STATEMENT REVIEW

on a dissertation for obtaining a educational-scientific degree "doctor" (PhD) in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.4. Earth Sciences, scientific specialty "Ecology and Ecosystem Conservation".

Author of the dissertation: IVELINA DIMITROVA NEIKOVA, PhD student at the Department of Microbiology and Environmental Biotechnology at the Agricultural University, Plovdiv.

Topic of the dissertation: "Phytoremediation of heavy metals in contaminated soil through composts and beneficial microorganisms in vegetable crops".

Reviewer: Assoc. Prof. Ivelin Aldinov Mollov, PhD, University of Plovdiv "Paisii Hilendarski", Faculty of Biology, Department of Ecology and Environmental Conservation (field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.3. Biological Sciences, scientific specialty "Ecology and Ecosystems Conservation"), appointed as member of the scientific jury by order № RD-16-611 / 31.05.2022 by the Rector of AU.

1. Relevance of the problem.

The problem considered in the dissertation is extremely relevant, as one of the most useful approaches related to the purification of the environment from the accumulation of heavy metals in the soil is phytoremediation. This biotechnology has many advantages, such as the relatively small resources and support it requires and the ability to be applied on site at the time of research. From this point of view, the dissertation is not only a purely scientific, but also an applied contribution.

2. Purpose, tasks, hypotheses and research methods.

The goal and the tasks are well formulated and set correctly and reflect the topics indicated in the title of the dissertation. The research was conducted according to a modern and adequate, well-developed methodology, correctly applied, which allows the achievement of the set goal and the solution of the tasks. Microorganisms tolerant to heavy metals, stimulating the growth of the vegetable plants used in the experiments (radishes, spinach and peas), which were grown in contaminated soils with Cd, Pb and Zn, were isolated. The obtained results are appropriately processed by means of mathematical methods and statistical analysis.

3. Visualization and presentation of the obtained results.

The results presented in the dissertation work follow the logical sequence and correspond to the set goal and tasks. They are presented on 200 pages, illustrated with the help of 29 tables and 61 figures, which also present the results

of statistical data processing. The presented results are completely sufficient in terms of volume and discussed and analyzed in detail.

4. Discussion of the results and used literature.

The obtained results show that spinach, peas and radishes can be successfully used for phytoremediation of soils contaminated with heavy metals. The introduction of compost leads to an increase in the supply of soils with nitrogen, phosphorus and organic matter, and the introduction of compost leads to a significant reduction in the accumulation of heavy metals in the biomass of vegetable crops. The strongest accumulation is observed in spinach. There is a direct relationship between the concentration of heavy metals in the soil and their accumulation in plants. It is most pronounced in cadmium and to a lesser extent in zinc and lead.

A total of 14 conclusions have been formulated, which also follow the set goals and objectives and correctly reflect the results obtained.

The literature used in the dissertation numbers 508 titles (506 in Latin and 2 in Cyrillic). The literature review is detailed and adequately reflects what has been done so far on the issues of the dissertation.

5. Contributions to the dissertation.

The contributions of the dissertation can be grouped into three categories: **scientific contributions** - a comprehensive scientific study is conducted on the influence of compost and populations of beneficial bacteria on the development, growth and accumulation of heavy metals in spinach, peas and radishes, as well as soil research microbial communities based on their metabolic profile in phytostabilization of soils contaminated with heavy metals; **scientific and applied contributions:** the introduction of compost in soil contaminated with heavy metals leads to the improvement of the overall condition of the studied vegetable plants; improvement of the development of soil microbial communities and reduction of the concentration of bioavailable fractions of heavy metals as a result of compost application have been shown; **applied contributions:** spinach can be successfully used as a test crop to detect heavy metal contamination of agricultural soils; the use of quality organic additives together with populations of beneficial bacteria is an appropriate and promising approach for phytostabilization of soils contaminated with heavy metals.

6. Critical remarks and questions.

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

7. Published articles and citations.

The PhD student presents a total of 4 publications, 2 of which were published in proceedings of conferences ("Ecology and Health" Seminar from 09-10 June 2016 and "4th National conference" of BHSS, 8-10 September 2016), one was published in a collective monograph "Microbial Interventions in Agriculture and Environment, Volume 2: Rhizosphere, Microbiome and Agro ecology", published

by Springer and one was published in a refereed journal - Journal of chemical technology and biotechnology, Q2. The presented publications reflect some of the results achieved in the dissertation and carry the required number of points for PhD degree in the professional field 4.4. from The Act on Development of the Academic Staff in the Republic of Bulgaria.

The presented abstract objectively reflects the structure and content of the dissertation and is prepared entirely according to generally accepted criteria.

CONCLUSION:

Based on the research methods learned and applied by the PhD student, the correctly performed experiments, summaries and conclusions, I believe that the presented dissertation meets the requirements of The Act on Development of the Academic Staff in the Republic of Bulgaria and the Regulations of the Agricultural University for its application, which gives me reason to evaluate it as **POSITIVE**.

I allow myself to suggest to the esteemed Scientific Jury also to vote **positively** and to **award** IVELINA DIMITROVA NEIKOVA the scientific and educational degree "Doctor" (PhD) in the field of higher education 4. Natural sciences, Mathematics and Informatics, professional field 4.4. Earth Sciences, scientific specialty "Ecology and Ecosystem Conservation".

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Plovdiv