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RESEARCH ON THE EFFECTIVENESS OF SOME INSECTICIDES IN COMBATING PESTS IN AN OAT CROP

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Abstract

The behavior of oat varieties against harmful insects is an essential agronomic property. In the protection of plants in general and in oat culture, in the present case, insecticides will be applied only at the times when they are needed and in the optimal doses. In addition to respecting the technological links (quality ploughing, crop rotation, sowing in the optimal season), combating oat pests is a priority to minimize quantitative and qualitative production losses. In this work, the identified harmful species are presented: Sitobion avenae, Helicoverpa armigera, Haplodiplosis marginata, Haplothrips tritici, Agrotis segetum, Phorbia fumigata and mites,as well as the effectiveness of insecticide treatments based on cypermethrin 100 g/liter (Faster 10 CE), lambda-cyhalothrin 50 g/liter (Karate Zeon® 50 CS) and deltamethrin 100 g/liter (Decis® Expert 100 EC) against them. The research was carried out under conditions of natural infestation of the Ovidiu variety, during the vegetation period of 2021 in Mircea Vodă commune, Brăila county. Among these species, the greatest abundance was represented by the species Sitobion avenae. The effectiveness of the insecticide treatments applied to the oat crop was reflected in a very significant increase in production of 325 kg/ha in the case of the Karate Zeon® 50 CS product, a distinctly significant increase of 279 kg/ha in the case of the Decis® Expert 100 EC product and a insignificant increase, of 130 kg/ha, in the case of the product Fastac 10 CE.

Key words**:** *oats, pests, insecticides, effectiveness*

INTRODUCTION

Spring oats (*Avena sativa* L.), is an annual grass belonging to the family *Poaceae* and is planted for a late summer harvest.

Oats were initially cultivated as a green manure for wheat and barley crops [2].

At present, oats can be used to produce oatmeal or oat flour used for oat cakes or oat bread, but less than five percent of the world crop is used as human food, while most of the oats are used as livestock feed (horses and young stock of other animal species and poultry) [29].

Oats is an important cereal in Romania, besides maize, wheat, barley, both in conventional and organic agricultural cultivation system [17].

It is assumed that insects have been around for approx. 250 million years. Of the over 1 million species worldwide, approx. 10,000 eat crops, and of these, about 700 species cause the most damage to agricultural crops [34].

Although the first substances with an insecticidal effect date back to the time of Homer, around 1000 BC, it was only after the Second World War that the first synthetic organic insecticides appeared [33]. Worldwide losses caused by insects are about 18 (20-37)% of production [13, 20].

The grow population of the world will cause an increased global demand for food and more intensive food production is associated with more intensive use of insecticides [30].

Along with population growth, the amount of pesticides used in agriculture will increase (a 2.7-fold increase is estimated in 2050 compared to 2000), which could create problems for people and the environment. In order to reduce the risks, the most optimal solutions will be chosen to combat harmful insects, and the insecticides used must be safe, affordable, and effective at the same time [28].

Although oat are not targeted by a great species number of insects some of them such as cutworms, wireworms and aphids can all cause damage to oat [22].

Farmers usually face a oat harvest management problem due to loss caused by a variety of insect pests [19].
Production fluctuations recorded in oat culture are greatly influenced by the appearance of harmful insects and the variability of climatic conditions in its cultivation areas [21].
In this context, the purpose of the research carried out in the experimental field was to combat the pests present in the oat crop, by applying the phytosanitary treatment with Faster 10 CE (cypermethrin 100 g/liter), Karate Zeon® 50 CS (lambda-cyhalothrin 50 g/liter) and Decis® Expert 100 EC (deltamethrin 100 g/liter) insecticides at the optimal time, respecting the dose recommended by the manufacturers in the context of sustainable agriculture [5, 6, 11].

MATERIALS AND METHODS

To run this experiment, application doses approved in Romania against harmful insects in oats of Karate Zeon® 50 CS insecticide: 0.15 l/ha, Faster 10 CE: 0.15l/ha, and for Decis® Expert 100 EC: 62.5 ml/ha.
Karate Zeon® is a contact insecticide that, in addition to the quick and shock effect against pests, offers the longest period of protection, thanks to Zeon®technology [32].
Faster is an insecticide with a mode of action through contact and ingestion, having a broad spectrum of action on a diversity of insect species, with a high potential for damage in field crops. The approval of Faster 10 CE insecticide expired on 01.02.2023, with a grace period for the use/exhaustion of stocks from farmers, until 01.08.2024 [4].
Decis® Expert acts by contact and ingestion on harmful insects in the larval and adult stages. Deltamethrin is a synthetic pyrethroid that paralyzes the insect's nervous system and has a rapid knockdown (shock) effect of the insects, while also having a repellent and anti-feeding effect, thereby protecting the treated plants [8].
Field experiments were conducted in 2021 to evaluate insecticides efficacy Faster 10 CE, Karate Zeon® 50 CS and Decis® Expert 100 EC against harmful species and impact on yields of spring oat Ovidiu variety.
Ovidiu is a spring oat variety created at the Lovrin Agricultural Research and Development Station, approved in 2019.
The Ovidiu spring oat variety is characterized by a high and stable production capacity of approx. 5,000 kg/ha [1].
The research was carried out in the oats experimental fields from Mircea Vodă commune, commune located in the central-western part of Brăila county, on the right bank of the Buzău river, at 45°7′40″ latitude and 27°22′37″ longitude, in natural conditions during the vegetation period of 2021 [35].
The soil is chernozem type, favorable for growing oats.
Recent apparent global climate change may pose a threat to global food production (including that from oats) through direct effects on plant growth and changes in the prevalence and distribution of insect pests [9, 24].
Oats are a plant of temperate climates [2].
Climate is one of the dynamic components of the environment, which greatly influences the appearance of insects [36].
Climatic conditions and plant protection management are essential factors in obtaining high productions from a qualitative and quantitative point of view [15, 31, 37].
The main climatic parameters (maximum, minimum and average temperatures; atmospheric relative humidity and amount of precipitation) recorded during the oat vegetation period, which influence the emergence and development of harmful insects, can be found in Figures 1-4.

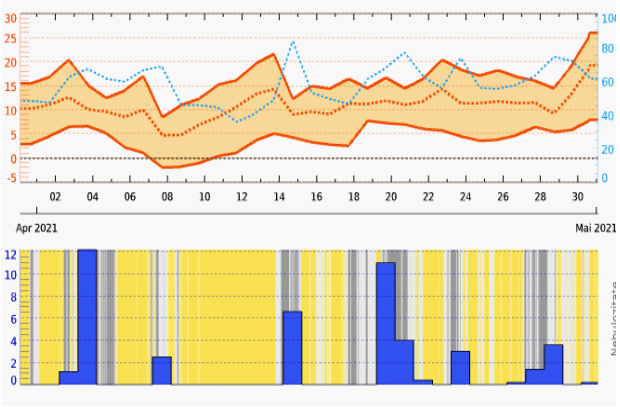

Fig. 1. Graph: top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). April, 2021.
Source: Meteoblue.com, Archive Meteo București [18].

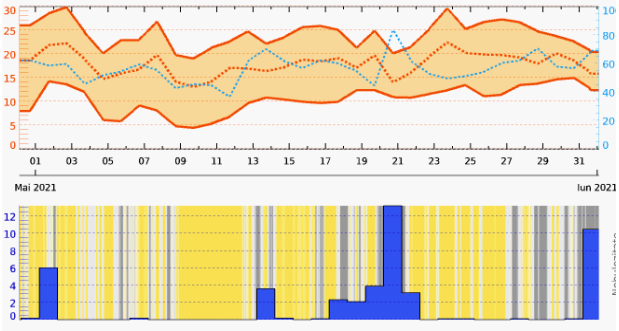

Fig. 2. Graph top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). May, 2021.
Source: Source: Meteoblue.com, Archive Meteo București [18].

The modification of abiotic factors manifested in the conditions of climate warming by the installation of particularly warm periods, in the spring-summer months, favors the development of the populations of a narrow spectrum of species, which become dominant and dangerous through numerical increases, reflected in strong attacks [16].

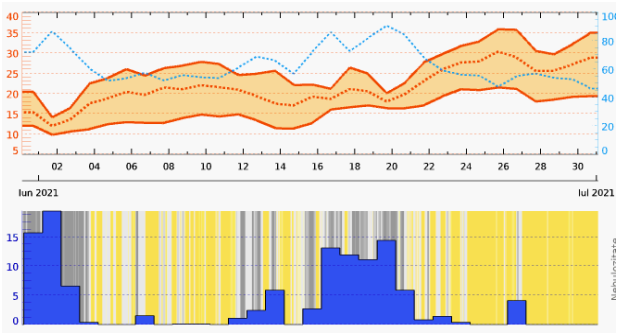

Fig. 3. Graph top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). June, 2021.
Source: Meteoblue.com, Archive Meteo București [18].

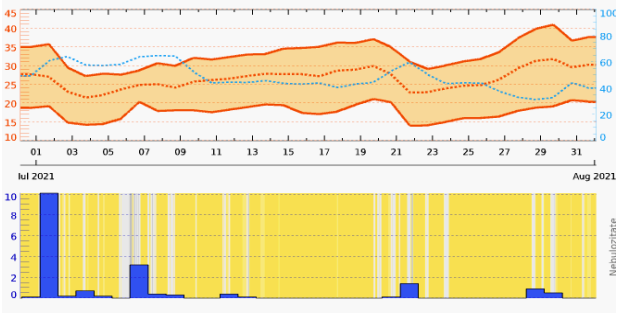

Fig. 4. Graph top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). July, 2021.
Source: Meteoblue.com, Archive Meteo București [18].

The experience regarding the influence of insecticides in combating harmful insects in oats was of a monofactorial type, with 4 variants: V1-control variant (not treated with insecticide); V2-treatment with Faster 10 CE;V3-treatment with Karate Zeon® 50 CS insecticide; V4-treatment with Decis® Expert 100 EC insecticide.
Sampling was carried out with the help of the entomological net by "mowing", i.e. by a fixed number of movements (30 double mowings representing 10 m^2, and the collected insects form a sample), over the place where the insects are found.
The experiment was arranged in a randomized block design, with 4 repetitions for each variant. The harvestable surface of the plot was 50 m^2 [27].
In order to identify the existing insect species and the number of specimens, 10 oat plants were harvested from each experimental plot, which were brought to the entomology laboratory of the Faculty of Agriculture within USAMV Bucharest [4].
The importance of oat pests in Mircea Vodă commune (Brăila) was highlighted by noting the numerical abundance and percentage structural weight of the main groups of arthropod fauna harvested during 2021.
The species were determined with the help of specialized catalogues [7, 25].
The statistical interpretation of the experimental results was carried out by analysis of variance [10].

RESULTS AND DISCUSSIONS

The identified species

Most specimens found belonged to the species -*Sitobion avenae* Fabricius-english grain aphid (Photo 1).
The greatest damage caused by *Sitobion avenae* Fabriciusis recorded between ear emergence and flowering. Direct damage is recorded by feeding on oat stalks, leaves, and spikelets (which causes some of the nutrients to decrease), and indirect damage consists of honeydew excretion (reflected by reduced photosynthesis) and virus transport [12].
In the control variants, without the application of insecticides, specimens of the predatory aphid species *Tachyporus hypnorum* Fabricius were also detected (Photo 2).

Photo 1. English grain aphid
Source: original (Popa A.).

Photo 2. *Tachyporus hypnorum*
Source: original (Popa A.).

Among the polyphagous species we identified: - pupae and adults of *Phorbia fumigata* Meigen-*late wheat shoot fly* (Photo 3). However, the larvae of this species do not harm oats [3].

Photo 3. *Phorbia fumigata*:pupa and adult
Source: original (Popa A.).

- larvae and adults of the species *Haplothrips tritici* Kurdyumov-wheat thrips (Photo 4). It is a monovoltine species, which spends about two months on the rachis or inflorescences of the host plant.

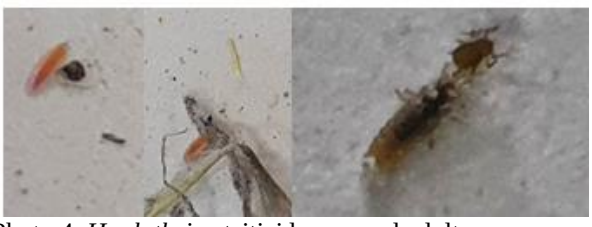

Photo 4. *Haplothrips tritici*:larvae and adult
Source: original (Popa A.).

Larvae stings cause the affected organs to turn white, and in the case of berries, they lose weight [26].

- larvae species *Helicoverpa armigera* Hübner- old world bollworm (Photo 5, left), and and the larvae of the species *Haplodiplosis marginata* Roser-red straw worm (Photo 5, right).

Oats are one of the 120 host species of *Helicoverpa armigera* [23].

Photo 5. Left: larva of *Helicoverpa armigera*; right: larva of *Haplodiplosis marginata*
Source: original (Popa A.).

The red straw worm prefers oats less. The attack of the larvae, which are located along the internodes in the area between the sheath and the stem, consists in the decrease of the height of the plant, the stagnation of the spike and a premature ripening resulting in a reduced number of grains.

- mites (Photo 6, left) present on oat plants can cause economic damage only after the natural enemies have been eliminated through the use of insecticides, and larva of *Agrotis segetum* Denis & Schiffermüller-common cutworm (Photo 6, right). The larvae can attack the roots and lower stems of oat.

Photo 6. Left: Mite (*Arachnida*); right: common cutworm
Source: original (Popa A.).

The influence of insecticides in the control of harmful insects in oats

Agrophytotechnical measures from land preparation to harvesting were the same in all variants.

To highlight the role of insecticides application, it was weeded in the variants and two fungicide treatments were applied, so that weeds and diseases do not influence the productions.

Regarding the abundance of harmful species, the most specimens belonged to the species *Sitobion avenae* (27 specimens/plant, which represents a weight of 40.29% of the total species), in second place was *Haplothrips tritici* (18 specimens/plant, with 26.86% weight), and in third place, *Haplodiplosis marginata* (16 specimens/plant, with 23.88% weight). A sporadic presence, of only 1 specimen/plant and a weight of 1.5%, was recorded by the mites, *Helicoverpa armigera* and *Agrotis segetum* (Table 1).

Table 1. Abundance of harmful species in control variant, before the application of insecticides

Species	Order	No. specimens/ plant	Share (%)
Sitobion avenae	*Hemiptera*	27	40.29
Phorbiafumigata	*Diptera*	3	4.47
Haplodiplosis marginata		16	23.88
Haplothrips tritici	*Thysanoptera*	18	26.86
Helicoverpa armigera	*Lepidoptera*	1	1.5
Agrotis segetum		1	1.5
Mites	*Araneae*	1	1.5

Source: original results.

The time of application of the insecticides was in the phenophase of flag leaf sheath swolle-BBCH 45 [14].

Table 2. Ovidiu oat variety production, following insecticides application in 2021

Variant	Productions		Difference q/ha	Significance
	q/ha	%		
Control	45.1	100	-	-
Karate Zeon®	48.35	107.2	3.25	***
Decis® Expert	47.89	106.19	2.79	**
Faster 10 CE	46.4	102.88	1.3	*
DL 5%(*)=1.3 q/ha; DL 1%(**)= 2.5 q/ha;DL 0.1%(***)= 3.0 q/ha.				

Source: original results.

In 2021, we recorded a very significant increase in production, of 3.25 q/ha in the variant with the application of the Karate Zeon® insecticide, a distinctly significant increase of 2.79 q/ha in the variant with the application of the Decis® Expert insecticide and a insignificant growth, of only 1.3 q/ha in the variant with the application of the Faster 10 CE insecticide (Table 2).

CONCLUSIONS

It is very important to consult the insecticides label for the most up-to-date products information.

It is of particular importance to respect the recommended dose of insecticides application, as well as the time of application, which contributes to avoiding pollution of the environment and production, with positive effects on the health of the final consumer, animals or people.

Insecticides phytosanitary treatment represent an important part of oat production.

Effective oat crop monitoring will help farmers make the right decisions about when to apply insecticides and the number of treatments/vegetation period.

Accurate knowledge of insect species allows farmers to plan in advance the required mechanical equipment, fuel and insecticides for successful harmful insects control with minimal environmental pollution.

The presence of harmful insects represents a risk situation in oat culture.

Sitobion avenae is oane of the most important oat pests from an economic viewpoint, because cause yield loss nearly every year.

Most of the insects present in the oat culture (*Phorbia fumigata*, *Haplothrips tritici*, *Helicoverpa armigera*, *Haplodiplosis marginata*, mite species, common cutworm) are only occasional pests and cause economic damage sporadically, when the climatic conditions are favorable for outbreaks to occur.

The presence of the entomophagous species *Tachyporus hypnorum* in the oat crop, from sunrise to harvest, contributes to the natural biological limitation of aphids.

Protecting against oat field pests is critical to avoid production losses.

The application of insecticides favored the increase of oat production.

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