinal herbs etc. The extraction cycle alternates, a dynamic phase obtained through a programmed pressure with a static phase to transfer the extract in the solvent, while the circulation of solvent in countercurrent is performed during the high-pressure extraction cycles.

In microPLC found in the endowment of the monitoring and control system of the EXT BIO experimental model it has developed a control software of the integrated extraction system that sets the parameters of the following process (parameters) of extraction, according to Figures 4 and 5: extraction time: 5600 seconds; high pressure of extraction: 8.7 bar; low pressure of extraction: 1.25 bar; number of cycles at high pressure: 5 cycles; number of cycles at low pressure with quasi-dynamic variation of pressure between 0 and 1.25 bar: 5 cycles, each with 5 quasi-dynamic cycles; duration of high pressure cycle: 600 seconds; duration of low pressure cycle: 520 seconds with the duration of a quasi-dynamic cycle of 40 seconds, pause of 80 seconds before and after high-pressure cycle and pause of 40 seconds between the quasi-dynamic cycles of low pressure;; extraction temperature: 37 °C; countercurrent circulation of the solvent during the high pressure cycle (Fig. 5).

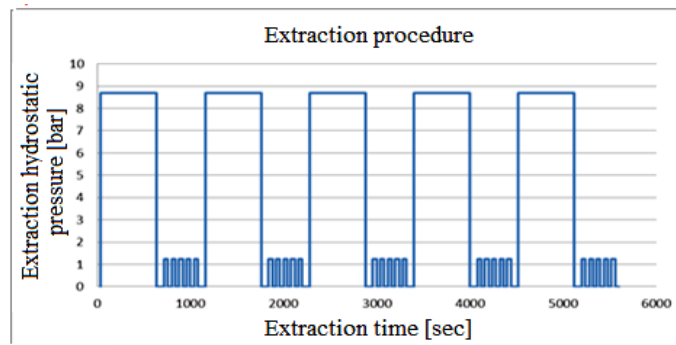


Fig. 4. Representation of the extraction process

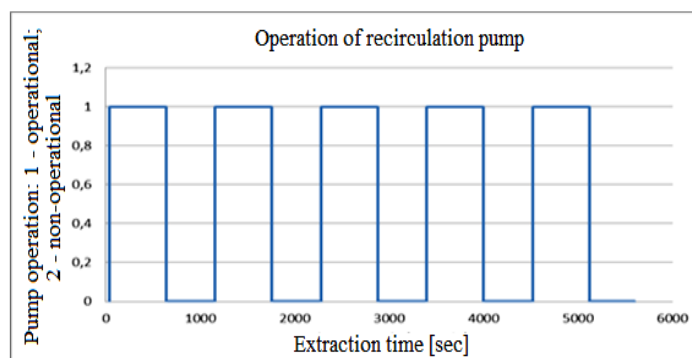


Fig. 5. Operation of recirculation pump

4. Conclusions

For the experiment were used as raw material the following plants: tobacco in order to obtain an extract with bioactive substances acting as foliar bioinsecticides, and nettle to obtain an extract with bioactive substances acting as foliar biofertilizers. The solvent used in the testing was microbiologically pure water, obtained in the Chemistry laboratory of the INMA Bucharest. By testing of the EXT BIO experimental model, have resulted two extracts (products): nettle extract with bioactive substances acting as biofertilizers and tobacco extract with bioactive substances acting as bioinsecticides, presented in Figure 6.



Fig. 6. Nettle extract (foliar biofertilizer) and tobacco extract (foliar bioinsecticide)

The mass of the dry raw material subjected to the extraction process was of 1 kg, moisture of the sample subjected to the extraction process was of 8.75% for tobacco and 9.10% for nettle. The degree of extraction of active ingredients from tobacco was 32.75%, and the degree of extraction of active ingredients from nettle was 33.33%. Given the obtained results, it can be concluded that the realized extraction system, EXT BIO, as well as the identified process have allowed obtaining optimum extraction yields.

References

- [1] K.S. Arun, "Bio-fertilizers for sustainable agriculture", Mechanism of P-solubilization, Agribios Publishers, Jodhpur, India, pp.196-197, 2007;
- [2] A. Hossein, S. Sanne, M. Hossein, D. Ben, De M. Philippe, F. Witloxa, "Organic agriculture and sustainable food production system: Main potentials", Agriculture, Ecosystems and Environment 144, pag. 92–94, 2011;
- [3] A. Pruteanu, A. Muscalu, I. Voicea, M. Ferdes, "Current stage of experimental research on extraction of biologic active substances from medicinal and aromatic plants / Stadiul actual al cercetarilor experimentale privind extractia substantelor biologic active din plante medicinale si aromatice", Revista INMATEH Agricultural Engineering, Volume 44 / No. 3 / 2014;
- [4] C. Popescu, A. Pruteanu, I. Voicea, B. Ivancu, I. Găgeanu, V. Vlăduț, "Study regarding biochemical characterization and some preparations from nettle and wormwood in order to capitalize them as bioinsecticide / biofertilizers in organic agriculture", *SCIENTIFIC SYMPOSIUM WITH INTERNATIONAL PARTICIPATION „SUSTAINABLE DEVELOPMENT IN AGRICULTURE AND HORTICULTURE- Second edition” Craiova, 13-14 November 2014 ISSN 1841-8317, ISSN CD-ROM 2066-950X*;
- [5] D.J. Mishra, S. Rajvir, U.K. Mishra, S.S. Kumar, "Role of bio-fertilizer in organic agriculture: a review", Research Journal of Recent Sciences, Vol. 2(ISC-2013), pp.39-41, 2013;
- [6] L. A. Swapna, "Development of Bio-Fertilizers and its Future Perspective", Scholars Academic Journal of Pharmacy (SAJP) ISSN 2320-4206, Sch. Acad. J. Pharm., 2013; 2(4):327-332;
- [7] K. Vilku, R. Mawson, L. Simons, D. Bates, "A review Bio-Fertilizers for Organic Agriculture", Innovative Food Science and Emerging Technologies 9, 2008.