REVIEW

on a dissertation for obtaining the educational and scientific degree **"PhD"** at:

- field of higher education 6. „Agricultural sciences and veterinary medicine";
- professional field: 6.2. „Plant protection";
- Scientific specialty: „Plant protection" (Entomology)

Author of the dissertation: **Maria Valerieva Hristozova - full-time PhD student at the Department of Entomology; Agricultural University - Plovdiv**

Thesis topic: Biology and control options of the southern green stink bug *Nezara viridula* (Linnaeus) and the brown marmorated stink bug *Halyomorpha halys* (Stal.) (Hemiptera: Pentatomidae)"

Reviewer: Prof. Radoslav Andreev Andreev PhD, Agricultural University – Plovdiv, habilitated in the field of higher education: 6. „Agricultural sciences and veterinary medicine"; Professional field: 6.2. "Plant protection"; scientific specialty: "Plant protection" (Entomology), appointed as a member of the scientific jury by order № RD- 16-1262/06.12.2023. from the Rector to the AU.

1. Brief presentation of the candidate.

Maria Valerieva Hristozova was born on 18.07.1989 in Stamboliyski, region Plovdiv, where she completed his secondary education. In 2016 she graduated as a "bachelor" in the specialty "agronomy - field farming" at the Agricultural University of Plovdiv. During the period 2016-2017 he was a part-time student in the Master's Degree of Plant Protection at the Agricultural University. From 2018 to 2023 she is a full-time PhD student at the Department of Entomology at the Agricultural University of Plovdiv. In the period 2021 - 2022 performs the function of a chief expert, and in the period 2022 – 2023, within two academic years, she was appointed as an assistant at the Department of Entomology at the Agricultural University - Plovdiv. She is fluent in English and has conducted classes with foreign students trained in English. She specialized in 2021 in Novi Sad, Serbia and in 2022 in Podgorica, Montenegro..

2. Actuality of the problem.

Invasive species are one of the great challenges to the global development of mankind in various aspects – for obtaining high crop yields and healthy food, for sustainable environmental management and in particular for human health.

Southern green stink bug *Nezara viridula* and brown marmorated stink bug *Halyomorpha halys* are just two of the numerous examples of alien insect species accidentally entering the territory of Bulgaria. Then they established themselves as important pests in different crops. Both bugs are already found ubiquitously and in the highest density compared to all other local representatives of the family. Pentatomidae (Hemiptera; Heteroptera). Their harmful activity is present in several aspects: direct injury from sucking juice, leading to a decrease in quantity and quality of production; indirect damage from creating conditions for infection with phytopathogens; as an allergen for people, creating discomfort in households where they hibernate, etc. The problem is extremely relevant, given the importance of these two pests and the lack of information on their biology in Bulgaria and the possibilities for control.

3. Purpose, tasks, hypotheses and research methods.

This dissertation aims to study the biology and control options of the southern green stink bug (*Nezara viridula* (Linnaeus)) and the brown marmorated stink bug (*Halyomorpha halys* (Stål)) for the conditions of Bulgaria.

To realize the set goal, the following more important tasks were identified:

1. To conduct observations and establish the most preferred species of cultivated and wild host plants in the Plovdiv and Pazardzhik regions.

2. To study various aspects of the life cycle: duration of development of individual stages, reproductive behaviour, number of generations per year, etc. under laboratory and field conditions.

3. To identify predatory and parasitoid species from natural populations associated with the southern green stink bug and the brown marmorated stink bug.

4. To study the regulatory possibilities of the established species of parasitoids.

5. To establish the biological efficacy of selected insecticides authorized for use in the European Union.

The studies were conducted in the period 2018-2021. Laboratory and field studies were conducted using appropriate methods.

The data from the trials, subject to statistical analysis, were processed by computer programs.

4. Visualization and presentation of the results obtained.

The dissertation has a volume of 126 standard pages. Structured is correct, not only as content, but also as volume/ratio of individual sections. It is very good displayed with 17 tables and 96 figures, some of which are original photos. The studies were conducted at a modern scientific, theoretical and methodological level and presented in the most adequate way.

They have been studied:

The species composition of the preferred host plants of the two invasive species of pentatomid bugs;

The polymorphism (morphological forms) of the southern green sting bug;

The biological characteristics of both species:

Duration of development of individual stages;

Adult life expectancy;

Number of copulations and duration of copulation;

Duration of pre-oviposition period;

Length of egglaying period;

Egg productivity.

Predators and parasitoids from natural populations that have a nutritional relationship with both species of bedbugs. A degree of egg, nymph and adult parasitism was established;

The biological efficacy of 7 insecticides, with different active ingradients, selected from the register of the BFSA for authorised plant protection products or with registrations in other EU countries.

5. Discussion of results and literature used.

The results in the dissertation are original and fully achieved by the student in fulfillment of the set goals and tasks. It is available on 52 pages.

The conclusions are well founded and correspond to the results obtained.

The list of literature includes 252 sources, of which only one in Cyrillic and 251 in Latin. The literature review is thorough and comprehensive, written on 31 pages. including both older and contemporary studies on both species.

6. Thesis contributions.

The studies carried out warrant formulating the following contributions:

I. Scientific contributions of an original nature

1. For the first time in Bulgaria, different morphological forms of the southern green stink bug are reported, which are found in Pazardzhik and Plovdiv regions, as well as their percentage ratio.
2. For the first time in Bulgaria, the phenological development of *N. viridula* and *H. halys,* the duration of development of their individual stages and the

number of generations per year under field conditions for the Plovdiv region have been studied.

3. For the first time in Bulgaria, the following species of parasitoids from local populations that parasitize stages of *N. viridula* are reported: *Trissolcus basalis, Ooencyrtus telenomicida, Ooencyrtus sp.,* and *Trichopoda pennipes.*
4. For the first time in Bulgaria, the following species of parasitoids from local populations that parasitize stages of *H. halys* are reported: *Trissolcus cultratus, Trissolcus basalis, Anastatus bifasciatus, Ooencyrtus telenomicida* and *Ooencyrtus* sp.
5. The degree of parasitization of the eggs by the parasitoids established for the southern green stink bug and the brown marmorated stink bug in natural conditions in different biocenoses in the Plovdiv and Pazardzhik regions was studied.
6. The degree of parasitism of adults and nymphs of the 5th instar of the southern green stink bug in different biocenoses in Plovdiv and Pazardzhik regions was studied.
7. The biological efficacy of plant protection products based on plant extracts and microorganisms, for which there are no previous studies in our country, was tested for both pest species.

II. Scientific contributions of a confirmatory nature

1. The established species of host plants in Pazardzhik and Plovdiv regions largely confirm what was observed by other authors in European countries.
2. The studies of the life cycle parameters of both species under laboratory conditions at temperature 25 ± 2°C, RH 50 - 60% and photoperiod 16 L:18D rather confirm the findings of other authors.
3. It has been confirmed that the egg parasitoid *Anastatus bifasciatus* from natural populations in Bulgaria successfully develops on the eggs of the southern green stink bug.

III. Applied contributions

1. The obtained results on the biological efficacy of the tested plant protection products can find practical application in the development of programs for IPM or in the organic farming.
2. The data on the phenological development of the two species and more specifically on the beginning of the hatching of the nymphs can be used when choosing the moment for treatment with PPPs - for the southern green

skink bug it is most suitable after the first ten days of May, and for the brown marmorated stink bug – after mid-June.

7. Critical remarks and questions.

As a critical note, some of the laboratory experiments, to establish the biological characteristics of both species, were conducted with a relatively small number of individuals and because of the wide variation, kwhich is characteristic when working with living organisms, the results do not meet the high statistical criteria of reliability/accuracy, but this does not diminish their value as a basis for further in-depth studies.

Question: Which of the two species is more dangerous as an pest of agricultural crops in Bulgaria?

8. Published articles and citations.

In connection with the dissertation, one scientific article is presented.:

Hristozova, M. (2020). Life Cycle Parameters of the Invasive Southern Green Stink Bug (*Nezara viridula*) at Laboratory Conditions. Scientific Papers. Series A. Agronomy, 63(2).

published in a scientifically referenced Web of Science journal.

In addition to its activities to promote the results of the conducted studies, the participation in 4 scientific and scientific-practical conferences was presented.

The presented autoabstract reflects objectively the structure and content of the dissertation.

CONCLUSION:

Based on what I have read, I believe that the dissertation presented meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Rules of the Agricultural University for its application, which gives me reason to rate it **POSITIVELY**.

I allow myself to suggest to the venerable Scientific Jury also to vote positively and to award **Maria Valerieva Hristozova** the educational and scientific degree **"PhD"** in the scientific specialty "Plant Protection" (Entomology).

Date: .....

Plovdiv

REVIEWER: .....

(Prof. Radoslav Andreev)