



STATEMENT

About the PhD thesis for the acquiring of academic and educational degree
"Doctor" in:

Field of higher education 4. Natural sciences, Mathematics and Informatics

Code of professional field 4.4. Earth sciences

Scientific area 'Ecology and ecosystems conservation'

Author of PhD thesis: Dessislava Gospodinova Angelova

Part-time PhD student at the Department of Microbiology and Ecological Biotechnologies

Title (theme) of the PhD thesis: Utilization of sludge from wastewater treatment plants by composting and vermicomposting

Reviewer: Assoc. Prof. Dr. Ekaterina Georgieva Valcheva

Department of Agroecology and Environmental Protection, Agricultural University – Plovdiv

Field of higher education 4. Natural sciences, Mathematics and Informatics

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appointed a member of the Scientific Jury by order № RD-16-1173 / 20.10.2021 by the Rector of the Agricultural University.

1. Actuality of the problem.

Sludge from wastewater treatment plants (WWTP) is becoming an increasingly valuable resource. They are obtained as a result of the process of wastewater treatment. Sludges contain recyclable ingredients and hazardous substances, usually heavy metals, organic pollutants and pathogens. The utilization of WWTP sludge in agriculture poses risks to the environment. Once imported in the environment, heavy metals accumulate in the soil or infiltrate deeply and can also cause contamination of surface and groundwater bodies. Taking the path of recovery, sludge must be treated in a way that makes it a product suitable for use in agriculture. An in-depth study of the possibilities for utilization of sludge in agriculture after composting has not been carried out in Bulgaria. In this context, the problem developed in the dissertation is relevant in scientific and applied aspect.

2. Aim, tasks, hypotheses and research methods.

The aim of the PhD thesis is clearly and precisely formulated. Four specific tasks have been defined and performed, which correspond to the chosen topic and the main goal of the study.

A well-planned methodological part is presented for the successful realization of the set goal and tasks.

"Material and methods" section is methodically properly structured. The steps and conditions for conducting the experiments are described in detail: composting, vermicomposting, testing the influence of composts and vermicomposts on experimental plants. Methods for mathematical and statistical data processing are also applied.

3. Visualization and presentation of the obtained results.

The presented PhD thesis is a purposeful research work that complements and expands the knowledge about the utilization of WWTP sludge.

It is formed according to the adopted classical model including 273 pages, and the illustration and presentation of the results is done through 97 figures, 38 tables and a list of abbreviations used.

The structure of the PhD thesis is well balanced, as the "Literature review" section is 49 pages, "Material and methods" section - 25 pages, "Results and discussion" section - 160 pages, "Conclusion and main findings" section - 4 pages.

4. Discussion of the results and literature used.

The obtained results are summarized and analyzed correctly and in depth, in a good scientific style. In their interpretation, the sequence of the presented problem in the literature review is followed. This in turn helped the PhD student to accurately and clearly describe the implementation of the main goal and objectives of the study. The discussion of the results obtained shows an in-depth knowledge of the issue. Sum of 481 literature references are listed, 9 of them in Cyrillic and 472 in Latin.

5. Contributions to the dissertation.

The following contributions of the PhD thesis can be pointed out as the most significant:

Scientific contributions

- For the first time in Bulgaria a comprehensive study of the treatment of WWTP sludge by composting and vermicomposting was made.
- Models for utilization of WWTP sludge in agriculture, landscaping and reclamation of disturbed terrains have been prepared.
- An approach to reduce the concentration of heavy metals arising from WWTP sludge in joint treatment has been established, allowing to obtain a final product meeting the requirements set out in the Bulgarian Regulation norm on separate collection of biowaste and treatment of biodegradable waste (2017).
- An approach to reduce the loss of organogenic elements in the final products has been established by returning the infiltrate to the system by dew (in sludge with low content of heavy metals).

Scientific and applied contributions

- An improvement in the technology of vermicomposting has been made including the use of composters instead of the so-called "beds".
- The effect of the principles of the circular economy is clearly demonstrated through the recycling of production waste and its conversion into final products compost and vermicompost applied in agriculture.
- The developed technology for recycling of WWTP sludge was applied in partnership with ViK-Plovdiv at the place of formation of sludge - in WWTP-Hissarya, WWTP-Sopot and WWTP-Karlovo. As a result, the composted sludge amounts to about 1050 t per year, and the obtained in-situ vermicomposts meet the requirements for compost product set in the Bulgarian Regulation Norm on separate collection of biowaste and treatment of biodegradable waste (2017) and are used as quality complex fertilizer for maintaining green areas.

6. Critical remarks and questions.

I have no critical remarks or questions to the doctoral student.

Published articles and citations.

Revealing the results obtained in PhD thesis, 4 scientific articles have been published in reputable and indexed journals. All publications are co-authored, as in 3 of them the PhD student the first author, which emphasizes her leading role. Any citations of the published articles are not found. The total number of points is 50, which exceed the national minimum requirements for the academic and educational degree "Doctor", according to the Regulations for applications of the law for development of the academic staff in the Republic of Bulgaria. The presented autoreferat (published summary) of the PhD thesis objectively reflects the structure and content of the dissertation.

CONCLUSION:

Based on the learned and applied different research methods, correctly performed experiments, summaries and conclusions made by the PhD student, I believe that the presented PhD thesis meets the requirements of the Law for development of the academic staff in Bulgaria and the Regulations of the Agricultural University for its application, which gives me reason to rate it **POSITIVELY**.

I allow myself to suggest to the esteemed Scientific Jury also to vote positively / negatively and to award / not to award to **Dessislava Gospodinova Angelova** the academic and educational degree "Doctor" in Scientific area "Ecology and ecosystems conservation".

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Plovdiv City, Bulgaria

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