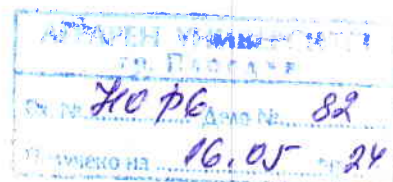


REVIEW



on a PhD Thesis for obtaining the educational and scientific degree "Doctor" in: area of higher education 6. Agricultural sciences and veterinary medicine, professional direction 6.2. Plant protection, the scientific specialty Plant protection

Author of the dissertation:

Atanas Ivanov Ivanov, doctoral student at the Department of "Chemistry and Phytopharmacy" at the Agricultural University- Plovdiv

Dissertation topic: INNOVATIVE METHODS FOR CONTROL OF ECONOMICLY IMPORTANT PESTS IN WINTER OILSEED RAPE

Reviewer: Prof. Dr. Vili Borisova Harizanova, Agricultural University-Plovdiv, area of higher education 6. Agricultural sciences and veterinary medicine, professional direction 6.2. Plant protection, the scientific specialty Plant Protection (Entomology), appointed as a member of the Scientific Jury by order No. RD-16-459/01.04.2024 by the Rector of the Agricultural University-Plovdiv.

1. Brief introduction of the candidate

Atanas Ivanov Ivanov was born in the city of Plovdiv on May 15, 1991. He completed his secondary education in 2020 at the Science and Mathematics High School "Acad. Boyan Petkanchin" in the city of Haskovo in Informatics with German language. In 2014 he got a Bachelor degree from the AU-Plovdiv, with a major in Agronomy-Hydromelioration, and in 2015 – a Master degree at the same university, majoring in Plant Protection. From June 2022, he was enrolled in doctoral studies, independent preparation at the Department of Chemistry and Phytopharmacy for a period of three years (Order No. RD-26-52/5.07.2022, with scientific supervisors Assoc. Prof. Dr. Atanaska Stoeva and Assoc. Prof. Dr. Miroslav Tityanov.

The doctoral student's work experience began in 2015 as an inspector-agronomist at SGS Bulgaria EOOD, Sofia, whose responsibility was to carry out experiments with plant protection products. In 2017, he took a new position - inspector in the "Organic Agriculture" department, with the main activity of inspecting organic operators, and in 2018, he became the head of the "Soils, seeds and crops" department in the same company, where he will continue to work until 2024. by deriving registration trials for efficacy and selectivity. From July 2018 to November 2023, he worked as a Global

G.A.P. auditor. to audit farmers according to the Global GAB standard. From August 2018 to 2024, he continues to work with SGS Bulgaria EOOD, Sofia, as head of the Fumigation department.

From 2021 to the present, he works as an assistant at AU-Plovdiv and conducts exercises in the disciplines of Phytopharmacy, Ecotoxicology and Chemical Protection. From November 2021 to the present, he is the director of the Center for Biological Efficacy Testing of plant protection products at AU-Plovdiv. From November 2023 to the present, he also holds the position of product manager at BASF EOOD, Sofia.

Atanas Ivanov has excellent written and spoken English and uses Microsoft Office, LINUX, Field Pro. He holds a field crop variety examiner certificate.

2. Relevance of the problem

Environmental pollution and loss of biodiversity are two of the global threats to sustainable development on a planetary scale. Agriculture is one of the sectors directly related to the problem, and therefore Europe's policies in the new millennium are aimed at reducing its negative impact. In the field of plant protection, alternatives are actively being sought that are not only safe for human health, but at the same time do not affect biodiversity. On the other hand, practices and actions are launched that encourage restoration of the natural balance. In this context, the topic of the doctoral dissertation submitted for review is relevant and innovative. Canola is attacked by a large number of pests, most of which have practically no authorized means of control. The selection of the little-studied potassium salts of fatty acids as alternative means of control of two of the most important pests of canola is innovative, and the study of the effect of flowering plant species on the beneficial entomofauna is relatively new in Europe and the first of its kind in the country.

3. Purpose, tasks, hypotheses and research methods

The aim, as formulated in the thesis, is to investigate innovative alternative means of controlling economically important pests of winter oilseed rape and agricultural practices corresponding to the integrated pest management strategy of this crop.. The identified tasks to achieve the goal are appropriately selected and feasible: to study harmful and beneficial entomofauna on winter oilseed rape in the region of the city of Plovdiv; to test environmentally friendly means of control of rape blossom borer (*Brassicogethes aeneus*) and cabbage looper (*Dasineura brassicae*) and to investigate the effect of flowering plant species on the beneficial entomofauna of winter oilseed rape.

The studies were conducted in the period 2019-2023 under field conditions in the

region of Plovdiv, Stara Zagora and Ruse. The species composition of pest and beneficial entomofauna of winter oilseed rape was studied in the Plovdiv region using standard entomological methods. The author selected potassium salts of aliphatic carboxylic acids (fatty acids) as alternative agents suitable for the control of small soft-bodied insects to test their efficacy against adults of the pollen beetle and the cabbage pod midge. The experiments were carried out in selected locations in the regions of Plovdiv (Zhelyazno, Vojvodinovo and Trud), Ruse (Trastenik) and Kazanlak (Koprinka). As a standard, products with active substances deltamethrin and tau-fluvalinate were used. The relevant EPPO standards were used for the biological efficacy tests.

The influence of 21 flowering plant species on main groups of pollinators, predators and parasites was studied in the experimental fields of AU-Plovdiv.

All experiments were performed with a sufficient number of replicates to allow statistical processing of the data.

4. Visualization and presentation of the obtained results

The 108-page dissertation is richly illustrated with 43 tables, 17 figures and 44 photographs, 10 of which are presented in the Appendix.

The established pest and beneficial insect species on winter oilseed rape in the Plovdiv region are presented as a species composition in tabular form and figures illustrating the distribution of enemies by order, the average population density by month of the main species of the order Coleoptera and original photographs. In a similar way, the results regarding the species composition of beneficial insects - predators and parasitoids - are presented.

The results of a test of the biological efficacy of potassium salts of fatty acids are presented in an analogous way for both pests - the pollen beetle and the cabbage pod gall and for each of the locations and the years of the experiment: the number of adults of the rape flower eater per 50 branches before treatment and on the 2nd, 7th, 10th and 14th day after treatment in two doses of the test products, two standards and an untreated control. For the cabbage pod midge, the number of damaged pods per 25 branches was recorded before the 1st treatment, on the 6th and 15th day after treatment. Then, results are presented for the quantitative and qualitative indicators of the harvested produce by variants.

The influence of flowering plant species on the beneficial entomofauna of winter oilseed rape is represented by the average population density of pollinators (honeybees, bumblebees and syrphid flies) and entomophages (mainly flower-visiting predators) attracted to the respective plant species. The most preferred flowering species are presented in separate lists for pollinators and predators.

The results obtained in the studies 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.

Data interpretation is meaningful and sufficiently detailed.

5. Discussion of results and used literature.

As a result of the experiments and studies conducted in the Plovdiv region, the doctoral student identified 23 species of herbivorous insects, of which the most numerous are the pollen beetle and weevils of the genus *Ceutorhynchus*. Of the beneficial species, 14 species of predators were identified, as well as parasitoids from three families, the predominant species being the species of the Ichneumonidae family.

Of the phytophagous insects that reproduce in high density and attack the generative organs of rape, the pollen beetle (*Brassicogethes aeneus*), the pod weevil (*Ceutorhynchus obstrictus*) and the cabbage pod midge (*Dasineura brassicae*) stand out.

The tested potassium salts of aliphatic carboxylic acids with a carbon chain length of C14-C20 were found to exhibit good insecticidal properties against adults of the pollen beetle and the cabbage pod midge and are a suitable alternative to pyrethroids. Their biological efficacy against adults of the pollen beetle depends on the dose of application, 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, respectively. Persistence lasts up to 15 days after the first treatment.

Against the cabbage pod midge, the biological efficacy varies 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 conducted tests, the efficacy of the second dose was higher compared to that of the standard pyrethroids - deltamethrin and tau-fluvalinate. When treated with potassium salts of aliphatic carboxylic acids, no negative effect on rape yield was observed, and a slight increase was even recorded at a dose of 5 l/ha.

Strips of flowering plant species in canola 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 asparagus (*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 agroecosystem of winter oilseed rape and these are: phacelia (*Phacelia tanacetifolia*), borage (*Borago*

officinalis) and coriander (*Coriandrum sativum*).

The extensive literature review refers to 92 sources, of which 2 are in Cyrillic and 90 are in Latin.

6. Contributions of the dissertation work.

The dissertation has a number of contributions to science and plant protection practice, summarized below:

Scientific contributions

- For the first time in Bulgaria, the effect of products containing potassium salts of aliphatic carboxylic acids (fatty acids) against the pollen beetle *Brassicogethes aeneus* and the cabbage pod midge *Dasineura brassicae* was established.

Potassium salts of aliphatic carboxylic acids (fatty acids) with a carbon chain length of C14-C20 have been found to exhibit good insecticidal properties against adults of pollen beetle and the cabbage pod midge and are a suitable alternative to pyrethroids.

- It was found that the efficacy of potassium salts of aliphatic carboxylic acids (fatty acids) (C14-C20) against adults of pollen beetle and the cabbage pod midge depends on the dose of application and can reach 100% at a dose of 5 l/ha, as persistence lasts up to 15 days after treatment.

For the first time in our country, it was established that the treatment with potassium salts of aliphatic carboxylic acids (fatty acids) (C14-C20) is completely safe for winter rape and does not negatively affect the yield of the crop, and in some cases 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 agroecosystem 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 sainfoin (*Onobrychis vicifolia*) have been found to be the plant species whose flowers attract pollinators and predators from the widest range of families.

- Three species of phacelia (*Phacelia tanacetifolia*), borage (*Borago officinalis*) and coriander (*Coriandrum sativum*) can be recommended to create buffer strips of flowering plant species in the agroecosystem of winter oilseed rape.

Scientific and applied contributions

- Potassium salts of aliphatic carboxylic acids (fatty acids) with a carbon chain length of C14-C20 have been shown to be a suitable alternative to pyrethroid PPPs and a tool for resistance management.
- Potassium salts of aliphatic carboxylic acids (fatty acids) can find practical application in the development of IRZ schemes in the production of winter oilseed rape. Long persistence makes them suitable for application in critical phases of culture.
- The results of the studies on the role of flowering plant species in rapeseed can find practical application in the creation of strips of such plants, supporting the beneficial entomofauna in the agrocenosis.

7. Critical notes and questions.

As critical remarks that do not detract from the value of the work, I would point out the following:

1. In the title of tables 6,7,8, 9, 10, 12, 13, 14, 15, 16, 18, 20, 21, 22, 24, 25, 26, 27, 28 it says "number of live beetles" without to indicate which species it is. For clarity, it should be written "number of pollen beetle adults".
2. For each of the species of insects and plants, the Bulgarian or Latin name can be given, or both, but in this case one of the two must be in parentheses. In single cases, both names are written in the dissertation without parentheses for one of the two (p. 23, p. 55, p. 73, p. 93).
3. Based on the experiments of other scientists, would it be possible to say what is the recommended width of border strips with flowering plant species?

8. Published articles and citations.

In connection with the dissertation, the doctoral student has presented 2 publications with two authors each, in which he is the first author, printed in Scientific papers. Series A. Agronomy 65 with which he covers the required number of points.

The presented abstract reflects (does not reflect) objectively the structure and content of the dissertation work.


CONCLUSION:

Based on the various research methods learned and applied by the doctoral student, the experiments correctly carried out, the generalizations and conclusions made, I consider 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 Agrarian University for its application, which gives me grounds to evaluate it
POSITIVELY

I take the liberty of proposing to the honorable Scientific Jury to also vote positively and award Atanas Ivanov Ivanov the educational and scientific degree "Doctor" in the scientific specialty Plant Protection.

Date: 15 May 2024
Plovdiv

REVIEWER: 
(Prof. Vili Harizanova)