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SPECIES OF *TRICHOGRAMMA* SPP. COLLECTED FROM DIFFERENT AGRICULTURAL CROPS IN THE REPUBLIC OF MOLDOVA

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KEYWORDS

Trichogramma spp.
Percentage of parasitism
Cereal moth
Sitotroga cerealella Ol.

ABSTRACT

Between 2022-2024, 38 exposures with small cards containing *Sitotroga cerealella* eggs were conducted to collect *Trichogramma* from the wild. The identified species were *T. embryophagum*, *T. pintoi*, *T. evanescens*, *T. dendrolimi*, and *T. leucania*. The parasitism percentage of moth eggs exposed in the field depended on weather conditions (temperature, humidity, etc.). The highest parasitism rates were observed in irrigated tomato crops, while extreme heat and low humidity negatively affected *Trichogramma* populations. Due to the naturally low parasitism rates, additional field releases of *Trichogramma* are necessary for effective biological protection of crops. The use of entomophages has several advantages, including reduced financial costs for crop protection, conservation of beneficial organisms, increased biological efficiency in the field, improved agricultural production, better food quality, and minimal reliance on chemical treatments, reducing environmental pollution.

INTRODUCTION

Trichogramma spp. is a small insect, measuring 0.3-0.5 mm, which lays its eggs inside the eggs of pests, making it an oophagous parasite. Its legs consist of three segments. *Trichogramma* has two pairs of wings, with the forewings being twice as long as their width and rounded at the tips. Female antennae are shorter and end with a slightly rounded segment with short sensilla, whereas males have smaller wings and longer sensilla-covered antennae. Determining *Trichogramma* species requires morphological and biological characteristics, with the primary distinguishing feature being the male genitalia (Gavrilita, 2014). To achieve this, temporary glycerin-based or permanent preparations are made. Individuals are first kept in lactic acid until they decolorize (approximately 3-4 days) to better observe the genital structure before the preparations are completed. The reproduction ratio of *Trichogramma* is determined by the condition of the biological material—both the *Trichogramma* and the eggs of the cereal moth—depending on the host-to-parasite ratio (P:G). In the initial stages (obtaining the mother culture), a high P:G ratio is more rational. However, in the final multiplication stage (producing *Trichogramma* for field release), when cost efficiency is a priority, lower ratios (1:5 or 1:10) may be more profitable. A unilateral approach to this issue could significantly reduce the quality of *Trichogramma* or unjustifiably increase production costs. Only by considering all factors can an appropriate strategy for *Trichogramma* multiplication be determined (Dyurich, 2008). To optimize *Trichogramma* multiplication, it is important to evaluate the dependence of fecundity indices and parasitism percentage on the P:G ratio and parasitism exposure. At temperatures above 30°C or below 15°C, female fecundity decreases by half.

To enhance the vitality of laboratory populations, it is recommended to renew the mother culture annually by collecting *Trichogramma*-parasitized lepidopteran eggs from the wild. During mass reproduction of *Trichogramma spp.*, the numerical density of initial colonies increases exponentially, leading to a rise in inbreeding, signs of inbreeding depression, and disturbances in the sexual structure of populations. These factors collectively reduce the quality of the entomophage.

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Genetic diversity is maintained by collecting large numbers of initial colonies from the wild (no fewer than 1,500-2,000 parasitized eggs) to preserve the gene pool.

MATERIALS AND METHODS

To determine *Trichogramma* species, both morphological and biological characteristics are analyzed, with male genitalia being the key distinguishing feature.
Temporary glycerin-based or permanent preparations are used for identification. Individuals are first kept in lactic acid until decolorized (3-4 days) to better observe their genital structures before the preparations are completed.
To collect *Trichogramma* from the wild, exposure experiments were conducted from March to August during the vegetation period of annual and perennial crops between 2022-2024. Different crops were sampled, including apple, plum, acacia, rosehip, sunflower, soybean, beans, peas, tomatoes, maize, cherry, and sage. The percentage of *Sitotroga cerealella* eggs exposed and parasitized by *Trichogramma* in nature was determined.

RESULTS AND DISCUSSION

In 2022, 14 exposures were carried out in different agricultural crops from April 14 to August 3. The percentage of parasitism in apple crops varied from 0.3% to 2.8%, plum from 0.3% to 3.1%, sunflower from 3.4% to 5.8%, beans from 3.0% to 3.4%, peas from 2.8% to 3.1%, tomatoes from 3.0% to 12.0%, soybeans from 2.0% to 5.0%, maize from 2.2% to 8.0%, and cherry from 0% to 1.1%. The identified *Trichogramma* species were *T. embryophagum, T. pintoi, T. evanescens*, and *T. dendrolimi*.

Table 1. Percentage of cereal moth eggs exposed and parasitized by *Trichogramma sp.* in nature for different crops (2022)

No.	Date	Crop	Percentage of parasitized eggs	*Trichogramma sp.* Species
1	14.04.22	Plum	0.3	*T. embryophagum*
		Apple	0.3	*T. embryophagum*
2	19.04.22	Plum	0.6	*T. embryophagum*
		Apple	1.0	*T. embryophagum*
3	27.04.22	Plum	2.0	*T. embryophagum*
4	05.05.22	Apple	2.1	*T. embryophagum*
		Cherry	1.1	*T. dendrolimi*
5	25.05.22	Plum	2.7	*T. dendrolimi*
6	06.06.22	Apple	2.8	*T. dendrolimi*
7	08.06.22	Plum	3.1	*T. embryophagum*
8	14.06.22	Soybean	3.0	*T. dendrolimi*
9	22.06.22	Soybean	5.0	*T. dendrolimi*
10	27.06.22	Soybean	2.0	*T. evanescens*
11	05.07.22	Soybean	2.5	*T. dendrolimi*
		Sage	25.0	*T. evanescens*
		Corn	2.2	*T. evanescens*
12	15.07.22	Soybean	2.8	*T. dendrolimi*
		Tomato	3.0	*T. evanescens*
13	26.07.22	Corn	8.0	*T. dendrolimi*
		Tomato	12.0	*T. evanescens*
14	03.08.22	Tomato	10.0	*T. dendrolimi*

In 2023, 11 exposures were conducted from April 14 to July 24. Parasitism percentages varied as follows: apple (0.6%-8.8%), plum (0.8%-1.2%), sunflower (3.4%-5.8%), beans (3.0%-3.4%), peas (2.8%-3.1%), tomatoes (7.5%-8.8%), soybeans (4.2%-5.4%), maize (6.0%-7.2%), and rosehip (0%-1%). The identified *Trichogramma* species included *T. embryophagum, T. pintoi, T. evanescens, T. leucania*, and *T. dendrolimi*.
In 2024, 13 exposures were conducted from April 15 to July 16 across various crops. The parasitism percentage varied from 0.6% to 8.8%. The highest parasitism rates were recorded in irrigated tomato crops. In late July, exposed moth eggs dried due to high field temperatures (32-34°C) and low relative humidity (38-42%), significantly reducing *Trichogramma* development. The collected species were *T. embryophagum, T. pintoi, T. evanescens*, and *T. dendrolimi*. The effectiveness of biological control using *Trichogramma spp.* is enhanced when the species is used on the specific crop from which it was collected. The collected material was multiplied over three generations and then induced into diapause for further research.

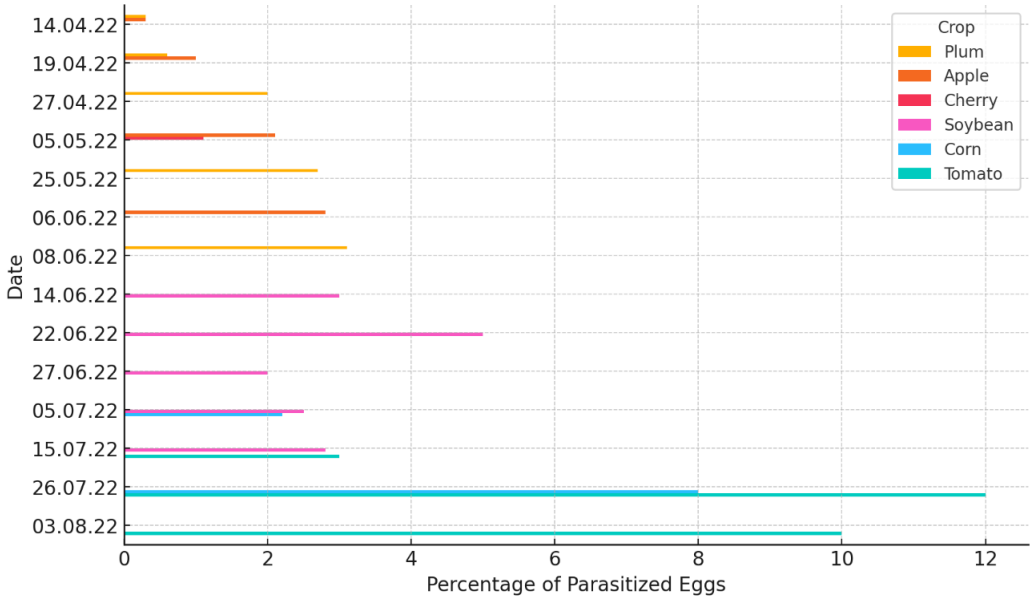

Figure 1. Parasitized eggs percentage by crop (2022)

Table 2. Percentage of cereal moth eggs exposed and parasitized by *Trichogramma sp.* in nature for different crops (2023)

No.	Date	Crop	Percentage of parasitized eggs	*Trichogramma sp.* Species
1	14.04.23	Apple	0.6	*T. embryophagum*
2	19.04.23	Plum	0.8	*T. embryophagum*
		Acacia	0.8	*T. embryophagum*
3	27.04.23	Plum	1.0	*T. embryophagum*
		Dog rose	1.0	*T. dendrolimi*
4	05.05.23	Plum	1.2	*T. embryophagum*
		Apple	1.3	*T. dendrolimi*
5	25.05.23	Plum	1.2	*T. dendrolimi*
		Apple	1.5	*T. dendrolimi*
6	16.06.23	Sunflower	3.0	*T. pintoi*
7	22.06.23	Sunflower	3.4	*T. evanescens*
		Bean	3.0	*T. pintoi*
		Pea	3.1	*T. evanescens*
8	27.06.23	Sunflower	4.4	*T. pintoi*
		Bean	3.4	*T. evanescens*
		Pea	2.8	*T. evanescens*
9	06.07.23	Tomato	7.5	*T. evanescens*
		Soybean	4.2	*T. pintoi*
		Corn	7.2	*T. evanescens*
		Sunflower	5.7	*T. evanescens*
10	17.07.23	Tomato	8.4	*T. evanescens*
		Soybean	5.4	*T. pintoi*
		Corn	6.1	*T. evanescens*
		Sunflower	5.5	*T. leucania*
11	24.07.23	Tomato	8.8	*T. evanescens*
		Soybean	5.0	*T. pintoi*
		Corn	6.0	*T. dendrolimi*
		Sunflower	5.8	*T. evanescens*

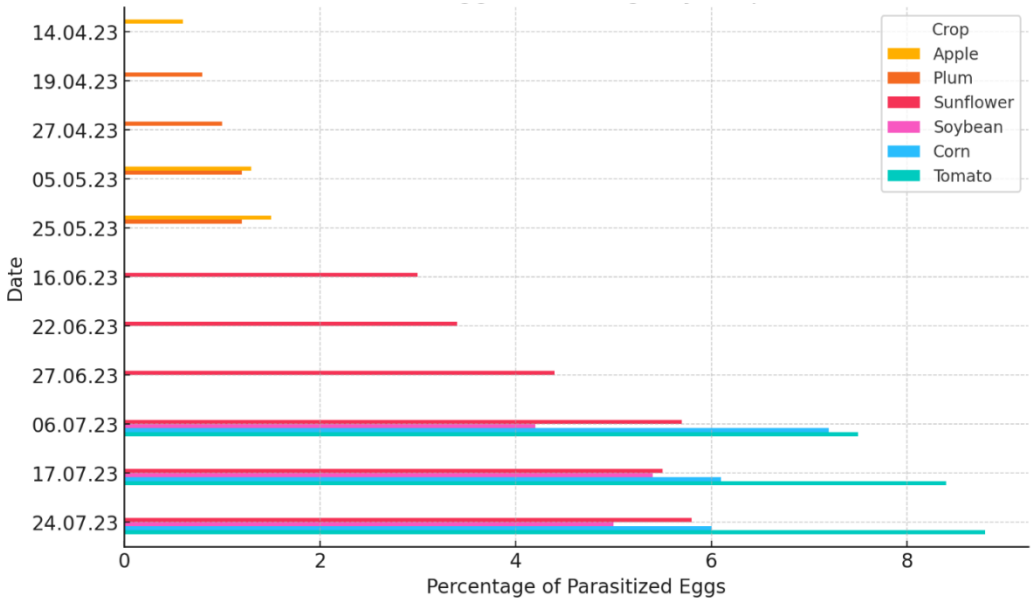

Figure 2. Parasitized eggs percentage by crop (2023)

Table 3. Percentage of cereal moth eggs exposed and parasitized by *Trichogramma sp.* in nature for different crops (2024)

No.	Date	Crop	Percentage of parasitized eggs	Trichogramma sp. Species
1	15.04.24	Sour Cherry	1	None
		Plum	2	*T. dendrolimi*
		Apple	4	*T. embryophagum*
		Lilac	3	*T. pintoi*
2	22.04.24	Plum	2	*T. pintoi*
		Apple	2	*T. pintoi*
		Sour Cherry	2	*T. embryophagum*
3	30.04.24	Plum	3	*T. pintoi*
		Golden Acacia	3	*T. dendrolimi*
		Apple	3	*T. pintoi*
4	07.05.24	Plum	0	*None*
		Apple	2	*T. pintoi*
5	14.05.24	Plum	2	*T. pintoi*
		Apple	3	*T. dendrolimi*
		White Acacia	4	*T. dendrolimi*
6	20.05.24	Soybean	2	*T. pintoi*
		Rose	0	*None*
7	23.05.24	Apple	5	*T. dendrolimi*
		Plum	6	*T. dendrolimi*
8	03.06.24	Corn	4	*T. evanescens*
		Soybean	4	*T. evanescens*
9	12.06.24	Tomato	8	*T. evanescens*
		Corn	6	*T. evanescens*
		Soybean	7	*T. pintoi*
10	18.06.24	Tomato	9	*T. evanescens*
		Corn	8	*T. evanescens*
		Soybean	7	*T. pintoi*
11	25.06.24	Tomato	10	*T. evanescens*
		Corn	9	*T. pintoi*
		Soybean	6	*T. pintoi*
12	03.07.24	Tomato	9	*T. evanescens*
		Corn	8	*T. evanescens*
		Soybean	0	*None*
13	16.07.24	Tomato	11	*T. evanescens*
		Corn	10	*T. pintoi*
		Soybean	0	*None*

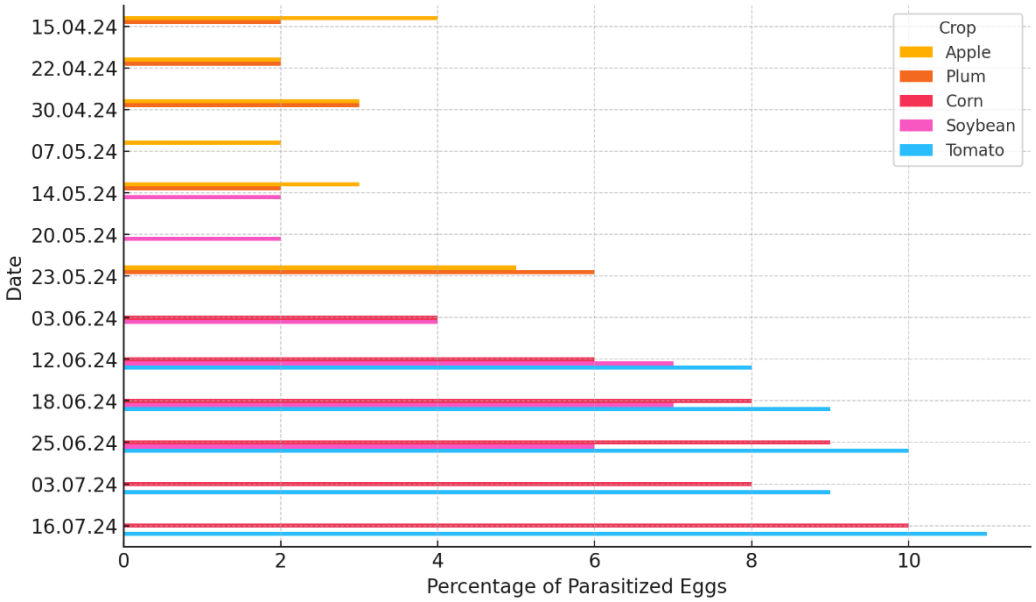

Figure 3. Parasitized eggs percentage by crop (2024)

CONCLUSIONS

Between 2022-2024, 38 exposures with small cards containing *Sitotroga cerealella* eggs were conducted to collect *Trichogramma* from the wild. The identified species were *T. embryophagum*, *T. pintoi*, *T. evanescens*, *T. dendrolimi*, and *T. leucania*.

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