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LABORATORY EVALUATION

of the possibility of using the eggs of the chestnut moth Cameraria ohridella Deschka & Dimic, 1986 (Lepidoptera: Gracillariidae) of feed the trichogram Trichogramma pintoi Voeg. and Trichogramma evenescens Westw.

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Goal. *Evaluation of the suitability and eggs of chestnut moth Cameraria ohridella for parasitism and development of trichogramma.* ***Methods.*** *Laboratory cultures of Trichogramma pintoi Voeg were used for research. and Trichogramma evanescens Westw., which were bred on the eggs of Sitotroga cerealella Oliv. The experiment was performed according to the following scheme: female trichogramma after mating was placed in a test tube in 5 replicates for each species. The tube was closed with a stopper and the sex of individuals under binoculars was checked. In test tubes with trichogram laid strips of paper with one-day eggs of chestnut moth (25 copies.). In 5 replicates and kept in a thermostat (temperature — 24—25°C; relative humidity — 65—67%). The percentage of trichogram revival and the ratio of males to females, life expectancy and fertility of females were determined. Trichogramma individuals, which were fed with grain moth eggs, served as controls. The experiment lasted until the complete death of the trichogram. The obtained results were processed statistically according to standard methods.* ***Results.*** *A small number of chestnut moth eggs pierced by trichogramma were detected, but embryonic development of the parasite's eggs was not observed. Comparing the size of the eggs of the chestnut moth with the size of the eggs of the main squamous pests against which different species of trichogramma are effectively used, we can conclude that for the successful development of eggs T. pintoi and T. evanescens chestnut moth eggs are not suitable as feeders. Probably, in terms of size and biological quality, they do not correspond to the parameters of the ecological niche of the hosts of the family Trichogrammatidae.* ***Conclusions.*** *In the laboratory, it was found that the eggs of the chestnut moth are not suitable for parasitizing the trichogramma of T. pintoi and T. evanescens. The main pests of crops, which are effectively parasitized by different species of trichogramma, have an egg size in the range of 0.4—1.0 mm, while the size of chestnut moth eggs does not exceed 0.27—0.32 mm. It is possible that the size and biological quality of chestnut moth eggs do not meet the parameters of the ecological niche of entomophagous feeders of the family Trichogrammatidae. Further researches with use of various types of a trichogramma, first of all — T. dendrolimi Mats appear actual.*

trichogramma; chestnut passing moth; biological method

Deteriorating environmental conditions and gradual climate change are the main causes of irreversible functional changes in the environment. Imbalance of ecosystems leads to disruption of trophic relationships and, as a consequence, there are large-scale population changes in biota. The emergence and rapid spread of a new invasive species in Ukraine — the chestnut passing moth *Cameraria ohridella* Deschka & Dimic, 1986 (Lepidoptera: Gracillariidae) poses a serious threat to bitter chestnut common *Aesculus hippocastanum* L. (Hippocastanaceae), a potential threat to this biomass.

In mature cells there is a constant mass reproduction of chestnut moth, which is provided by a fairly high fertility of females (20—40 eggs), high viability of eggs (50—70%), polyvoltage (3—4 generations per season) and provides a high survival rate of the pest population in winter. One pair of butterflies, with a fertility of 30 eggs and 50% survival of the population, reproduces up to 3375 individuals in three generations. It is well known that when more than 70% of the leaf blade surface of any plant is damaged, the leaf loses its assimilative properties and the plant sheds such leaves [1, 2].

In plant protection, the biological method is based on the use of parasitic and predatory insects, pathogens and other enemies that do not pose a threat to the environment. Trichogramma in Ukraine is used on vegetable, technical, grain, legumes and orchards against a complex of scoops, whiteflies, fireflies, leafhoppers and other pests [3, 4]. Among the practical aspects of the biomethod in plant protection is widely used trichogramma.

Currently, 26 species of trichogramma have been described in

Ukraine [5]. The agrocenoses of vegetable crops are dominated by species *Trichogramma pintoi* Voeg., *T. evenescens* Westw., *T. semblidis* Auriv., In fruit — *T. dendrolimi* Mats., *T. embryophagum* Hart. The optimal norms of application of trichogramma of different species on different cultures are determined. T. *dendrolimi* Mats has the maximum efficiency (77.5—80.1%) in the agrocenosis of the apple orchard [6].

The problem of using the trichogram to regulate the number of chestnut moths is currently controversial, there is not enough literature to solve it. According to the personal message of V.N. Fursov (Candidate of Biological Sciences, Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine) at a conference on biomethods at the Institute of Plant Protection of the National Academy of Sciences of Ukraine. The experience of European countries has also shown the fundamental impossibility of protecting chestnuts from moths by using methods and techniques known in the field of plant protection [7]. However, scientific papers suggest that *Cameraria ohridella* Deschka & Dimic, 1986 (Lepidoptera: Gracillariidae) is recommended to release *T. dendrolimi* Mats to control the pest [7]. With four entomophagous releases, the degree of leaf surface damage was 10—16%, which allowed the chestnuts to successfully complete the growing season and prepare for winter. The advantage of this method is its complete safety in an urban environment [8].

Given the practical need for biological regulation of the number of chestnut moth in an urban environment, a detailed assessment of the prospects for the use of trichogramma is relevant.

Goal. Investigation of the suitability of chestnut moth eggs for parasitism and development of *Trichogramma pintoi* Voeg and *Trichogramma evanescens* Westw.

Research methods. The use of trichogramma requires high efficiency of industrial production and seasonal colonization, which depends on a number of factors, the determinants of which are species, set of hygrothermal regimes of laboratory cultivation and features of use [9—11].

Laboratory cultures of the trichogramma *T. pintoi* Voeg and *T. evanescens* Westw., which were bred on the eggs of *S. Cerealella* Oliv, were used for research.

Each species of trichogramma has its own feeders and biocenoses, which are preferred by *T. pintoi* Voeg is widespread, hatched from eggs of fireflies, moths and others. Used: on vegetable crops — against the complex of scoops and whiteflies; on sugar beet crops — against meadow butterfly, scoop complex, beet thyme; on corn — against a corn butterfly; on busy couples — against the scoop complex.

T. evanescens Westw is adapted to field biocenoses, herbaceous vegetation, is derived from the eggs of cabbage and winter moth, white cabbage, corn butterfly.

To obtain one-day-old chestnut moth eggs in the laboratory, chestnut moth pupae from chestnut leaves were transferred to the laboratory. The sex of individuals was determined by morphology — in males VII segment of the abdomen of the pupa is distally enlarged [1]. Pupae of different sexes were planted in glass jars, in which corrugated green paper was previously placed as a substrate for laying eggs. The garden was covered with a thick cloth moistened with water with added sugar. The optimum temperature for egg laying by chestnut moth females is 25°C, at which embryonic development of eggs lasts 6.1 ± 0.12 days [12].

The study was performed in the laboratory according to the following scheme: female trichogramma after mating was placed in a test tube in 5 replicates for each species. After that, the tube was closed with a stopper and checked the sex of individuals under binoculars.

Subsequently, strips of paper with one-day-old chestnut moth eggs (25 pcs. each) were placed in trichogram tubes in 5 replicates and kept in a thermostat (temperature — 24—25°C; relative humidity — 65—67%) until parasitism of eggs chestnut moth. The percentage of trichogram revival and the ratio of males to females, life expectancy and fertility of females were determined.

The control was a trichogramma, which is live eggs of grain moth.

It is known that eggs infected with trichogramma, in a few days as the larvae develop a characteristic black color, in most cases with a bluish tinge. This distinguishes infected eggs from uninfected ones. Sometimes the trichogramma pierces the eggs of insects without laying their eggs in them. Pierced eggs of the pest do not develop, but turn black and die.

The experiment lasted until the complete death of the trichogramma. The obtained results were processed statistically by standard methods of statistical processing of the results of biological experiments.

Results and discussion. The results of the evaluation of the possibility of using chestnut moth eggs in the laboratory to feed Trichogramma are shown in table 1. A small number of chestnut moth eggs pierced by *Trichogramma* (*T. pintoi* Voeg or *T. evanescens*) were found, but embryonic development of parasite eggs was not observed.

The effectiveness of trichogramma in natural conditions against different pests of crops depending on the size of the pest's eggs was carried out (table 2).

According to O.L. Andriychuk, the effectiveness of a single issue of trichogramma against the complex of scoops (winter scoop (*Agrotis segetum* Schiff), scoop c-black (*Xestia c-nigrum* L.), scoop (*Agrotis exclamationis* L.) and scoop epsilon (*Agrotis ipsilon* Hfn.) sugar beet reached 66%. In variants with a double release of the trichogram, plant damage decreased three times [13].

The effectiveness of *Trichogramma* against turnip whitefly is 27—44%, garden or lettuce scoop — 75, cabbage scoop — 36—100, winter scoop — 60—70, cabbage white — 40—100, gamma scoop — 83—90, grain moths — 3, cabbage moth — 30—40, scoops-epsilon — 66, corn butterfly — 40—86% [13—20].

By using the trichogramma against the winter moth and other gnawing moths on sugar beet crops, the parasite infects up to 70% of the pest's eggs. The use of trichogramma is also effective against cabbage moth, whiteflies and fireflies in cabbage plantations [8].

With the use of trichogramma against pea weevil (*Laspeyresia nigricana*) in the usual rate of release of eggs on the third — fifth day is 8—11%. Only two weeks later, when the mass laying of eggs by the pest begins and the breeding of the daughter generation of trichogramma, the population of eggs increases sharply and reaches 64—78% [18].

With the use of trichogramma against meadow butterfly (*Margaritia sticticalis*) during the period of

mass laying of eggs by the pest for two releases, the level of parasitism of egg-laying reaches 60—70%. The efficiency of the daughter generation of the trichogram of the fiery form reached 69%. The incidence of eggs in the first 3—7 days was 27—31%, and by the period of mass egg laying reached 83—90% [15].

Comparing the size of the eggs of the chestnut moth with the size of the eggs of the main scale insects against which the trichogram is effectively used, we can conclude that the chestnut moth eggs are too small for the successful development of *T. pintoi* Voeg and *T. evanescens* eggs. It is possible that in size and biological quality they do not meet the parameters of the ecological niche of entomophagous hosts of the family *Trichogrammatidae*.

1. The effectiveness of trichogramma against chestnut moth in the laboratory

		Repetition	Number of eggs	*Trichogramma pintoi*		*Trichogramma evanescens*	
				Parasitic eggs	Revived %	Parasitic eggs	Revived %
Experiment	Chestnut passing moth Cameraria ohridella	1	25	0	0	0	0
		2	25	0	0	0	0
		3	25	0	0	0	0
		4	25	0	0	0	0
		5	25	0	0	0	0
	everything	-	-	0	0	0	0
Control	Sitotroga Sitotroga cerealella Oliv	1	100	36	26	36	26
		2	100	54	36	54	36
		3	100	25	24	25	24
		4	100	53	43	53	43
		5	100	67	78	85	95
	everything	-	-	**235**	**24—78**	**253**	**24—95**

2. Effectiveness of trichogramma (T. pintoi and T. evanescens) in natural conditions against pests of agricultural crops [2, 4, 7, 13—20]

Pests	Size of pest eggs (diameter, mm)	Trichogramma infection %
Rape beetle (*Pieris rapae* L.)	**≈1**	27—44%
Meadow butterfly (*Margaritia sticticalis*)	**0.8—1.0**	83—90%
Call moth (*Scotia excilamationis* L.)	with 34—38 radial ribs, **0.7—0.9** in diameter	66%
Pea fruit eater (*Laspeyresia nigricana*)	**0.7—0.8**	36—100%
Garden or lettuce moth (*Memestra oleracea* L.)	**0.7—0.75**	75%
Cabbage moth (*Mamestra brassicae* L.)	with 32—38 radial ribs, **0.6—0.7** in diameter	78—100%
Winter moth (*Scotia segetum* Schiff.)	with 45—48 radial ribs, **0.5—0.6** in diameter	60—70%
Cabbage moth (*Pieris brassicae* L.)	length 1,25, diameter — up to **0.6**	40—100%
Gamma moth (*Autographa gamma* L.)	**0.5—0.6**	83—90%
Grain moth (*Sitotroga cerealella* Oliv)	**0.5**	3%
Cabbage moth (*Plutella maculipennis* Curt.)	**0.4—0.5** and 0,2—0,3 mm wide	30—40%
Epsilon moth (*Scotia ipsilon* Hfn.)	with 40 radial ribs, **0.4—0.5** in diameter	66%
Corn butterfly (*Perausta nudslalis*)	**0.4**	40—86%
Chestnut passing moth (*Cameraria ohridella*)	**0.27—0.32**	—

CONCLUSIONS

The main pests of crops, which are effectively parasitized by the trichogramma *T. pintoi* Voeg and *T. evanescens*, have an egg size in the range of 0.4—1.0 mm, while the size of chestnut moth eggs does not exceed 0.27—0.32 mm. It is possible that the size and quality of the chestnut moth egg are not included in the ecological niche of the trichogramma of *T. pintoi* Voeg and *T. evanescens*.

Further studies on the use of different species of trichogramma, primarily *T. dendrolimi* Mats, remain relevant.

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Лабораторна оцінка можливості використання яєць каштанової мінуючої молі *Cameraria ohridella* Deschka & Dimic, 1986 (Lepidoptera: Gracillariidae) для живлення трихограми *Trichogramma pintoi* Voeg. та *Trichogramma evanescens* Westw.

Мета. *Оцінити придатність яєць каштанової молі Cameraria ohridella для паразитування і розвитку трихограми.* **Методи**. *Для досліджень використовували лабораторні культури трихограми видів Trichogramma pintoi Voeg. та Trichogramma evanescens Westw., яких розводили на яйцях ситотроги Sitotroga cerealella Oliv. Дослід проводили за схемою: самиць трихограми після спаровування розміщували у пробірку в 5-ти повторностях для кожного виду. Пробірку закривали пробкою і перевіряли стать особин під бінокуляром. У пробірки з трихограмою закладали смужки паперу з одноденними яйцями каштанової молі (по 25 екз.) у 5-ти повторностях й утримували в термостаті (температура 24—25°С; відносна вологість повітря 65—67%). Визначали відсоток відродження трихограми та співвідношення самців та самиць, тривалість життя і плодючість самиць. Контролем слугували особини трихограми, яких живили яйцями зернової молі. Дослід тривав до повної загибелі трихограми. Одержані результати обробляли статистично за стандартними методиками.* **Результати**. *Виявлено незначну кількість яєць каштанової молі, проколотих трихограмою, але ембріональний розвиток яєць паразита не спостерігався. Порівнявши розмір яєць каштанової мінуючої молі з розміром яєць основних лускокрилих шкідників, проти яких ефективно використовуються різні види трихограми, можна зробити висновок, що для успішного розвитку яєць T. pintoi та T. evanescens яйця каштанової молі, як живителі, не придатні. Вірогідно, за розміром та біологічною якістю вони не відповідають параметрам екологічної ніши живителів родини Trichogrammatidae.* **Висновки.** *В лабораторних умовах встановлено, що яйця каштанової молі не придатні для паразитування трихограми видів T. pintoi та T. evanescens. Основні шкідники сільськогосподарських культур, яких ефективно паразитують різні види трихограми, мають розмір яєць в діапазоні 0,4—1,0 мм, в той час як розміри яєць каштанової молі не перевищують 0,27—0,32 мм. Можливо, за розміром та біологічною якістю яйця каштанової молі не відповідають параметрам екологічної ніші живителів ентомофагів родини Trichogrammatidae. Представляються актуальними подальші дослідження з використанням різних видів трихограми, у першу чергу — T. dendrolimi Mats.*

трихограма; каштанова мінуюча міль; біологічний метод

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Лабораторная оценка возможности использования яиц каштановой минирующей моли *Cameraria ohridella* Deschka & Dimic, 1986 (Lepidoptera: Gracillariidae) для питания трихограммы *Trichogramma pintoi* Voeg. и *Trichogramma evanescens* Westw.

Цель. *Оценить пригодность яиц каштановой моли Cameraria ohridella для паразитирования и развития трихограммы.* **Методы**. *Использовали лабораторные культуры трихограммы видов Trichogramma pintoi Voeg. и Trichogramma evanescens Westw., которых разводили на яйцах ситотроги Sitotroga cerealella Oliv. Опыт проводили по следующей схеме: самок трихограммы после спаривания размещали в пробирку в 5-ти повторностях для каждого вида. Пробирку закрывали пробкой и проверяли пол особей под микроскопом. В пробирки с трихограммой закладывали полоски бумаги с однодневными яйцами каштановой моли (по 25 экз.) в 5-ти повторностях и удерживали в термостате (температура 24—25°С, относительная влажность воздуха — 65—67%). Определяли процент возрождения трихограммы и соотношение самцов и самок, продолжительность жизни и плодовитость самок. Контролем служили особи трихограммы, которых кормили яйцами зерновой моли. Опыт продолжался до полной гибели трихограммы. Полученные результаты обрабатывали статистически по стандартным методикам.* **Результаты**. *Выявлено незначительное количество яиц каштановой моли, проколотых трихограммой, но эмбрионального развития яиц паразита не наблюдали. Сравнив размер яиц каштановой минирующей моли с размером яиц основных чешуекрылых вредителей, против которых эффективно используются различные виды трихограммы, можно сделать вывод, что для успешного развития яиц T. pintoi и T. evanescens яйца каштановой моли не пригодны по размеру и биологическому качеству.* **Выводы.** *В лабораторных условиях установлено, что яйца каштановой моли не пригодны для паразитирования трихограммы видов T. pintoi и T. evanescens. Основные вредители сельскохозяйственных культур, которые эффективно паразитируют различные виды трихограммы, имеют размер яиц в диапазоне 0,4—1,0 мм, а размеры яиц каштановой моли не превышают 0,27—0,32 мм. Возможно, по размеру и биологическим качествам яйца каштановой моли не соответствуют экологической нише живителей энтомофагов семьи Trichogrammatidae. Представляются актуальными дальнейшие исследования с использованием различных видов трихограммы, в первую очередь — T. dendrolimi Mats.*

трихограмма; каштановая минирующая моль; биологический метод

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