

## REVIEW

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| АГРАРЕН УНИВЕРСИТЕТ<br>П.Д. ПЛОВДИВ |                  |
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on a dissertation work for obtaining the educational and scientific degree "doctor" in: field of higher education 6. Agricultural sciences and veterinary medicine, professional direction: 6.2. Plant protection, scientific specialty "Plant protection"

**Author of the dissertation:** **ATANAS IVANOV IVANOV**, PhD student of independent study at the Department of "Chemistry and Phytopharmacy" at the Agricultural University, Plovdiv

**Topic of the PhD thesis:** **INNOVATIVE METHODS FOR THE CONTROL OF ECONOMICALLY IMPORTANT PESTS OF WINTER OILSEED RAPE**

**Reviewer:** **Prof. Dr. MARIYANA YORDANOVA IVANOVA**, University of Agribusiness and Rural Development (UARD) - Plovdiv; higher education field: 6. Agricultural sciences and veterinary medicine, professional direction: 6.2. Plant protection, the scientific specialty "Plant protection" (Entomology), designated as a member of the scientific jury by order of the Rector of the Agricultural University (№ RD-16-459/ 01.04.2024).

### 1. 1. Brief introduction of the candidate.

Atanas Ivanov Ivanov was born in the city of Plovdiv on May 15, 1991. He completed secondary education in 2010 at the Science and Mathematics High School "Acad. Boyan Petkanchin" in the city of Haskovo in Informatics with German language. In the period 2010 - 2014, he studied at educational and qualification degree Bachelor at the Agricultural University - Plovdiv and acquired the qualification of agronomist in the specialty Agronomy-hydromeliorations, then in the period 2014 - 2015 he studied in Master program in Plant Protection at the same university. By Decision of the Faculty Council at the Faculty of Plant Protection and Agroecology from 09.06. 2022 Atanas Ivanov was enrolled in a PhD program of self-study at the Department of "Chemistry and Phytopharmacy" for a period of three years (Order No. RD-26-52/ 05.07.2022), with scientific supervisors Prof. Dr. Miroslav Tityanov and Assoc. Prof. Dr. Atanaska Stoeva.

Atanas Ivanov's work experience began in 2015 as an inspector-agronomist at SGS Bulgaria Ltd., Sofia, whose responsibility was to carry out experiments with plant protection products. In 2017, he held a new position - Inspector in the "Organic Agriculture" department, with the main activity of auditing organic operators, and in 2018, he was already the head of the "Soils, seeds and crops" department in the same company, where he continues to work until 2024 by conducting registration trials for efficacy and selectivity. From July 2018 to November 2023, he worked as a Global GAP auditor and audited farmers according to the Global GAP standard. In the period August 2018 - 2024, he continues to work at SGS Bulgaria Ltd., Sofia, as the head of the "Fumigation" department.

From April 2021 until now, Atanas Ivanov works as an assistant at the Agricultural University of Plovdiv and conducts exercises in the disciplines of Phytopharmacy,

Ecotoxicology, Chemical Protection. From November 2021 until now, he is the Director of the Center for Biological Testing of Plant Protection Products at the Agricultural University. From November 2024 - until now, he also holds the position of product manager at BASF, Sofia.

Excellent command of the English language - written and spoken.

Good command of Microsoft Office; LINUX, ARM, Field Pro. Has skills and competencies in ARM Training - Hints, tips and techniques, ISO 9001:2015, HACPP Systems, etc. He holds a field crop variety examiner certificate.

## **2. Relevance of the problem.**

The PhD thesis submitted for review is related to the study of innovative methods for the control of economically important pests of winter oilseed rape. The relevance of the problem related to innovative methods for the control of economically important enemies of winter oilseed rape is expressed in several key aspects:

Rapeseed is one of the main oil crops in Bulgaria with extremely important economic importance for the country. It is a significant crop for quite a few farmers in our country and for the economic stability of the regions where it is grown. Losses from pests and diseases can be significant and reduce farmers' profitability. In this sense, innovative control methods can help reduce these losses.

With the growing population of the planet and the increase in global trade volume, food security is becoming more important, and winter oilseed rape is an important element in the food chain, therefore the control of its pests is essential for food security.

Traditional methods of pest control, such as the use of pesticides, have negative environmental consequences, such as soil and water pollution, loss of biodiversity, etc. Therefore, innovative methods that are environmentally friendly and reduce the negative effect on the environment should be sought.

Changes in climate lead to changes in the distribution dynamics of economically important pest insects and diseases of winter oilseed rape. Therefore, it is necessary to develop innovative methods to adapt to changing climatic conditions.

In combination, these factors emphasize the relevance of the developed PhD thesis and the need to find sustainable, effective and environmentally friendly solutions for the control of pests on winter oilseed rape.

## **3. Objective, tasks, hypotheses and research methods.**

The aim of the present study is to investigate innovative alternative methods for the control of economically important pests of winter oilseed rape and agricultural practices corresponding to the integrated pest management strategy of the crop.

In connection with the implementation of the set aim, the following objectives have been defined:

- Study of pest and beneficial entomofauna on winter oilseed rape in the region of Plovdiv;
- Testing of the efficacy of eco-friendly insecticides for the control of pollen beetle, *Brassicogethes aeneus* (Fabricius, 1775);

- Testing of the efficacy of eco-friendly insecticides for the control of brassica pod midge, *Dasineura brassicae* (Winnertz, 1853);
- Study of the effect of flowering plant species on the beneficial entomofauna of winter oilseed rape.

The studies of the species composition of the entomofauna in rape agroecosis were conducted in 2020-2023 in the region of the city of Plovdiv, where most of the trials to test various means of control against economically important pests were carried out. Surveys to establish the species composition of pest and beneficial entomofauna on rapeseed were carried out every 14 days from the beginning of the growing season until the harvest of the crop. After the sprouting of the rapeseed, visual observations were carried out to establish the appearance of flea beetles, weevils, etc. as well as beneficial species, with attention being paid at the beginning to the periphery of the crops. Later, the observations were carried out on test plots with dimensions of 50/50 cm, located at 20 places within the crop. As the vegetation progresses and the development of the plants, in addition to the visual sampling to register the species composition of the entomofauna, and sweep-net sampling was also carried out to take into account the population density of some pests - in 20 places arranged in a checkerboard pattern, 5 swaths were made. Population density is calculated per 1 m<sup>2</sup>. The species requiring microscopic technique for their identification were transported and stored in the laboratory of the Department of Entomology.

Environmentally friendly means have been tested for the control of:

- Pollen beetle, *Brassicogethes aeneus*, and the tests were conducted in the period 2019-2021 in the Plovdiv and Ruse regions;
- Brassica pod midge, *Dasineura brassicae*. The tests were conducted in the period 2020-2022 in two locations in the region of the city of Plovdiv (in 2020 and 2021) and one in the region of the village of Koprinka, Stara Zagora Region (in 2022).

Of interest is the study conducted to establish the influence of flowering plant species on the beneficial entomofauna of winter rape, which is part of the doctoral student's work on an international project under the Horizon 2020 program: EcoStack: "Stacking of ecosystem services, mechanisms and interactions for optimal crop protection, pollination enhancement, and productivity". It was conducted under field conditions at the training-experimental and implementation base at the Agricultural University, Plovdiv in 2021-2023.

#### 4. Transparency and presentation of the results obtained.

The PhD thesis submitted for review has a total volume of 107 pages. The main text contains 43 tables, 17 figures and 44 photos, which perfectly illustrate the dissertation work. The cited literature includes 93 sources, of which 2 are in Cyrillic and 91 are in Latin. Electronic resources with data and analyzes of the Ministry of Agriculture and Food are also used and cited.

The dissertation is well structured and balanced. It contains all generally accepted sections, namely: introduction, literature review, aim and objectives, material and methods, results and discussion, conclusions, literature.

In the introduction, the PhD student emphasizes the importance of oilseed rape and justifies the need for the ongoing research and the search for alternative means of

control that meet the strategy of integrated pest management, as well as the inclusion of appropriate agricultural practices contributing to the protection of beneficial entomofauna (conservation) in this crop.

The literature review demonstrates the good awareness of the PhD student on the research problem. Thematically, it is well arranged, consistent with the issues considered in the PhD thesis. It provides information on the species composition of pest and beneficial entomofauna of winter rapeseed, presents conventional means of controlling canola pests, as well as alternative methods and means of control of some economically important pests of rapeseed.

It is noteworthy that contemporary literary sources were used, with 88.12% being after 2000. In the course of the discussion, the cited literature was skilfully used in analyzing the results and formulating the conclusions.

The results were processed statistically and the data were analyzed by one-way analysis of variance (one-way ANOVA, Tukey HSD (Honestly Significant Difference) at a significance level of  $\alpha = 0.05$ ) with the statistical software package IBM SPSS Statistics 19.

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

The "Results and Discussion" section is the main one, covering 48 pages and reflecting the results of the experiments carried out.

During the monitoring of pest entomofauna on winter oilseed rape in the region of Plovdiv in the period 2020-2023, 23 species of pest insects from 5 orders and 11 families were identified. The order Coleoptera has the largest participation - 50% of the total number of species established during the study period, followed by the order Hemiptera - 27%. During the growing season of 2021-2022, the population density of Coleoptera pests was monitored and it was found that the pollen beetle, *Brassicogethes aeneus* and the weevils of the genus *Ceutorhynchus* were dominant. The average population density of the pollen beetle reaches almost 20 adults/m<sup>2</sup>, and of the weevils up to 10 adults/m<sup>2</sup>. The dominant species of the weevils of the genus *Ceutorhynchus* is *C. pallydactylus* – more than 50% of all recorded individuals, followed by *C. obstrictus*.

The beneficial entomofauna observed on oilseed rape in the region of Plovdiv includes both predatory and parasitoid species. Fourteen species of predatory insects from 4 orders and 7 families were found. The Coleoptera order has the largest number of identified species.

The predatory entomofauna is mainly represented by species having a wide food specialization, such as lacewings (Chrysopidae), soldier beetles (Cantharidae) and predatory bugs (Miridae, Nabidae). Predatory ladybirds (Coccinellidae) and syrphid flies (Syrphidae) are specialized aphidophagous insects, and tachinid flies and more specifically the species *Ectophasia crassipennis* is known as a parasite on adults of bugs from the families Pentatomidae, Coreidae, Lygaeidae. The parasitoid entomofauna was recorded using the D-VAC sampling method. Species from 4 families were registered, with the family Ichneumonidae taking a dominant place.

A trial of environmentally friendly means for the control of pollen beetle, *Brassicogethes aeneus* was conducted in the period 2019-2021 in the regions of Plovdiv and Ruse, using 5 variants (together with the control), and the trials were carried

out following EPPO standard PP 1 /178(3) - *Meligethes aeneus* (syn. *Brassicogethes aeneus*) on rapeseed. The experiment was carried out in 4 locations: three in Plovdiv region (Zhelyazno village, Trud village, Plovdiv city) respectively in 2019, 2020 and 2021 and one in Ruse region (Trastenik village) in 2020.

The results of the experiments carried out in four locations in three calendar years that the efficacy when applying the potassium salts in the higher dose of 5 l/ha varies from 70 to 92.7% in the first assessment (1-3 days after treatment), from 95.9 to 100% at the second assessment (7 days after treatment), from 54.3 to 100% at the third assessment (10-11 days after the first and 3-4 days after the second treatment) and from 56.4 to 100 % at the last assessment (14-15 days after the first and 7-8 days after the second treatment). Compared to the reference products (Decis 100EK and Mavrik 2F), the results of treatment with these salts are similar or better. At the lower application rate of 2.5 l/ha, efficacy varied from 26% to 91.8% in the different years and locations where the trials were conducted.

In terms of yields, all variants in almost all locations show higher results compared to the control, with the exception of the experiment conducted in the Plovdiv region in 2020, where the highest yield was reported for the variant treated with Decis 100EK. In all other locations, the variant treated with salts of aliphatic carboxylic acids in a dose of 5 l/ha showed the best results.

The PhD student conducted research in the period of 2020 – 2022 to test environmentally friendly means of controlling the brassica pod midge, *Dasineura brassicae*. The trials were carried out in the period 2020-2022 in two locations in the region of the city of Plovdiv (in 2020 and 2021, respectively) and one in Stara Zagora region, in the village of Koprinka (in 2022). 5 variants were used, together with one untreated control, and the experiments were carried out following the EPPO standard - PP 1 / 220 (1) - *Dasineura brassicae*.

As a result of the conducted research, it was found that the tested potassium salts of fatty acids, applied at the higher dose of 5 l/ha, show an efficacy close to the reference products against brassica pod midge. At the first assessment (5th-6th day after treatment) the efficacy varied from 55.6 to 100% in different locations and years, and at the second assessment (15th-16th day after first treatment) it was from 45.24 to 89.7 %. At the lower dose, the efficacy was between 14.3% and 100%. In 2022, during the experiment in the village of Koprinka, they showed even higher efficacy compared to Decis 100EK and Marvik 2F. In terms of harvested production, all products showed an increase in yields compared to the untreated control.

As a result of the experiments carried out with the two key enemies of canola, the doctoral student found that:

- The potassium salts of aliphatic carboxylic acids (or fatty acids) with a carbon chain length of C14-C20 exhibit a good insecticidal effect against adults of the pollen beetle and the brassica pod midge and are an effective alternative to pyrethroids.
- Efficacy of potassium salts of aliphatic carboxylic acids (C14-C20) tested against pollen beetle is dose-dependent, ranging from 26% to 91.8% at a dose of 2.5 l/ha and from 54.3 to 100% at a dose of 5 l/ha. Persistence lasts up to 15 days after the first treatment.
- Efficacy of potassium salts of aliphatic carboxylic acids (C14-C20) tested against brassica pod midge ranged from 14.3% to 100% at a dose of 2.5 l/ha and from

- 45.24% to 100% at a dose of 5 l/ha. In one of the tests, the efficacy of the higher dose exceeded that of the reference products - deltamethrin and tau-fluvalinate.
- Treatment with potassium salts of aliphatic carboxylic acids (C<sub>14</sub>-C<sub>20</sub>) does not negatively affect yield in oilseed rape, at a dose of 5 l/ha there is even a slight increase in yield.

The study of flowering plant species on the beneficial entomofauna of winter rapeseed is of interest. For this purpose, a crop of winter oilseed rape (ES Capello variety) was created, in which 4 strips of flowering plant species were separated. Each of these strips includes 21 plant species sown in separate squares, each with an area of 1 m<sup>2</sup>, spaced 1 m apart from each other and from the rapeseed.

Strips of flowering plant species in rapeseed crops attract beneficial insects and increase ecosystem services such as pollination and biological control. The largest number of pollinators in both years of the study was found on phacelia (*Phacelia tanacetifolia*). The largest number of predators in 2022 was found on phacelia, and in 2023 - on fennel (*Anethum graveolens*). Phacelia, borage (*Borago officinalis*), coriander (*Coriandrum sativum*), white mustard (*Sinapis alba*), fennel (*Anethum graveolens*), marigold (*Calendula officinalis*) and common sainfoin (*Onobrychis vicifolia*) are the plant species whose flowers attract pollinators and predators from the widest range of families. Three types of flowering plants can be recommended to create flower strips in the agrocenosis of winter oilseed rape and these are: phacelia (*Phacelia tanacetifolia*), borage (*Borago officinalis*) and coriander (*Coriandrum sativum*).

## 6. Contributions of the dissertation work.

As a result of the good theoretical training, the precisely performed laboratory and field experiments, as well as the objective analysis of the data from them, the PhD student has presented scientific contributions of an original nature and contributions of an applied nature, reflecting his personal achievements.

### Scientific contributions of an original nature

- For the first time in Bulgaria, the effect of products containing potassium salts of aliphatic carboxylic acids (fatty acids) is being tested against the pollen beetle, *Brassicogethes aeneus* and the brassica pod midge, *Dasineura brassicae*.
- Potassium salts of aliphatic carboxylic acids (fatty acids) with a carbon chain length of C<sub>14</sub>-C<sub>20</sub> have been found to have good insecticidal activity against adults of pollen beetle and brassica pod midge and are an effective alternative to pyrethroids.
- Efficacy of potassium salts of aliphatic carboxylic acids (fatty acids) (C<sub>14</sub>-C<sub>20</sub>) against adults of pollen beetle and brassica pod midge is dose-dependent and could reach 100% at a dose of 5 l/ha, as the persistence lasts up to 15 days after treatment.
- For the first time in our country, it has been proven that the treatment with potassium salts of aliphatic carboxylic acids (fatty acids) (C<sub>14</sub>-C<sub>20</sub>) is completely safe for winter oilseed rape and does not negatively affect the yield of the crop, in some cases it increases it.
- For the first time in Bulgaria, the role of flowering plant species to increase ecosystem services, such as pollination and biological control, in the agrocenosis of winter oilseed rape is being studied.

- Phacelia (*Phacelia tanacetifolia*), borage (*Borago officinalis*), coriander (*Coriandrum sativum*), white mustard (*Sinapis alba*), fennel (*Anethum graveolens*), calendula (*Calendula officinalis*) and common sainfoin (*Onobrychis vicifolia*) have been found to be the plant species whose flowers attract pollinators and predators from the widest range of families.
- Three plant species phacelia (*Phacelia tanacetifolia*), borage (*Borago officinalis*) and coriander (*Coriandrum sativum*) can be recommended for sowing strips of flowering plant species in agrocenosis of winter oilseed rape.

### **Contributions of an applied nature**

- Potassium salts of C<sub>14</sub>-C<sub>20</sub> aliphatic carboxylic acids (fatty acids) have been shown to be an effective alternative to pyrethroids and a resistance management tool.
- Potassium salts of aliphatic carboxylic acids (fatty acids) can find practical application in the development of IPM schemes in the production of winter oilseed rape. Long persistence makes them suitable for application in critical phases of the crop.
- The results of the studies on the role of flowering plant species in oilseed rape can find practical application in the sowing of strips of such plants, supporting the beneficial entomofauna in the agrocenosis.

I accept the contributions as actually proven in the course of the research and in the publications related to the dissertation work. I consider them to be the personal work of the doctoral student.

## **7. Critical Notes and Questions.**

I believe that the correct spelling of the scientific names of pest and plant species in the Latin within the text could be refined as required.

Question: Does the PhD student have any observations of resistance in the pollen beetle during the study period?

I recommend that the PhD student's future research should focus on resistance management in pollen beetle, which is a major challenge given the ability of this species to develop resistance to the insecticides used.

## **8. Published articles and citations.**

The PhD student Atanas Ivanov has published 2 scientific articles related to the topic of the PhD thesis, in which he is the first author. They are published in Scientific Papers. Series A. Agronomy - a publication of the University of Agronomic Sciences and Veterinary Medicine in Bucharest, Romania, indexed in Web of Science. A verification committee certifies that the PhD student meets the minimum scientometric requirements and that the articles presented in connection with the dissertation cover the required number of points.

The submitted abstract (54 pages), which is prepared according to generally accepted requirements and fully reflects the structure and content of the dissertation work.

## CONCLUSIONS

Based on the various research methods learned and applied by the PhD student, the correctly performed experiments, the generalizations and conclusions made, I believe that the presented dissertation work on the topic: "Innovative methods for controlling economically important pests of winter oilseed rape" meets the requirements of the Law for development of academic staff in Republic of Bulgaria and the Regulations of the Agricultural University for its application, which gives me reason to evaluate it **POSITIVELY**.

I allow myself to propose to the honorable Scientific Jury to also vote positively and award **Atanas Ivanov Ivanov** the educational and scientific degree "Doctor" in the scientific specialty 6.2. Plant protection.

Date: 14.05.2024  
Plovdiv

REVIEWER:   
(Prof. Mariyana IVANOVA, PhD)