OPINION

on a Dissertation for obtaining an educational and scientific degree "**Doctor**" in: Field of higher education 6. Agricultural sciences and veterinary medicine, Professional field 6.2 Plant Protection (Phytopathology)

Author of the PhD thesis: Rosan Said Shaalan is a doctoral student at the Department of Plant Protection, Faculty of Agronomy, University of Forestry, Sofia.

PhD thesis title: Impact of *Beauveria bassiana* and *Metarhezium aniopliae* on the interactions between *Cucumis sativus* L., coton aphid (*Aphis gossypii* Glover) and Cucumber mosaic virus (CMV)

Member of the Scientific Jury,Assoss.prof. D-r Violeta Savova Kondakovaq field of higher education 6. Agricultural sciences and veterinary medicine, professional field 6.2 Plant protection / Phytopatology,/.appointed a member of the scientific jury by order № ЗПС-642,5.12.2022 год. by the Rector of the University of Forestry, Sofia.

1. **Relevance of the problem**

   The relevance of the problem is clearly defined by the formulation of the topic and the purpose of the dissertation work. The complex relationships between endophytic fungal pathogens /Beauveria bassiana and Metarhizium anisopliae/-plant-cucumber /Cucumus sativus/ and the aphid /Aphis gossypii Glover/ carrier of the cucumber mosaic virus /CMV/ are examined. In-depth studies on the individual components of this interaction allow to develop an alternative to the use of synthetic insecticides against the vector Aphis gossypii. The selection of cucumber as a target in the experiments is a good choice - it is an important greenhouse crop with great economic importance and widespread distribution. The inclusion of metabolomics as a new field in this type of research allows the identification of changes in the metabolic profile during the endophyte-plant-pest interaction, and also, at a later stage, categorization of the genes involved in the process, which will contribute to a better understanding.

2. **Degree of knowledge of the state of the problem and creative interpretation of the literature review.**

   In her dissertation, the doctoral student has presented a very precise and up-to-date list of the used literary sources more than 400 items. In the literature review, the results and the discussion, she accurately cites the authors in the relevant fields and comments and compares her results with the achievements of the individual authors.

3. **Purpose, tasks, hypotheses and research methods. Correspondence of the chosen research methodology with the set goal and tasks of the dissertation work.**

   The aim of the dissertation work is the study of endopathogenic endophytes as a potential alternative to insecticides used against Aphis gossypii, and their application for the destruction of this pest, which is also a vector of the widespread cucumber mosaic virus/CMV/. The aim also includes the use of metabolic studies of CMV-infected cucumber plants to determine the effect of application of the endophytes Beauveria bassiana and Metarhizium anisopliae (EPF) on the induced defense mechanism against the virus. 8 tasks were formulated in great detail towards the goal, and their implementation led to the obtained results and the achievement of the goal. In her research, the doctoral student used a wide range of methods - phytopathological, virological, entomological, physiological, biochemical, molecular, methods used in metabolomics, scanning electron microscopy, which is proof of the excellent and methodical training.

4. Visualization and presentation of the obtained results

The dissertation work is illustrated with 7 tables, 43 figures and 13 appendices, which are precisely prepared and with high quality figures and photographs that complement the obtained results. The scientific work has been prepared and complied with the requirements of the Republic of Bulgaria. The structure of the dissertation is balanced and includes literature review /33 p./, Materials and Methods /15 p./, results and discussion

/46 p. / and conclusions and contributions /2 p. /.

5. **Discussion of the results and the used literature**.

The results obtained are the result of very well-planned activities that cover every step of unraveling the endophyte-plant-pest interaction. The precise execution of every detail is impressive, and the discussion related to them is supported by a comparative analysis with authors cited in the literature review. This honest and very intelligent approach allows satisfaction with the results obtained and giving the PhD student a high rating for her thorough and precisely done experimental work.

6. Contributions of the dissertation work.

Scientific and scientific-applied contributions of significant value are outlined in the dissertation work. The colonization of cucumber plant tissues by the two entomopathogenic endophytes B. bassiana and M. anisopliae is a scientific contribution that is commented for the first time in the present study. Another important scientific contribution is the change of the metabolic profile of cucumbers treated with endophytes, which is in response to CMV infection, as a result of which a significant change of metabolites in amino acid derivatives is reported. Colonization by fungal entomopathogens of cucumbers was found to generally negatively affect aphids A. gossypii, reducing their population size. This method of applying endophytes to plants can be useful for organic growers.

7. Assessment of the degree of personal participation of the PhD student in the contributions

The oral presentation of the dissertation, the results obtained, the contributions and the conclusions drawn show mastery of the subject and are undoubtedly entirely the result of the doctoral student's work.

8. Critical notes and questions.

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

9 .Published articles and citations.

In connection with the dissertation, 3 scientific articles were published - in the Journal of Plant Protection Research and in Horticulturae and one report was published in the Proceedings of the IX International Scientific Symposium on Agriculture AGROSYM 2018", Bosnia and Herzegovina, and 1 accepted for printing. 6 citations noted for the printed articles.

10. Assessment of the publications based on dissertation work: number, nature of the editions in which they are published. Reflections in science- use and citation by other authors

In connection with the results of the dissertation work, two papers are presented, one of which has been published and the second has been accepted for publication in a refereed and indexed edition, such as the Journal of Plant Protection Research and Horticulturae. He is the lead author in all articles. She has given two oral presentations at Agrosym 2018 in Bosnia and Herzegovina and Sixth CRSL Research Conference - American University of Beirut AUB, 2022. At a conference at Balamand University, Lebanon (2018) she participated in a poster

session. The presented abstract objectively reflects the structure and content of the dissertation work.

CONCLUSION:

Based on the set goal and the obtained results, conclusions and significant scientific and scientifically applied contributions, I consider that the presented dissertation fully meets the requirements of the ŽRASRB and the Regulations of the Forestry University for its application, which gives me reason to evaluate it POSITIVELY. I allow myself to propose to the respected scientific jury to vote positively and award Rossan Said Shaalan the educational and scientific degree "doctor" in the field of higher education 6. Agricultural sciences and veterinary medicine, professional direction 6.2 Plant protection (Phytopathology).

Date: 06.12.2022

Sofia

OPINION PREPARED BY:

/ Assoss. prof. D-r Violeta Savova Kondakova /