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Insect pathogens and entomoparasitic nematodes

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Field evaluation of entomopathogenic nematodes for controlling fall webworm *Hyphantria cunea* (Lepidoptera: Arctiidae) in West Georgia

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Abstract: The present work deals with results of application of entomopathogenic nematodes of the genus *Steinernema* (*S. carpocapsae, S. thesami* and *Steinernema* sp.) against the harmful pest of the forest and agricultural crops *Hyphantria cunea* (Lepidoptera: Arctiidae) distributed in Georgia. Field experiments were carried out in August of 2012 on private plots of Guria region of the West Georgia in hazelnut plantations diseased with pest's larvae. A high percentage of mortality ranging from 93.6% to 98.3% was observed in all experiments as a result of entomopathogenic nematode application. Among the species used, the efficiency of a new *Steinernema* species was specially noticed. High efficiency of the treatment was also promoted by optimum climatic conditions (Temperature = 28 °C and hygrometry = 99%).

Key words: entomopathogenic nematodes, bioformulation, *Hyphantria cunea*

Introduction

The American white webworm or fall webworm (FWW) *Hyphantria cunea* Drury (Lepidoptera: Arctiidae) is a very harmful quarantine pest. It is distributed in west Georgia. The pest is a polyphag insect. It has been established that the species damages more than 400 plant species in Georgia (Edilashvili, 2002). As FWW is also an urban insect, the control of this pest needs special bioformulations (entomopathogenic fungi, viruses, bacteria, nematodes and other organisms) which are safe for human and environment. Numerous experiments have been carried out using the mentioned bioformulations, which show that their efficiency fluctuates within the range 55-98% (Burjanadze *et al.*, 2012; Chkhubianishvili *et al.*, 2011; Gorgadze, 2000; Edilashvili , 2002; Lortkipanidze *et al.*, 2010).

The objective of the present investigation was to study the efficiency of entomopathogenic nematodes belonging to the genus *Steinernema* (*S. carpocapsae, S. thesami* and *Steinernema* sp.) against fall webworm at optimum conditions in the field.

S. carpocapsae introduced to Georgia is associated with a specific symbiotic bacteria *Xenorhabdus nematophila*, whereas local forms, such as *S. thesami* and *Steinernema* sp., which belong to the *S. affine/intermedium* group are associated with the symbiotic bacteria *Xenorhabdus bovienii*. Species of bacteria associated with local nematodes have been identified at the Laboratory of Diversity, Genome, and Microorganisms-insects Interactions (DGIMI, INRA) of the National Institute of Agronomical Research of Montpellier University (France).

Material and methods

Infective juveniles *of S. carpocapsae, S. thesami* and *Steinernema* sp. were reared on worms of *Galleria melonella* and *Bombyx mori* (Veremchuk, 1986; Dutky, 1964). Field experiments were carried out in the second decade of 2012 in Guria region (west Georgia) in hazelnut plantations diseased with FWW worms. The pest produces two generations during the season in the mentioned region – in May and August. The warmest month August was chosen for experiments. Concentrated nematodes were transported in icebox in order to prevent mortality of nematodes due to transfer to long distance (300 km). Before starting the experiments and treatment of beforehand chosen experimental and control plants, the number of pests per 1m2 area of branches was evaluated. The number of pests per square meter fluctuated from 65 to 289. Experiments were carried out as follows: One control plant without any nematode application and 3 experimental plants, one with *S. carpocapsae*, a second one with *S. thesami* and the third one with *Steinernema* sp.). All suspensions used in trials contained equal concentration of nematodes (2500±120 nematodes per 1 ml of water). Treatment of experimental plants by nematode suspension was performed using the hand apparatus of the OBX-14 type in evening hours, in cloudy weather at 28oC temperature and 99% relative humidity. Monitoring of treated plants and accounting of dead pests was made on 3rd, 5th and 7th days after spraying according to the method by Abbot (Abbot, 1925).

Results and discussion

Checking of sprayed plants after 14 hours after treatment has shown that the nematode suspension was not dried out on leaf surfaces, especially on the lower sides of leaves, where the pests were assembled in colonies. While examining such leaves only living and active forms of invasive juveniles were revealed. None of individuals of larvae was dead. Larvae were in passive condition, though reacted on irritant.

Twenty hours after treatment with entomopathogenic nematodes, damage on leaves caused by pests was reduced, while mortality rate of pests was significantly increased from the third day post-treatment.

Only three days after treatment, more than 90% of the pest larvae were dead whatever the nematode species used. Where suspension of *S. carpocapsae* was used for spraying, 94.3% mortality of pest's larvae has been stated on the experimental plant; on the 5th day it reached 98.1%; and on the 7th day mortality rate of pests almost was not changed. Average mortality rate of pests in this variant of experiment made 98.3% (Figure 1).

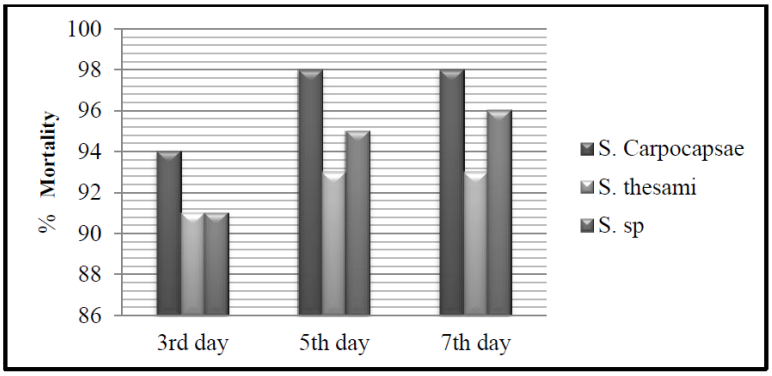

Figure 1. Mortality of *Hyphantria cunea* III-IV instar larvae after application of entomopathogenic nematode suspension of the genus *Steinernema* (2500±120 nematodes per 1 ml of water) on in field conditions (temperature: 28oC and hygrometry: 99%).

Similar results of mortality were obtained using *S. thesami* for biocontrol. The highest mortality rate of the pest - 93% was reached 5 days after treatment.
As concerns testing of new form of *Steinernema sp*. against FWW, here too mortality rate made 95% on the 5th day from application like other nematodes (*S. carpocapsae* and *S. thesami*). In control experiment, no mortality of the pest was observed. When checking under the binocular microscope in each dead worm of FWW 22-36 individuals of developed IV-V instar *Steinernema* nematodes have been revealed.
In all experiments where *S. carpocapsae, S. thesami* and *Steinernema* sp. were used for the biological control of FWW, high level of mortality was observed – 98.3, 93.6 and 96.8% respectively. It is worth to note the special efficiency of a new species *Steinernema* sp. against the pest. High efficiency of the used formulations seems to be favoured by optimal climatic conditions (temperature, hygrometry, etc.) during the experiment. These parameters are of great importance for the activity and efficiency of entomopathogenic nematodes.

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