THE INFLUENCE OF NANOMAGNETIC PARTICLES ON *Trichogramma sp* SEX RATIO AND PROLIFICACY

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Abstract. *Trichogramma* is one of the most significant egg parasitoid in the biological and unpolluted pest control.

Key words: *Trichogramma* sp; Nano Magnetic Particles (NMPs), Sex Ratio, Prolificity;

Introduction

The extension of pest biological control represents one of the perspective trends in plant protection. Different species of *Trichogramma* are released to control more than 25 different caterpillar pests attacking corn, vegetables, sugar beets, fruit and forest trees, spruce and rice, sugarcane, cotton, pine tree (in Romania as well as all over the world respectively; Ryvkin, 1959). *Trichogramma* wasps occur naturally in almost every terrestrial and some aquatic habitats (Kehail et al., 2007). Their distribution is done according to the cultivated area, crops, pest attack and species. In some Europe Countries (France, Germany, Republic of Moldavia and Switzerland) an important corn areas were treated with *Trichogramma* against European corn borer (Hassan, 1994). In Romania research programs (BIOTECH and PNII) were initiated which led to developing models that can improve the wasp biological parameters for field delivery.

To increase the biological efficiency of the parasite different measures can be used (Consoli & Parra, 1997). Among them we introduced Magnetic Fluids (MFs), mixtures of Nano-Magnetic Particles (NMPs) as active part. The use of NMFs was desired as an alternative method to increase wasp's biological parameters with a low production costs.

Magnetic Fluids are any kind of fluid with magnetic properties, representing an appart material, pointing out and inducing new phenomena. Ferro Fluids / Magnetic Fluids or Nano Magnetic Fluids are ultrastable colloids of magnetic nanoparticles in water and organic carriers (O'Connor, 1962; Papell, 1965). Electrical conductivity ($\sigma = 0$) and magnetic permeability ($\mu \geq \mu 0$) are important parameters on hydrodynamics of ferrofluids (magnetic fluids) under the action of an applied magnetic field (Neuringer&Rosensweig 1964).

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Introduction of new methods and technologies, as nanotechnologies, represents a great perspective with practical implications in many domains of biological sciences.

At list two species of *Trichogramma* have been selected for experimental purposes *T. evanescens* ssp corn (strain TMZ02) and cabbage (strain TMBOC02) and *T. embryophagum*.

The main aim of this study was:

- to establish the Sex Ratio modification in specific conditions, different types of MFs and NMPs concentration;
- to point out the MF/NMPs in order to increase the *Trichogramma* prolificacy.

Materials and Methods

Trichogramma (Westwood) stocks and culture: *Trichogramma evanescens* (T. ev.) and *Trichogramma embryophagum* (T. embr.) species collected in Timişoara were used. The collected wasps are considerate as "landraces" because their evolution took place in this area. Two forms of *Trichogramma evanescens* were followed. To control *Ostrinia nubilaris* Hbn. and *Mamestra brassicae* L. *Trichogramma evanescens* – corn (strain TmZ02) and *Trichogramma evanescens* - cabbage (strain TmC02) respectively were used. *T. embryophagum* population composed of females only was a subject to evaluate NMPs effect. In laboratory condition both entomophagous species were allowed to develop on the host eggs of *Sitotriga cerealella* Oliv.

Magnetic nanofluids (MNFs) used in experiments have been prepared at the *Center for Technical Fundamental and Advance Research, Romanian Academy, Timişoara subdivision* (Dr. Chim. Doina Bica), characterized at the *National Center for Complex Fluids Systems Engineering „Polytechnica" University* Timişoara (Dr. Fiz. Ladislau Vekas), since 1987, were used in biological fields at the USAMVB Timişoara.

To improve the wasp prolificacy two types of MFs *with different NMPs* were used: γ-Fe_3O_4 and $CoFe_2O_4$ ($\theta = 0.45x10^{-5}$ and $\theta = 0.87x10^{-5}$ g Fe/cm^3 concentrations respectively). Prior to be parasitized by *Trichogramma* wasp the host eggs were pretreated with MFs (30µl/l). The *Trichogramma* female finds a *Sitotroga* egg, drills a hole through the chorion (egg shell) and inserts one or two eggs into the host. The internal pressure provides a drop of yolk, the necessary feed for the female. After 8-9 days a new adult wasps emerge. The new *Trichogramma* generation was considered as being FM wasps. Our observations on FM wasps were made.

The experimental data were statistically analysed, using plifactorial analysis (Ceapoiu, 1968)

Results and Disscution

In 1998 local landraces of *Trichogramma* were collected in Timişoara natural areas vegetable garden, fruit trees and parks. *Trichogramma* found favorable conditions around *Albizzia julibrissin* (Willd) trees to enhance their populations.

1. The Sex Ratio modification in FM populations. The sex ratio in different population of *Trichogramma* was less studied previously. A high proportion of females provide a larger number of butterflies and more moth eggs are parasitized. In natural environment or standard insectaria the sex ratio is almost one female for one male or 50 percent females. The antennae hairs were the criteria of female identification. Adult females have a few short hairs/antennae in opposition to males having long and large number of hairs (Grissel & Schauff, 1990).
The experimental work was focused on MNPs utilization to see if it could induce specific conditions to enhance the female proportion in the population frame (Figure 1). Experimental state changed sex ratio in the females favor.

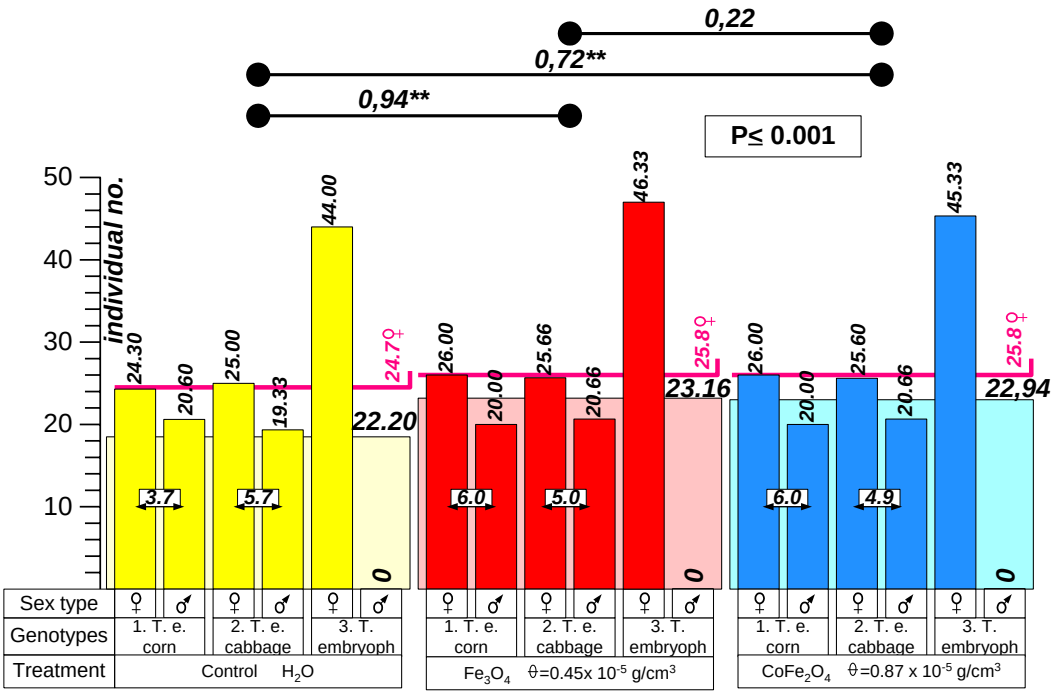

Figure 1. The sex ratio established in experimental conditions and in presence of different types of MNPs

Legend:
- Control – the normal *Trichogramma* adults emerged from *Sitotroga cerealiella* (S.c.) eggs prepared with distilled water;
- γFe_3O_4 and $CoFe_2O_4$ – NM *Trichogramma* adults emerged Magnetic Fluid used for S.c. eggs pretreatment.

Between the population size of control and treatments significant differences were established ($P \leq 0.01$; Fig.1) and it was without significance if γFe_3O_4 and $CoFe_2O_4$ average were compared. Generaly, in NMPs presence the female number was 1.1 higher (25.8♀). It seems a small effect but if we have in mind the huge amount of parasitoids, 230,000 females individuals/ha/launching, then the economical effect is pretty high (an over plus of 5,060 active wasps).

Between *Trichogramma evanescens* ssp corn (*T. ev. ssp. ostriniae*) and cabbage (*T. ev. ssp. brassicae*) distinct behavior was accounted. On *T. ev. ssp. ostriniae* the sex ratio varied from control 1: 0.8 to 1:0.9 and 1:0.7 in the NM descendants of γFe_3O_4 and $CoFe_2O_4$ respectively. On *T. ev. ssp. brassicae* case in the NM population the amount of males was 0.1% higher than in control. It went up from 1:0.7 (Control) to 1:0.8 in both MF treated background. *T. embryophagum* responses pointed out a higher sensitivity to $CoFe_2O_4$ than to γFe_3O_4 (90.66%<92.66%).

2. The prolificacy on *Trichogramma* sp. in NMPs presence

Laboratory experiments for *Trichogramma* breeding required moth fresh eggs. The calculation of *Trichogramma* biological indices were done according to Mencer & Zemshman (1985) method. Each FM female was placed in a glass jar containing cards with host eggs fixed on it. 20 eggs carried the standard cards. In order to emphasize the potential of prolificacy, to set eggs in the host egg, the number of eggs fixed on a card varied from 10 to 100 (Figure 3). The experiment was organized in three replications. The jars were kept at room temperature (25 – 26ºC) at 75 – 80 percent of relative humidity. After 8 days the cards were replaced in Petri dishes and microscopically examined. To establish the prolificacy rates of adult female of *Trichogramma* sp. black eggs and hatching adults were recorded. The number of individuals on a new generation was checked out. The obtained data are presented in Figure 2 and Figure 3.

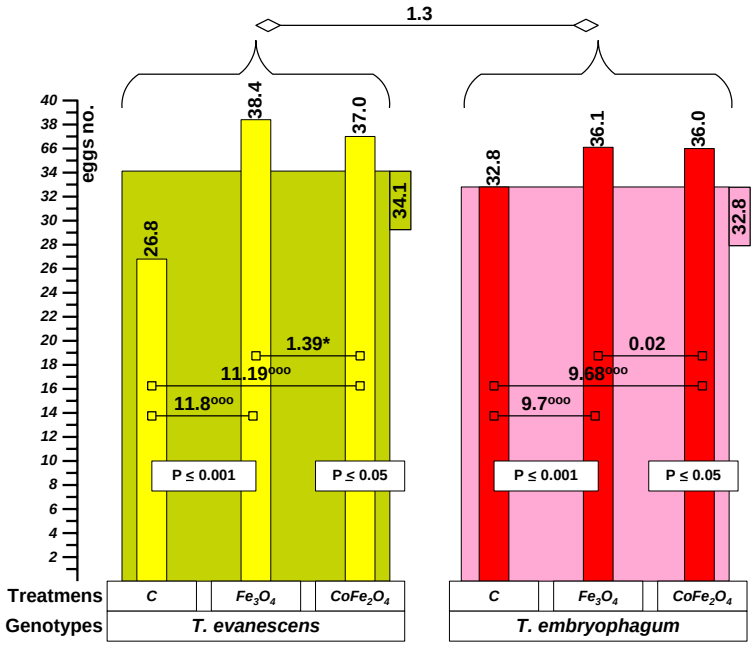

Figure 2. One female of *Trichogramma* sp. parasitism capacity of host eggs treated with different types of MFs

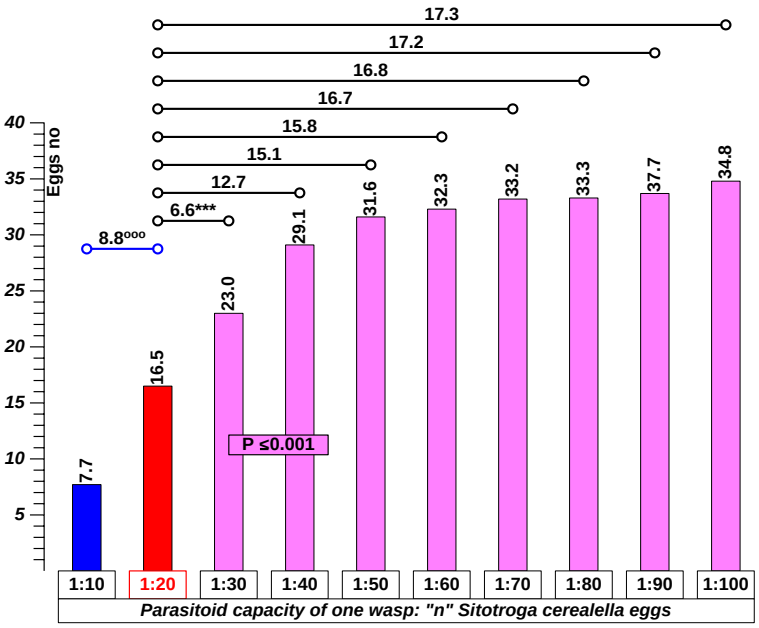

Figure 3. The relation between no. of host eggs proposed for an adult FM *Trichogramma* female and the parasitized eggs capacity

According to obtained data the majority of values of prolificacy were higher when the magnetic fluid γFe_3O_4 was used for host eggs pretreatment (Figure 2). Between general average of species it was a low and insignificant difference (d=1.3). *Trichogramma evanescens* MF reacted more sensitive to different types of Nano Particles. The differences were significant ($P \leq 0.001$). In comparison to Control the differences were d=+11.6 and d=+11.19 for γFe_3O_4 and $CoFe_2O_4$ respectively. *Trichogramma embryophagum* pointed out also significant differences among Control and experimental variants, but the values were smaller (d=+9.7 and d=+9.68 respectively).

Conclusions

The sex ratio was changed when the descendants were breed in MNPs presence. The descendants of *T. ostriniae* and *T. brassicae* reacted differently to γFe_3O_4 and $CoFe_2O_4$. *T. ostriniae* was more sensitive $CoFe_2O_4$ nanomagnetic particles. In *T. brassicae* NM population the amount of males was 0.1% higher than in control.

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