Studii şi Cercetări	Mai 2018	Biologie	27/2	11-15	Universitatea"Vasile Alecsandri" din Bacău

THE INFLUENCE OF INTERSPECIFIC COMPETITION OF *TRICHOGRAMMA* SP. TO MASS MULTIPLICATION

Lidia Gavrilita

Key words: *biological indices, prolificacy, pests, Trichogramma, competition, biological efficacy*

INTRODUCTION

Biological control plays an important role in integrated plant protection. Beneficial insects are rather important in modern biological control practice for reducing pests' density.

The Institute of Genetics, Physiology and the Plant Protection of Academy of Sciences of Moldova conducts fundamental and applied research with *Trichogramma* to settle technical issues, improve entomophage's quality and effectiveness in plant protection to obtain ecological safe products. To improve parasitoid quality and efficacy, it is necessary to select the right species best adapted to natural conditions of certain zones with certain species.

At the initiative of academician Ion Popusoi, there was set up within the Institute of Genetics, Physiology and Plant Protection, the laboratory of *Trichogramma*, initially headed by Dr. Ala P. Adaskevici (1976-1977), then by Dr. Şoil M. Greenberg (1977-1992), later on by Dr. Vladimir A. Sleahtici (1995-1999) and finally by Dr. Lidia T. Gavrilitsa (1999-2003).

In 2003 the Laboratory of *Trichogramma* was united with another laboratory and named „Phytopharmacy and Ecotoxicology", that has continued functioning till nowadays (2016). Thus the Labotatory of *Trichogramma* existed as a research unit in the Institute of Department Plant Protection within the Academy of Sciences of Moldova from year 1976 up to year 2013, i.e. 27 years and thus *Trichogramma* has continued being studied for 40 years (976 till present, 2016). Since its setting up, the Laboratory of *Trichogramma* has dealt with big and important issues.

Along the period *Trichogramma* studies in the laboratory conditions, resulted to important data which were described in national and international scientific publications. These results have been presented at various conferences, symposia, round tables and exhibitions.

In mass rearing of *Trichogramma*, the numerical density of the initial colonies grows by tents, even hundreds of times leading to a depression the number of inherited crossings and thus leading to sexual deregulation of the population, and to a lowering of the quality of *Trichogramma.*

Such factor as interspecific competition becomes particularly important at *Trichogramma* mass rearing and releasing into the field. At relative trophic specialization of *Trichogramma* competitive capacity impacts its efficacy (GAVRILITA et al. 1984; SOROKINA, 1984; MENCHER, RUSNAK, TARITSA, 1980).

MATERIALS AND METHODS

During the rearing of the laboratory host, biological indices have been determined for *T. evanescens* (prolificacy, hatching, females' rate) reared on these eggs. Experiments carried under laboratory and field conditions.

Experiments have been made in three climatic chambers SKP-1 at average daily temperatures of 15, 20 and 25^{o}C and relative humidity of 50, 65 and 80%, at photoperiod lasting for 16 hours. Experiments have been effectuated according to Box-3 plan.

Collecting, identification, storage and accumulation of *Trichogramma* species were done according to DIURICI (2008). Rearing of the laboratory host – grain moth (*Sitotroga cerealella* Ol.), for *Trichogramma* production was done by ABAŞCHIN et al. (1979) authors' methods. Mathematical data processing has been done using variance analysis method after MENCER & ZEMSHMAN (1986).

RESULTS AND DISCUSSIONS

Five trial variants in five repetitions have been conducted in the Institute of Genetics, Physiology and the Plant Protection of Academy of Sciences of Moldova, using various reports on *Trichogramma* species under laboratory and field conditions: 1. *T. evanescens* – 100%; 2. *T. pintoi* – 100%; 3. *T. evanescens* + *T. pintoi* – 50% +50%; 4. *T. evanescens* + *T. pintoi* – 10% +90%; 5. *T. evanescens* + *T. pintoi* – 90% +10%. Experiments conditions are shown in Table 1.

Table 1. Box-3 (planned conditions)

Levels of factors	T, °C	W, %	*T. evanescens* : *T. pintoi*
-1	15	50	1 : 9
0	20	65	1 : 1
1	25	80	9 : 1

Laboratory experiments have demonstrated that during 4 generations of *Trichogramma* development the *T. evanescens* species has been gradually substituted by *T. pintoi* (Table 2, Fig. 1). When share ratio of *T. evanescens* and *T. pintoi* equals to 1:1 passed through Angoumois grain moth eggs (*Sitotroga cerealella* Ol.) after the fourth generation it has been noticed that at T=15°C combined with different humidities, *T. pintoi* share has constituted from 68.3 to 83.95% and *T. evanescens* share – 16.1 to 31.7%; at T=20°C these parameters have ranged, respectively, from 76.0-95.0% and 5.0 to 24.0%,while at T=25°C – they ranged from 76.1 to 100% and from 0 to 23. 9%.

When shares of *T. evanescens* and *T. pintoi* have equaled respectively to 9:1 substitution rate of *T. evanescens* has been more reduced. However at T=15°C in mixed batch there remained from 42.9 to 45.0% of *T. evanescens* at T=20°C, respectively, from 38.9 to 45.0%, at T=25°C – from 31.5 to 38.35%. At the end of all experiment variants no *T. evanescens* have been found, while at T=25°C similar situation has been observed for the III-rd generation.

The mechanism of substituting one species by the other has been explained by different response of *T. evanescens* and *T. pintoi* on temperature and humidity regimes at mass rearing.

Lower prolificacy and sex index as well as longer duration of one generation of *T. evanescens* and *T. pintoi* have been observed in all experiment variants. The obtained results have demonstrated that the Angoumois grain moth is a more preferable laboratory host for *T. pintoi* and even small adding's of this species may lead to substituting *T. evanescens*. Experiments have been made with 4 generations due to the fact that commercial biological laboratories have been recommended to rear no more than 4 generations of *Trichogramma* on eggs of the Angoumois grain moth after passage on cabbage moth (*Mamestra brassicae*) eggs followed by field release. Substitution phenomenon of one species by the other may be explained by different reasons. Under conditions of South-West region of the former USSR *T. evanescens* has been a dominant species (up to 95-99%) in agrocenoses of cereal, technical and leguminous crops. The *T. pintoi* has been the laboratory population for which the Angoumois grain moth became a preferable host (Table 3).

Table 2. Influence of temperature and humidity of substituting process of *T. evanescens* by *T. pintoi* (after IV-th generation)

Temperature, °C	15°C						20°C						25°C					
Species ratio	1:1		1:9		9:1		1:1		1:9		9:1		1:1		1:9		9:1	
Species	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*
Humidity, %	Humidity 80%																	
Nr. of individuals, %	16.1 ±0,5	83.9 ±3.2	7.0 ±0.5	93.0 ±3.9	45 ±2.0	55 ±2.2	5.0 ±2.2	95 ±3.8	0	100	45 ±2.0	55 ±2.5	0	100	0	100	38.5 ±1.5	61.5± 2.0
Humidity, %	Humidity 65%																	
Nr. of individuals, %	29.5 ±0,8	70.5 ±3.7	9.0 ±0.3	91.0 ±4.2	44.0 ±2.2	56.0 ±2.3	7.0 ±2.3	93.0 ±4.8	0	100	43,0 ±2.0	57.0 ±2.6	5.0	95.0 ±3.5	0	100	35.0 ±1.5	65.0 ±2.2
Humidity, %	Humidity 50%																	
Nr. of individuals, %	31.7 ±1,8	68.3 ±3.0	22 ±0.9	78.0 ±3.8	42.9 ±3.1	57.1 ±2.6	24.0 ±2.8	76.0 ±3.3	6.0 ±0,5	94.0 ±4.9	38.9 ±2.4	61.1 ±2.8	23.9 ±1.8	76.1 ±3.8	8.0 ±0.8	92.0 ±4.9	31.5 ±0.8	68.5 ±2.8

Hence, the number of *T. pintoi* females that refused parasitizing eggs of the Angoumois grain moth has equaled to 2%, while that of *T. evanescens* – 38%. The *T. pintoi* reared on eggs of the Angoumois grain moth has higher prolificacy and sex index and a new generation develops faster than that of *T. evanescens*. It has been found that intensity of substituting of *T. evanescens* by *T. pintoi* has been regulated by response to temperature and humidity regimes at mass rearing (Tables 3, 4). The *T. pintoi* is ecologically more plastic species while *T. evanescens* stronger responds to humidity fluctuations under the same temperature. Field experiments have shown that cabbage moth eggs have been more parasitized by *T. evanescens* – 54 to 60%, than by *T. pintoi* – from 13 to 14%.

Figure 1. Influence of temperature and humidity on substitution of *T. evanescens* by *T. pintoi* (after IV-th generation)

Table 3. Influence of temperature and humidity on prolificacy and ratio of *T. evanescens* and *T. pintoi* species

Temperature, °C	Humidity, %	Prolificacy/female		Number of females, %		Period of generation development (days)	
		T. evanescens	*T. pintoi*	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*
15	80	17.6±1.0	19.7±1.8	58.4±2.8	60.2±2.9	27-28 ±1.3-1.9	25-26 ±1.2-1.6
	65	14.2±0.9	15.8±1.5	53.6±2.7	60.3±2.8		
	50	12.9±0.7.	17.2±1.0	50.2±2.3	59.8±2.3		
20	80	19.7±1.4	25.7±1.9	60.2±2.9	62.9±2.9	19-20 ±1.2-1.7	16-17 ±1.1-1.5
	65	15.6±1.3	18.9±1.4	56.4±2.0	64.2±2.3		
	50	14.1±1.0	15.4±1.0	53.4±2.3	60.7±2.6		
25	80	29.0±1.8	33.5±2.4	63.0±2.9	62±2.3	12-13 ±1.1-1.5	10-11 ±1.0-1.4
	65	19.8±1.2	23.2±2.0	59.1±2.3	61.5±2.7		
	50	16.7±1.0	20.2±1.8	55.4±2.2	59.8±2.3		
DEM		2.54	3.40	4.3	4.55	1.40-1.8	2.20-2.6

Table 4. Ratio of *Trichogramma* species in *Mamestra brassicae* parasitized egg laying (%) after field release

Experiment variant	Percentage of *Mamestra brassicae* eggs parasitized by *Trichogramma*.		Ratio of *Trichogramma* species in *Mamestra brassicae* parasitized egg-laying (%), after field release			
			Released on 3.06		Released on 9.08	
	Released on 23.06	Released on 19.08	*T. evanescens*	*T. pintoi*	*T. evanescens*	*T. pintoi*
T. evanescens (100 %)	54.3±2.7	60.4±3.7	100	0	100	0
T. pintoi (100 %)	13.8±1.4	12.6±0.8	0	100	0	100
T. evanescens + *T. pintoi* (50:50%)	40.8±1.9	39.0±1.8	91.1±2.4	8.9±1.0	94.5±3.4	5.5±0.5
T. evanescens + *T. pintoi* (10:90%)	14.2±1.0	23.3±1.1	85.6±3.9	14.4±1.8	88.8±3.3	11.2±0.7
T. evanescens + *T. pintoi* (90:10%)	42.4±3.5	49.9±3.0	100	0	100	0
DEM	2.33	2.45	3.67	3.56	4.32	3.78

Field experiments

Experiments have been conducted in one Grătieşti farm on cabbage to control *Mamestra brassicae* at density of 10 eggs/m^2. Temperature and humidity have been taken into accounts during research experiments. After field experiments *Trichogramma* species have been identified by their morphological structure, male genitalia and share of *Trichogramma* species that hatched from parasitized pest eggs. No releases have been made in the check.

After the first release of mixed populations of *T. evanescens* and *T. pintoi* (50 : 50%), share in percentage has constituted 91.05% for *T. evanescens* and 8.95% for *T. pintoi* (Table 4). After the second release respective shares have been as follows – 94.5% and 5.5%. After the first release of mixture of *T. evanescens* and *T. pintoi* (10:90%) egg laying of the cabbage moth have been parasitized at the level of 85.6% by *T. evanescens* and at the level of 14.4% by *T. pintoi*, after the second release – 88.8 and 11.2% respectively. After the first and second releases of *T. evanescens* and *T. pintoi* mixed populations (90:10%) analyses have shown that it is *T. evanescens* that actually controlled the pest in the field while *T. pintoi* has not been found.

It has been established that under natural conditions species competition has been lower. To the above said contribute fluctuations of temperature and humidity, localization of host eggs in time and space, as well as more intensive accumulation of species that are not specific for this biocenosis (for example *T. pintoi*). However, if further *Trichogramma* release is not made, the dominant species is restored. In case of presence of two species in the biotope quantitative share will depend on specific climatic conditions and the number of preferable host individuals.

CONCLUSIONS

In the laboratory experiments, it has been established that along the 4 development generations of mixed populations of *Trichogramma*, gradual substitution of *T. evanescens* by *T. pintoi* occurs.

In the field of cereal, technical and vegetable crops, *T. evanescens* a dominant species (up to 95-99%). The *T. pintoi* represents a laboratory population, which's preferred host is *Siotroga cerealella*. In the presence of the two species of *Trichogramma* in the biotope, their quantitative ratio depends on the specific conditions of climate and resource of preferred host's eggs. Biological indices for *T. pintoi* are higher than ones of *T. evanescens*, therefore, in the laboratory conditions we substitute *T. evanescens* by *T. pintoi,* but in the field it's opposite.

It has been established that under natural conditions species competition has been lower. To the above said it contributes fluctuations of temperature and humidity, localization of host eggs in time and space, as well as more intensive accumulation of species that are not specific for this agrocenoses (for example *T. pintoi*).

However, if further *Trichogramma* release is not made, the dominant species is restored. In case of presence of two species in the biotope quantitative share will depend on specific climatic conditions and the number of preferable host individuals.

ABSTRACT

As a result of the laboratory experiments, it has been established that along the 4 generations in mixed populations of *T. evanescens* Westw. and *T. pintoi* Voeg., gradual substitution of *T. evanescens* by *T. pintoi* occurs. The mechanism of interspecific competition on grain moth eggs was established. In the field of cereal, technical and vegetable crops, *T. evanescens* is dominant specie (up to 95-99%). *T. pintoi* represents a laboratory population, which's preferred host is *Siotroga cerealella* Ol..

In the presence of the two species of *Trichogramma* in the biotope, their quantitative ratio depends on the specific conditions of climate and resource of preferred host's egg. Biological indices for *T. pintoi* are higher than ones of *T. evanescens*. Therefore, in the laboratory conditions we substitute *T. evanescens* by *T. pintoi,* but in the field it's opposite.

REFERENCES

1. ABASHKIN A., VOROTINTSEVA, A., GREENBERG A. 1979 - *Guidelines for mass rearing and application of the Trichogramma*. Moscow: 23-44 [In Russian];
2. DIURICI G.. 2008 - *Collecting, identifying and maintenance of live cultures of Trichogramma Westw. (Hymenoptera, Trichogrammatidae). Methodical guidelines*. Kishinev: 35 [In Russian];
3. GAVRILITA, L., DIURICI, G., GREENBERG A. 1984 - *Intraspecific competition at Trichogramma. Mass rearing of Trichogramma*. Kishinev: 19-26 [In Russian];
4. MENCHER E., RUSNAK A., TARITSA C. 1980 - Fecundity of Trichogramma depending on host eggs quality. *Agricultural biology*. Moscow. 15(3): 400-403 [In Russian].
5. MENCHER, E., ZEMSHMAN A. 1986 - *Basics to planning experiences with elements of mathematical statistics in viticulture research*. Kishinev: 20-27. [In Russian];
6. SOROKINA A., 1987 - Biological and morphological proves of the species Trichogramma telengai sp. n. *Entomological Review*. Leningrad. 66 (1): 32-46 [In Russian].

AUTHOR'S ADDRESS

GAVRILITA LIDIA - Institute of Genetics, Physiology and Plant Protection, Pădurii Str., 20, Chişinău, Republic of Moldova, e-mail: lidia_gavrilita@yahoo.com