ORIGINAL PAPERS

ESTIMATION OF THE INTERACTION MECHANISM OF THE ENTOMOPHAGUS *TRICHOGRAMMA EVANESCENS* WESTW. AND THE PHYTOPHAGOUS SITOTROGA CEREALELLA OL. IN THE PRESENCE OF BIOLOGICAL ACTIVE SUBSTANCES WITH KAIROMONEAL PROPERTIES

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Key words: *Trichogramma, Sitotroga cerealella, kairomon, plant protection, propagation*

INTRODUCTION

Ensuring an adequate quality of the environment, its protection - as a necessity for survival and progress - is a matter of major interest and a certain topicality for social evolution, the main objectives being the adoption of solutions to reduce pollution and increase the quality of the environment as a whole. (ISTRATE & GONTARIU, 2020), (GONTARIU, 2018).

Within the modern concepts of integrated plant protection, biotechnical methods of pest control, kairomoneium are substances with attractive action, which stimulate the bodies to find their food sources. The concept of integrated control is a way of regulating and combating pests, based on technological, ecological and economic elements.

Cairoomon enhances their ability to play a role in shaping reproductive behavior, but later studies have found other interesting aspects. These substances, released by a sex (often female) in very small quantities, which convey an extraordinarily important informational message for the survival and perpetuation of the species, can be used to destroy other species. Cairomon is a messenger substance for the transfer of information between different species, which benefits the host organism.

The food chain can also be defined as a trophodynamic unit of food transformation and circulation, in which organic matter circulates from one species to another in one direction. Each organism, which is part of the food chain, forms a food chain.

The experiences of the author (VASILIEV, 2010), demonstrated that the extraction of Lepidoptera insects from the mandibular glands has attractive properties with influences on the density of Lepidoptera insects from grain storage depots. These insects damage both the larvae and the process of laying eggs by adults, attracting parasites and predators with properties with kairomoneal activities.

Annual crop losses of agricultural crops constitute 15-80%. The widespread use of the entomophagous *Trichogramma* spp. In plant protection is related to its quality in mass propagation and application in the field. The widespread use of the entomophagous Trichogramma spp. In plant protection is related to its quality in mass propagation and application in the field.

The aim of the research is: To estimate the effect of kairomones with attractive properties on the vitality of Trichogramma spp.

MATERIALS AND METHODS

PLACE OF RESEARCH in 2022: Fundamental research will be carried out in laboratory and field conditions in the Institute of Genetics Physiology and Plant Protection in different crops.
Research objects: *Trichogramma* species, laboratory host – *Sitotroga cerealella* eggs Ol. (Fig.1, 2, 3, 4).
PLACE OF RESEARCH in 2021: Fundamental research was conducted in laboratory and field conditions at the Institute of Genetics Physiology and Plant Protection.

In order to appreciate the behavior of the Westworm *Trichogramma evanescens* entomophagous to the action of biologically active substances with kairomoneal properties and to compensate the limited flight capacity of *Trichogramma*, several quality enhancement strategies have been developed such as the use of "kairomones".

Fig 1. *T. evanescens* Westw.

Fig. 2. Moment of parasitisation of Eggs by *Sitotroga cerealellaOl*. by the *Trichogramma*

Fig. 3. Cerealmoth *(Sitotroga cerealella)* adult

As a source of kairomonee (Biologically Active Substances) the extract of alcohol and eggs from cereal moth (*Sitotroga cerealella* Ol.) were used, where the action of the fractions extracted from the scales of cereal moth on the search capacity of *T. evanescens* W was appreciated, which is an active component for enhancing entomophagous quality and reducing the density of harmful insects. In the experiments from 2021, the kairomone with optimal properties was used, obtained in 2020 with the help of the "Optimclas" program and according to the Box 3 Plan, where the Age of eggs (X1) was 24 hours and 48 hours, Concentration 30% 1 - with kairomone; 30% 2 - without kairomone-Variant of comparison, Exposition of the treatment of moth eggs 5min. (X3), in witness - without kairomone. (Table 1).

Table 1. Experimental planning conditions, 2021

Nr. Variants	The age of the eggs (X1)	Concentrations, %. (X2)	The exhibition, min. (X3)
1	24	30^1	5
2	48	30^1	5
3	24	30^2	0
4	48	30^2	0
	Martor		
5	24	0	0
6	48	0	0

30^{1-} The kairomone variant; 30^2 – without kairomone; Comparison variant (Alcool 30%)

Formula for determining the amount of water required to dilute ethyl alcohol to the required strength is X = P * (N / M-1)
X- the amount of water needed to dilute the ethyl alcohol to the required strength.
P - the amount of ethyl alcohol for dilution by variants.
N-96 degrees - the strength of the initial ethyl alcohol.
M-30 degrees - required strength of alcohol.

Fig. 4. **a**. Female of *T.evanescens* Westw; **b**. Male of *T. evanescens* Westw;

RESULTS AND DISCUSSIONS

Estimation of the entomophagous-phytophagous interaction mechanism in the presence of Biologically Active Substances with kairomoneal properties

To determine the interaction mechanism of the entomophagous *Trichogramma* and the phytophagous *Sitotroga cerealella* Ol. In the presence of Biologically Active Substances with Kairomoneal Properties in 2021, a series of experiments were performed. Determination of the search capacity of *T. evanescens* as a result of the influence of biologically active substances with kairomoneal properties of *Sitotroga cerealella* Ol. at the egg stage at 24 hours and 48 hours. To carry out the research, experiments were set up in laboratory coding, where potted bean plants were grown, which were then placed in a mini-olfactometer (4 plants each), which were treated with kairomone. In order to carry out research on the behavior of the entomophagous *Trichogramma evanescens* W., the bean plants were treated with alcohol extract and eggs from cereal moths (optimal variant) with a concentration of 30%, exposure of 5 minutes. Labels with 24-hour-old cereal moth eggs were attached to the treated and dried plants. Visual inspection of the plants was performed after treatment. Cairomone was allowed to dry from the plants, then *T. evanescens* was released. In 4-5 days, the number of parasitized eggs was recorded. The percentage of parasitism was determined. In each variant, the entomophagous *Trichogramma evanescens* was added with an optimal host parasite ratio of 1:20, ie 1 female returned 20 eggs of the moth of cereals. *Trichogramma evanescens* search capability was determined in the 2021 micro-olfactactometer. (Fig. 5).

Biological protection can be defined as the use of living organisms and the products of their biological activity in order to regulate pest populations in field crops. The effectiveness of the application of entomophages in the integrated protection of agricultural crops has been demonstrated by several scientists in different countries, (FATOUROS, 2008), (KSENTINI, 2011). In order to carry out the research, experiments were set up in laboratory coding, where potted bean plants were grown, which were placed in a mini-olfactometer (4 plants each), which were treated with kairomone.

Fig. 5. Determining the olfactometer search capability *Trichogramma evanescens*, 2021

Table 2. Percentage of parasitism of eggs of cereal moth (*S. cerealella*) by *Trichogramma evanescens*, Period 26.05-10.06. 2021.Temperature -23-25°C, Relative air humidity -65-80%

Variants 26.05-10.06.21	Total eggs	Nr. of eggs				Difference %
		Parasitized		Non-parasitized		
		Number	Percentage	Number	Percentage	
	Eggs age -24 hours					
I. variant with kairomone	800.3	694.6	86.82±5.6	113.6	13.18	11.73
II. variant without kairomone	854.0	641.3	75.09±50	230.0	24.91	
III. standard with alcohol	774.0	570.6	73.72±4.0	203.3	26.28	13.1
	Eggs age - 48 hours					
IV. variant with kairomone	777.3	576.0	74.09±5.1	200.1	25.91	4.89
V. variavta without kairomone	817.6	566.3	69.2±4.0	250.0	30.8	
VI. standard with alcohol	789.6	553.0	70.02±4.0	236.6	29.98	4.07
DEM	(Td=1.7-3.3>1.96=To.o5)					

I. Variant with kairomone (egg age-24 hours); II. Control - without kairomone (egg age-24 hours).
II. Alcohol standard (egg age-24 hours); IV. Variant with kairomone (egg age 48 hours).
III. Control without kairomone (egg age -48 hours); Standard version with alcohol without kairomone (egg age-48 hours**).**

Table 3. The influence of Biologically Active Substances on the percentage of parasitism of *T. evanescens* (in the micro-olfactometer). Temperature -26-30℃, Relative humidity -60-70%, 2021

Variants 26.05-10.06.21	Total eggs	Nr. of eggs				Difference %
		Parasitized		Non-parasitized		
		Number	Percentage	Number	Percentage	
	Eggs age -24 hours					
I. variant with kairomone	4000	2410	60.23±4.9	1590	39.77	14.96
II variant without kairomone	4000	2181	45.27±3,6	1819	54.73	
III. comparative variants (alcohol 30%)	2000	820	41.0±4,5	1180	59.0	19.23
	Eggs age - 48 hours					
IV variant with kairomone	4001	2181	54.52±4.8	1819	45.48	11.86
V. variant without kairomone	2666	1274	42.66±4,5	1459.3	57.34	
III. comparative variants (alcohol 30%)	1666	666.6	40.0±4.5	1000	60.0	14.52
DEM	(Td=1,8-2,9>1,96=To,o5)					

I. Variant with kairomone (egg age-24 hours); II. control without kairomone (egg age-24 hours); .
III. Comparative variant (Alcohol 30%) egg age-24 hours; IV-variant with kairomone (egg age 48 hours); V. control without kairomone (egg age -48 hours); VI-. Comparative variant (Alcohol 30%) variant with alcohol without kairomone (egg age-48 hours)

The experiments - The influence of biologically active substances with kairomoneal properties on the biological indices of *T. evanescens* in 2021 were carried out in two stages:

In the first stage, between 26.05-10.06.21, the weather conditions were: Temperature -23-25^{o}C, Relative humidity -70-80%. In the second stage in the period 25.06-07.07.2, the average temperature was -26-30^{o}C, the relative humidity of the air -60-70%.

In the case of kairomone, the number of parasitic eggs is 86.82%, 11.73% higher than in the control, the age of the eggs is 24 hours. The percentage of parasitism in the kairomone variant was 13.1% higher than in the standard. In the second stage, the percentage of parasitism of *S. cerealella* eggs by *T. evanescens* in the kairomone variant, with an age of 24 hours, is 60.23, which is 14.96 higher than in the control, by 19, 23% higher than in the standard and 26.59% lower than in the first stage. than in the control and by 4.07% higher than in the standard. In the second stage, the percentage of parasitism of *S. cerealella* eggs by *T. evanescens* in the kairomone variant was 54.52, 19.47% lower than in the first stage. In the second stage, the percentage of parasitism of *S. cerealella* eggs by *T. evanescens* in this variant was 40.0, is 30.02% lower than in the first stage. (Table 2). The estimation of the entomophagous-phytophagous interaction mechanism in the presence of Biologically Active Substances with kairomoneal properties was also performed in two stages.

First stage (Period 16.03.-14.04.21) 1Variant Determination of the search capacity of *T. evanescens* as because of the influence of biologically active substances with kairomoneal properties of *Sitotroga cerealella* Ol. at the egg stage. To carry out the research, experiments were set up in laboratory coding, where potted and bean plants were grown, which were placed in a mini-olfactometer (4 plants each), which were treated with kairomone.

The difference between the variant with kairomone and control, with the age of eggs-24 hours is 24.17%, with the age of eggs-48 hours this difference is 21.64%. Difference between egg age-24 hours and egg age-48 hours). The percentage of parasitism of *S. cerealella* eggs by T. evanescens in the microolfactometer for 24 hours with an average age of 24 hours was 55.53%. In the control the percentage of parasitization of the eggs was 31.36, the difference between the variant with kairomone and the control was 24.17% At the age of 48 hours the average percentage of parasitization of *S. cerealella* eggs was 51.54 %, in the control average was 29.90%, the difference between the variant with kairomone and control was 21.64%. (Table 2).

In the second stage the difference between the variant with kairomone and control, with the age of eggs-24 hours is 11.96%, with the age of eggs-48 hours this difference is 3.95%. The difference between the options with the age of the eggs (24 hours and the age of the eggs - 48 hours) is 11.12%. The difference between the kairomone variant and the 24-hour egg standard is 17.24% and the 48-hour egg age is 11.12%. In the second stage the search capacity is higher, as a result and the percentage of parasitism is higher.

1. When comparing the results of stage I and stage II, it is observed that the percentage of parasitism (search capacity) in the micro-olfactometer is higher in stage II, because the temperature during the research is higher and the speed of movement of females towards the plants in the olfactometer, with moth eggs glued to the labels and fixed on them, is higher, where it can be said that the temperature also plays a special role.
2. At higher temperatures the action of the active substances is increased.
3. The percentage of parasitized eggs in the kairomone variant is higher than in the control.
4. The biologically active substance has a positive effect on the ability to search, both in the 24-hour-old egg version and in the 48-hour-old egg variant, because the biologically active substance serves as an entomophagous attractant.

5. The results obtained during the first stage coincide with the development of the first generation of pests in the field, the results obtained during the second stage coincide with the development of the second and third generation of pests in the field. The use of kairomones demonstrates the ability to increase the quality of the entomophagous *T. evanescens*.

CONCLUSIONS

1. The percentage of *T. evanescens* parasites in the kairomone-treated variants is significantly higher than in the control and Comparative variant (Alcohol 30%), because the biologically active substance serves as an entomophagous attractant.
2. The way of examining the interaction - phytophagous and entomophagous can be called as a process to increase the quality of *Trichogramma*, on the behavior of entomophagous act chemicals that are produced by the host, the so-called kairomonees, which have a high potential to regulate harmful insects.
3. Regardless of the temperature, in the variants treated with kairomone, where the action of the fractions extracted from the scales from the cereal moth was appreciated, on the search capacity of *T. evanescens*, which is an active component of the entomophagous quality, its quality is higher.

ABSTRACT

Researche have shown that the parasitisation percentage of *Trichogramma evanescens* in kairomone-treated variants is significantly higher than in the control and the comparison variant (alcohol 30%), because the biologically active substance serves as an entomophagous attractant. The mode of examination of the interaction - phytophagous and entomophagous as the procedure which stimulates the *Trichogramma* to find its food sources. The entomophagous reacts to the host's chemicals, the so-called kairomones, which have high potential in regulating harmful insects. To carry out research on the behavior of the entomophagous *Trichogramma evanescens* W., the bean plants were treated with alcohol extract and eggs of cereal moth with kairomone (concentration of 30%), exposure of 5min. In the variants treated with kairomone, where the action of the fractions extracted from the scales from the cereal moth was appreciated, on the search capacity of *T. evanescens*, its quality is higher than in the control.

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