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ASSESSMENT OF THE SUPPRESSION METHOD OF THE POPULATION OF *HELIOTHIS ARMIGERA* Hbn. IN SOYA CROPS BY THE CONSECUTIVE USE OF DIFFERENT BIOLOGICAL AGENTS

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INTRODUCTION

High rates have been currently reached in the field of plant protection but their overestimation wouldn't be right. There are many gaps left and unsolved issues in this field. The world population grows by around 70-80 million of people every year. Many countries already deal with the lack of enough food and the need of food products will soon become a more severe problem. At the same time, the world agriculture incurs huge losses as a result of disease and vermin attacks (about 20–30% yearly) – practically, every 5th hectare of processed arable land remains without harvest. This is a significant reserve which cannot be ignored.

The key problem in the industrial pattern of agriculture intensification consists in neglecting basic agronomic and ecological issues that have lead to the aggravation of negative consequences, including the increase of the level of occurrence of diseases in plants, the attacks of pests and wild grass. Thus, the solving of such issues involves the modernization of the whole agriculture system. Concurrently with the integration in the European Community, the role of the agricultural ecosystems will increase. In the Republic of Moldova, like in other countries, the aim of the experts in the field of the protection of plants is to lessen harvest losses caused by diseases and pests without having a negative impact on the beneficial fauna.

Over the last years, the basis of the protection of plants from diseases and pests is represented by the use of integrated systems, the purpose of which is to create unfavorable conditions for the mass reproduction of harmful organisms. We consider that the situations of crisis can be solved only by the development of a scientific conception of the biological protection that should be based on classic models of biological regulation inside the biocenosis and methods focused on managing biotic environment factors shall be used. Besides this, it should be reasonable to use the operational biological control over harmful organisms with the help of classic biological protection means and as well as the use of a wide range of biological regulators as levers.

In the Republic of Moldova, the areas where soy crops are cultivated constitute about 50 thousand hectares per year. This crop is affected by several species of pests, and the most important from the economic point of view in this regard is *Heliothis armigera* Hbn. The losses caused to the soy crops are enough significant. For protecting the harvest, a wide range of pesticides are used every year. The use of pesticides entails directly the decrease of the number of beneficial species as well. The created situation can be solved only by the development of methods based on natural control mechanisms of the relationships between harmful organisms and crops – the use of sexual pheromones and entomophages.

The aim of the researches consists in the optimization of the methods aimed at decreasing the density of the population of *Heliothis armigera* in soy crops by the consecutive use of pheromonal traps and of entomophages *Trichogramma evanescens* and *Bracon hebetor* resulting from the spatial distribution of different ontogenetic stages.

MATERIAL AND METHODS

The protection method of the soy culture from *Heliothis armigera* by the consecutive use of some biological agents (pheromonal traps- against the imago stage, the entomophage *Trichogramma evanescens* – against the egg stage, and the entomophage *Bracon hebetor* – against the larval stage) was developed and tested on experimental fields of the Institute of Genetics, Physiology and Plant Protection from the Republic of Moldova.

In result of the comparative assessment of the activity of the standard pheromonal composition by adding tocopherol (as antioxidant)– «Z11-16Al(97%)+Z9-16Al(3%)+[(2R-2,5,7,8-tetramethyl-2-(4R,8R)-4,8,12-trimethyltridecy-3,4-dihydro-2H-chromen-6-ol]» we found out an increase of male attractivity in time and number. According to these findings, we used the above-mentioned pheromonal composition in traps. The method of obtaining the main component of the sexual pheromone of the moth *Heliothis armigera* (cis-11-hexadecenal) was developed by us based on a modified synthesis pattern [1].

$$HC{\equiv}CCH_2OH \longrightarrow C_9H_{19}C{\equiv}CCH_2OH\ (1) \longrightarrow$$
$$HC{\equiv}C(CH_2)_{10}OH\ (2) \longrightarrow HC{\equiv}C(CH_2)_{10}OR\ (3) \longrightarrow$$
$$C_4H_9C{\equiv}C(CH_2)_{10}OR\ (4) \longrightarrow C_4H_9C{\equiv}C(CH_2)_{10}OH\ (5) \longrightarrow$$
$$\overset{cis}{C_4H_9CH{=}CH(CH_2)_{10}OH}\ (6) \longrightarrow \overset{cis}{C_4H_9CH{=}CH(CH_2)_9CH{=}O}\ (7)$$

R = tetrahydropyranil

Due to the use of the modified synthesis pattern, the cost of the relevant pheromone decreased by about 50% if compared to the cost of the pheromone synthesized according to the standard pattern. The pheromonal traps have been distributed on the whole area of the soy field in the shape of a chess table, i.e. 12 traps per hectare. The tracking and removal of males captured in traps was carried out during the vegetation period every 7 days (Fig.1). The gathering of the entomophage *Trichogramma* sp. was carried out by the method of exposing the egg cartons of the laboratory host *Sitotroga cerealella* in the experimental soy field. As a result of the analysis of the exposed cartons it was found out that the rate of the laboratory host eggs infested with the entomophage *Trichogramma evanescens* constituted about 55,0%. The other eggs have been infested with *T. semblidis* - 20%, *T. dendrolimi* - 15%, and *T. pintoi* - 10%.Thus, it was found out that the entomophage species *T. evanescens* is predominant in the soy field. The biological indices determined for *T. evanescens* were the following: prolificity – 23,0 eggs/female; locking - 83,0%; female rate – 55,0%; female life duration - 2,7 days; quality statical criterion – 10,5.

Entomophage launching was carried out 4 times during the vegetation period within a limit of 100 thousand representatives against the first generation of *Heliothis armigera* and within a limit of 150 thousand against the second and third generation. Entomophage launching was carried out in two types of capsules – flat and ball-shaped taking into account the amount of 200 units/ha (Fig. 2).

The eggs of *Heliothis armigera* infested with the entomophage *Trichogramma evanescens* got noticed once in 7 days during the vegetation period of 10 soy plants in 28 fixed places.

The digital maps of spatial distribution of the eggs *Heliothis armigera* in the experimental field were drawn up by using ”BIOCLAS” program.

The launching of the entomophage *Bracon hebetor* in the soy crop was made in order to decrease the density of the population of *Heliothis armigera* in larval stage. During the vegetation period of the soy crop, the entomophage *Bracon hebetor* was reproduced in laboratory conditions and launched in an amount of 450 thousand representatives. The larvae of the species *Galleria mellonella* served as laboratory hosts; this larvae have been reproduced in a nutritional environment (for preparing 1kg of nutritional environment the following is necessary: 200g oat bran+130g wheat flour + 130g corn flour + 110g honey + 130g glycerin + 100g milk powder + 200g honey rests).

Fig.1. Distribution of pheromonal traps on the soy field for the male trapping of *Heliothis armigera*

Fig. 2. Ball and flat-shaped capsules for launching the entomophage *Trichogramma evanescens*.

The entomophage was launched every 7 days starting with the 2nd decade of the month of July and up to the 3rd decade of the month of August.

The main purpose is to cover the time period where the maximum number of larvae *Heliothis armigera* with an age between the 3rd and 4th development stage are encountered (the most preferable period to infest them with *Bracon hebetor* entomophage). The entomophage was launched in shape of imago and pupa, in an amount of 25-30 thousand per hectare. The records and assessment of the infestation degree of *Heliothis armigera* larvae with *Bracon hebetor* entomophage were made every 7 days by assays made on 100 soy plants in 5 repetitions.

The obtained results were subjected to mathematical analysis according to Microsoft Excel program package.

RESULTS AND DISCUSSIONS

The monitoring of the development of the population of *Heliothis armigera* by pheromonal traps proved that it got extended on the whole vegetation period of soy crops (from the 1st decade of the month of may up to the 3rd decade of the month of september).

At the same time, it was found out that the most active flight period of the moth is the first decade of the month of August and the second decade of the month of September, i.e. the period when soy beans get developed and mature. The analysis of the obtained data proved that the insect *Heliothis armigera,* in the actual climatic conditions of the Republic of Moldova gets developed in three generations.

As a result, we drew a development diagram of the insect *Heliothis armigera* in seasonal dynamics (Fig. 3).

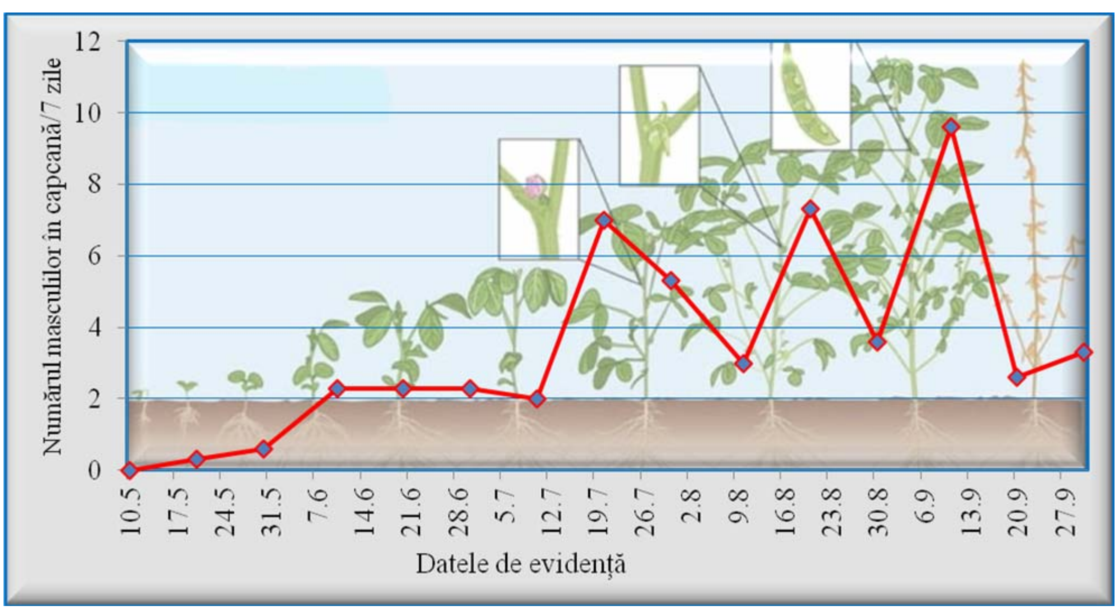

Fig. 3. Seasonal dynamics of *Heliothis armigera* population against the background of the vegetation period of soy crops. Vertically: Number of males in trap/7 days; Horizontally: Recorded data

Thus, it was proven that the most active seasonal development period of *Heliothis armigera* population is closely connected to the phenological development stages of soy crops.

For determining and localizing insect's spreading foci, digital maps have been drawn up for determining imago spatial distribution on the experimental soy field. The green color shows a low density of the population and different yellow shades show insect distribution foci on the experimental field, with a high population density (Fig. 4).

The analysis of the developed maps proved that the density of *Heliothis armigera* population gets considerably increased by generations. Thus, if the first generation shows a low density and the foci are not well-determined, the second and third generation has a considerably increased density and imago spreading foci are clearly noticeable.

About 1521 active males have been removed from insect population with the help of 12 pheromonal traps during the vegetation period of soy crops. This allowed having a significant influence on the decrease of population density by the fact that a large number of females (about 40%) remained unfertilized and this had a direct influence on the decrease of oviposition by the females on soy plants.

It was found out that, during the vegetation period, the density of the eggs laid on soy plants by the females of the insect *Heliotis armigera* varied depending on generation development. Thus, if during the development of the first generation about 7.5 eggs/100 plants were laid on an average, then, during the development of the third generation the number of laid eggs constituted already about 188,5 eggs/100 plants. We developed digital egg distribution maps based on the obtained data on the experimental field and we have assessed the foci in seasonal dynamics. This factor allowed us determining more precisely foci localization areas and optimizing the standards for launching the entomophage *Trichogramma evanescens* (Fig. 5).

1st generation 2nd generation 3rd generation

Fig. 4. The digital spatial distribution maps of *Heliotis armigera* in imago stage on the soy field depending on the seasonal development of generations (S=1,2 ha)

Fig. 5. Eggs laid on soy pods by the females of *Heliotis armigera* and infested with the entomophage *Trichogramma evanescens* as a result of 4 launchings

Thus, in the development period of the first two generations of the insect, the launching standards of the entomophage constituted 100 thousand per hectare, while during the development period of the 3rd generation, the launching standard of the entomophage was increased up to 150 thousand per hectare.

The launching of the entomophage *Trichogramma evanescens* had a considerable contribution to the decrease of the density of the population of this insect. Thus, the number of eggs of the insect infested with the above-mentioned entomophage constituted about 50% (after 4 launchings) on an average during the vegetation period, while on the reference sector, the number of infested eggs constituted only 2,7%.

For decreasing thenceforth the population of the insect *Heliotis armigera,* we have launched the entomophage *Bracon hebetor* for infesting it in the larval stage. Entomophage launching was carried out every 7 days in the period between the first decade of the month of July and the third decade of the month of August, covering in a maximum amount the time when insect larvae reach the 3rd development age (which is the most preferable for infestation).

Fig. 6. Soy pod infestation with the larvae of the insect *Heliothis armigera* and infested with the entomophage *Bracon hebetor* after entomophage launching

In this time period, we made 7 entomophage launchings. The launching of the entomophage *Bracon hebetor* on the experimental field with soy crops showed a high infestation degree of the larvae of *Heliothis armigera.* Thus, as a result of the monitoring performed, it was proven that the infestation degree of the larvae of *Heliothis armigera* on the experimental sector amounted to about 60,0%, while larvae infestation in the reference sector was only of 6,0% (Fig. 6).

CONCLUSIONS

It was proven that, due to the consecutive use of the mass capturing method of males, the launching of the entomophage *Trichogramma evanescens* and of the entomophage *Bracon hebetor* allowed decreasing the infestation of soy plants with the insect *Heliothis armigera* up to 3%, compared to the 44% of infestation in the reference variant.

ABSTRACT

It was proven that, due to the consecutive use of the mass capturing method (12 pheromonal traps per hectare), about 1521 males of the insect *Heliothis armigera* have been removed – as a result, about 40% females remained unfertilized. Consequently, due to the 4 launchings of the entomophage *Trichogramma evanescens* 50% of the insect eggs laid on the soy plants have been infested on an average. Then, after making 7 launchings of the entomophage *Bracon hebetor* about 52% of the larvae of this insect have been infested. One by one, the result of using biologic agents allowed decreasing soy plant infestation up to 3% compared to 44% of infested plants in the reference variant.

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