Trichogramma - EFFECTIVE SOLUTION FOR THE BIOLOGICAL CONTROL OF THE *Laspeyresia pomonella* L. IN APPLE TREE ORCHARDS

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Abstract. The entomophagous *Trichogramma embryophagum* HTG. is one of the most important biological agents which may be utilized against a complex of pests both in biological control, and in the system of integrated plant protection. The utilization of the eggs of *Sitotroga cerealella* OLIV. irradiated preliminary by gamma rays essentially increases *Trichogramma* biological indices and the efficiency in the field. Biological efficiency of *T. embryophagum* and the degree of damage in the first version (on irradiated eggs of grain moth) when compared with the second option (on the non-irradiated eggs) are significantly different.

Keywords: biological indices, prolificacy, effectiveness, *Trichogramma*, biological efficacy.

Rezumat. *Trichogramma* - soluţie efectivă pentru protecţia biologică în combaterea dăunătorului *Laspeyresia pomonella* L. în livezile de măr. Entomofagul *Trichogramma* este unul din cei mai importanţi agenţi biologici care poate fi utilizat în combaterea unui complex întreg de dăunători, atât în controlul biologic, cât şi în sistemul integrat de protecţie a plantelor. Utilizarea speciei *T. embryophagum* înmulţită în masă pe ouă de *S. cerealella* preliminar iradiate cu raze gama, permite creşterea esenţială a indicilor biologici şi a eficacităţii ei în câmp. Eficacitatea biologică a *T. embryophagum* este mult mai avantajoasă în prima variantă, unde ouăle de *S. cerealella* au fost preliminar iradiate. În acest caz şi gradul de dăunare al dăunătorului se micşorează, în comparaţie cu varianta a doua, unde ouăle de molie, pe care a fost înmulţit entomofagul nu au fost iradiate.

Cuvinte cheie: indicii biologici, prolificitatea, eficacitatea, *Trichogramma,* eficacitatea biologică.

INTRODUCTION

The predominance of the chemical pressure to reduce the number of pests in fruit plantings causes significant disruption of biodiversity of arthropods fauna, changing the number and behaviour of insects, which subsequently causes disruption of the numerical connection in the food chains as well as of stable agrocoenosis, resulting in unintended environmental consequences. Relevant and promising for plant protection practice is the development and implementation of integrated systems for the protection of fruit crops from pests, which combine elements of different methods. However long-range integrating elements in such systems are alternative means and the entomophagous *Trichogramma* is the most important and effective biological agent, limiting the number of many species of Lepidopterans including orchard pests (GULII *&* PAMUJAC, 1994).

The bibliographic sources contains many positive results on the effectiveness of *Trichogramma* in the orchards, as a promising entomophagous for regulating the number of *Lepidopterans* (ALMATNI et. al., 2001; BOTTO, 2004; BREEDVELD *&* TANIGOSHI, 2007).

The most common and economically damaging pest of the apple tree is apple moth (*L. pomonella*), against which entomophagous *Trichogramma* is used at the egg stage. The most widely spread specie of *Trichogramma* in the orchards of the Republic of Moldova is *T. embryophagum* HTG. For breeding *Trichogramma* in the laboratory conditions the grain moth (*Sitotroga cerealella* OLIV.) is traditionally used as the host, which is at the same time more technological in production than other types. In order to improve test quality and effectiveness of *Trichogramma,* dilution was held on the host eggs, irradiated with gamma rays.

In The Institute of Protection of Plants and Ecological Agriculture there was an intensive research conducted in order to find solutions for technological and applied aspects of *Trichogramma* application, especially in programs of producing ecologically clean products in different cultures. The aspect of *Trichogramma* application is studied less in permanent crops.

The objective of our research was to improve the production technology and application of the entomophagous *T. embryophagum*, as well as to determine its place in the integrated system of protection of apple from apple moth.

MATERIAL AND METHODS

The studies were conducted between 2002 and 2009, both in the laboratory and field conditions – in the Institute of Protection of Plants and Ecological Agriculture orchards, agricultural farms Mereni and Puhoi, Ialoveni county, using laboratory populations of *T. embryophagum* (based on isolates collected in an apple orchard).

Issues of entomophagous in agrocoenosis were done by placing caps and bags at the bottom of the tree crowns. The rate of release of *Trichogramma* in the orchard was 500-600 thousand species individuals per hectare.

The collecting, identification, storage and accumulation of *Trichogramma* were conducted according to the set procedure (DIURICI, 2008).

Breeding of grain moth and *Trichogramma*, evaluation of biological effectiveness of entomophagous and the extent of fruit damage by pest and mathematical data processing were conducted according to the relevant procedures and guidelines for the mass breeding and use of *Trichogramma* (ABAŞCHIN et al., 1979; MENCER & ZIMERMAN, 1986).

RESULTS AND DISCUSSION

1. Determination of biological indicators of the *T. embryophagum.*

In laboratory conditions, the entomophagous *T. embryophagum* was reactivated after prolonged diapause and accumulated for 3-4 generations, while defining the biological indicators of species representatives bred on irradiated with gamma rays grain moth eggs in comparison with non-irradiated eggs option. The biological indicators *T. embryophagum* (1st variant, radiation) were characterized by high fertility from 27.5 to 32.0 egg/female, good survival from 88 to 93 % and the absolute predominance of females to 100% in the static quality criteria of 25.0 to 28.8. For *T. embryophagum*, bred on unexposed grain moth eggs (II version), these rates differed significantly – lower fecundity of females from 16.6 to 18.0 eggs/female, species survival from 80 to 90 % and lower static performance index of 13.4 to 16.4 (Table 1, Fig. 1).

Table 1. Biological indicators of *T. embryophagum*.

Species	Breeding performance, eggs/female, P1	Hatching,%, a1	Quota of females,%, a2	Statistic quality criterion, Y1
T. embryophagum, option I	27.5 – 32.0 1.2 ± 1.6	88.0 – 93.0 2.6 ± 3.2	100.0	25.0-28.8 0.4 ± 1.5
T. embryophagum, option II	16.6-18.0 0.4 ± 1.0	80.0 – 90.0 3.1 ± 3.6	100.0	13.4- 16.4 0.3 ± 0.5

2. Application *T. embryophagum* in the apple tree orchards.

During the period 2002-2009, experiments were carried out in apple orchards with different densities of apple moth populations in the Institute of Protection of Plants and Ecological Agriculture of the ASM, and agricultural enterprises Mereni and Puhoi, applying *T. embryophagum* for the development of two full and part-time third-generations of apple moth pest. The launch scheme of *T. embryophagum* in the field in small bags is represented in Fig. 2. The results of the efficacy of *T. embryophagum* against apple moth in the period from 2002 to 2009 are presented in Table 2. Research was conducted in three variants: the 1st version of *T. embryophagum* was bred on grain moth eggs irradiated with gamma rays, in the 2nd variant *T. embryophagum* was bred on the non-irradiated grain moth eggs; the 3rd option - control - without *Trichogramma* releases, where it was the detection of entomophage presence in nature.

To monitor the pest the pheromone traps were set in the garden. Direct recording of density apple moth eggs and the percentage of infected *Trichogramma* was carried on there. The density of eggs according to generations and years ranged from 8.0 - 90.0 eggs per 100 fruits and leaves. The total area of the orchids where entomophage issues were conducted was 33.15 hectares. After six issues of *T. embryophagum* the biological efficacy ranged from 68.2 to 90% in the 1st variant and 64.0 - 84.7% in the 2nd version. Control check reflected that the number of pest-parasitized eggs ranged from 2.0 to 21.5% and fruit-damage ranged from 45.0-93.0%.

Table 2. Biological efficiency of *T. embryophagum* on the apple tree crop.

Year, area	Variants	Biological effectiveness, %	Apple fruit damage,%
2002 Mereni	I II III	75.5±2.5 64.0±1.9 3.5 ±0.2	4.7±0.3 6.8±0.2 45.0±1.1
2003 Chişinău	I II III	90.0±2,8 84.7±2.5 4.0±0.3	11.0±1.6 16.0±1.80 81.7±2.9
2005 Chişinău	I II III	86.0±3.0 80.0±2.8 5.0±0.1	9.0±0.8 15.0±0.9 80.0±2.9
2006 Chişinău	I II III	80.0±3.0 73.3±2.1 5.0±2.0	11.2±0.8 18.7±1.0 70.0±2.1
2007 Chişinău	I II III	83.3±3.5 78.1±2.5 5.7±0.7	25.5±1,9 27.8±1.0 90.1±3.5
2007 Puhoi	I II III	83.3±2.7 78.1±2.1 2.0±0.1	3.5±0.3 4.4±0.4 34.0±1.2
2008 Chişinău	I III	68.2±2.0 8.8 ±1.0	42.3±1.7 92.5±3.6
2009 Chişinău	I III	78.5±2.8 21.5±0.9	38.0±1.5 93.0±3.6

Legend: Variant I - *T. embryophagum* bred on irradiated grain moth eggs; Variant II - *T. embryophagum* bred on non-irradiated grain moth eggs; Variant III - control, without the release of *Trichogramma.*

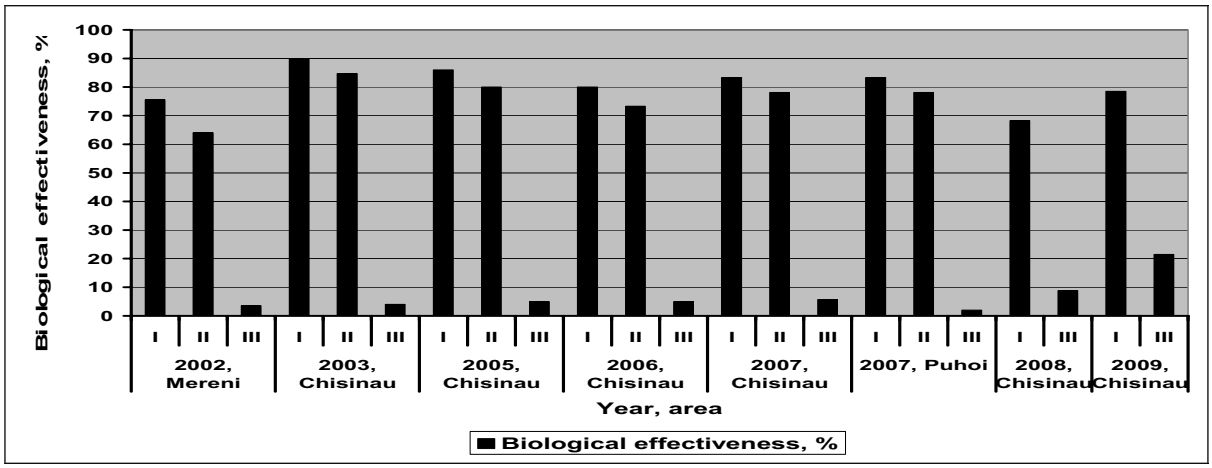

Figure 1. Biological effectiveness of *T. embryophagum* biological control over the *L. pomonella* in orchards.

Figure 2. Packed *T. embryophagum* launched (original).

Figure 3. *L. pomonella* eggs parasitized by *T. embryophagum* (original).

Therefore flooding issues of the entomophagous *T. embryophagum* to reduce the number of codling moth, the major pest of apple, can become one of the main methods of integrated garden protection, allowing the reduction of the number of insecticide treatments to a minimum.

The entomophagous *Trichogramma* is one of the most important biological agents which may by utilized against a complex of pests both in biological control and in the system of integrated plant protection. The utilization of the eggs of *S. cerealella.* irradiated preliminary by gamma rays essentially increases *Trichogramma* biological indices and the efficiency in the field. The biological efficacy of *Trichogramma* and the degree of damage in the first version (on irradiated eggs of grain moth) when compared with the second option (on the non-irradiated eggs) are significantly different.

The priorities of entomophagous in plant protection are: to reduce the financial expenses for protection, to save useful organisms in nature, to increase the biological effectiveness in the field, to increase the volume of agricultural production to provide food quality, to reduce the number of chemical treatments to a minimum of integrated system that prevents contamination of the environment, low price, safe, good-quality, easy usage, ecological cleanliness.

The entomophagous *Trichogramma* is one of the most important biological agents which may be used against a complex of pests both in biological control and in the Integrated Pests Management. The biological indicators of *T. evanescens* rearing on the eggs of different hosts irradiated with gamma rays increased by 2-2.5 times and its biological effectiveness in the field is more than 10-15%. Figure 3 summarizes *L. pomonella* eggs parasitized by entomophagous *T. embryophagum* in apple orchard.

CONCLUSIONS

Grain moth eggs *(Sitotroga cerealella)* irradiated with gamma radiation provide higher biological indicators of *Trichogramma* than its cultivation on non-irradiated eggs.

Consequential issues (5-6) - *T. embryophagum* in the garden provide a higher level of eggs parasitism thus significantly reducing the percentage of damaged fruit.

After six issues of *T. embryophagum* the biological efficacy ranged from 68.2 to 90% in the 1st variant and 64.0 - 84.7% in the 2nd variant. Control check reflected that the number of pest-parasitized eggs ranged from 2.0 to 21.5% and fruit-damage ranged from 45.0 to 93.0%.

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Received: March 13, 2013
Accepted: April 7, 2013