Entomology

Susceptibility of Entomopathogenic Nematodes to the Fall Webworm *Hyphantria cunea* Drury (*Lepidoptera: Arctiidae)*

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(Presented by Academy Member I. Eliava, December 2006)

ABSTRACT. **The fall webworm, *Hyphantria cunea* Drury *(Lepidoptera: Arctiidae)* is a quarantine insect pest damaging up to 600 species of plants. It is spread in West Georgia, including the Black Sea basin of Adjara. The use of environmentally safe means is significant for plant protection from pest insects. To this end the susceptibility of entomopathogenic nematodes *Steinernema feltiae* (SFG) and *Heterorahabditis bacteriophora* (HP) to the fall webworm has been studied. The pest invasion and mortality indices 96–93% respectively, have been established. These biological agents are considered to be potential means to plant protection.** *© 2007 Bull. Georg. Natl. Acad. Sci.*

Key words: *fall webworm, entomopathogenic nematodes, plant protection.*

The fall webworm, *Hyphantria cunea* Drury *(Lepidoptera: Arctiidae)* is a quarantine pest insect damaging more than 600 species of plants: forest and bush plants, orchard and berry plants, field and vegetable cultures, ornamental trees, herbs, etc.

At present the pest is widely spread in West Georgia, including the Black Sea basin of Adjara. The pest mainly inhabits populated areas, parks and underwood belt, in places of mass resort. The fall webworm produces two generations. Its range of population gradually extends [1]. In this connection it is very important to use it for plant protection as an environmentally safe biological method.

Insect pathogenic nematodes are effective biological agents for pest insects control. A series of beneficial characteristics, their excellent suitability for use within Integrated Pest Management (IPM), due to the possibility of combined applications together with numerous chemical and biological control agents, the feasibility of cheap mass production, as well as the possibility of application with equipment commonly used in practice. Their broad host range, high safety for vertebrates and non-target organisms make them one of the most promising control agents for the future.

The main goal of investigations was the study of interrelationship between the fall webworm and entomopathogenic nematodes from the genus *Steinernematidae* and *Heterorhabditidae.* Steinernema and Heterorhabditis nematodes have similar life histories. The non-feeding infective juvenile seeks out insect hosts, especially in the soil environment. When a host is found, the nematodes penetrate into the insect body, usually through natural body openings (mouth, anus, spiracles) or areas of thin cuticle. Once in the body cavity, a symbiotic bacterium (*Xenorhabdus* for steinernematids, *Photorhabdus* for heterorhabditids) is released from the nematode, which multiplies rapidly and causes rapid insect death. The nematodes feed upon the bacteria and liquefying insect, and mature into adults. Thus, entomopathogenic nematodes are nematode-bacterium complexes. The nematode may appear as little more than a biological syringe for its bacterial partner, yet the relationship between these organisms is one of classic mutualism. The growth and reproduction of nematodes

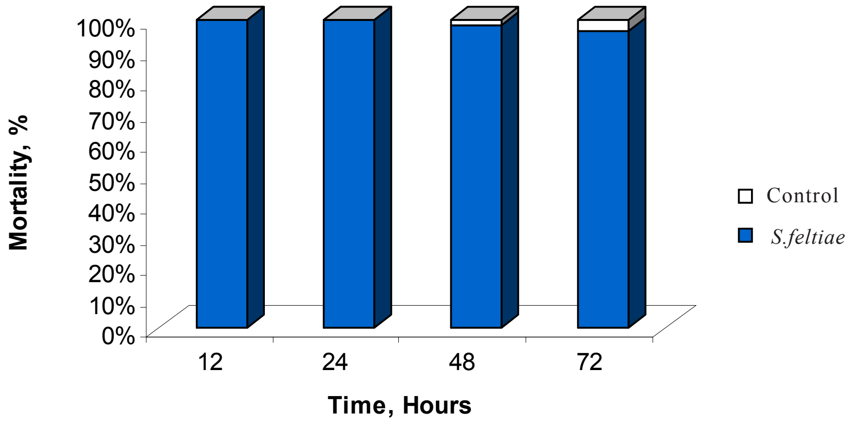

Fig. 1. Results of action of *S.feltiae* to the fall webworm

depends upon the conditions established in the host cadaver by the bacterium. In turn, the bacterium develops anti-immune proteins to assist the nematode in overcoming the host defence, and anti-microbials that suppress colonization of the cadaver. Steinernematid infective juveniles may be males or females, whereas heterorhabditids develop into self-fertilizing hermaphrodites, although subsequent generations within a host produce males and females as well. The life cycle is completed in a few weeks, and hundreds of thousands of new infective juveniles emerge in search of fresh insect hosts.

Entomopathogenic nematodes are remarkably versatile in being useful against many soil insect pests in the diverse cropping systems. Like other biological control agents, nematodes are constrained by being live organisms that require specific conditions to be effective. Unlike pesticides, desiccation or ultraviolet light rapidly inactivates insecticidal nematodes.

There are no data on the presence of entomopathogenic nematodes in the populations of the fall webworm in literature. The receipt of invasion larva of the fall webworm in laboratory was conducted with the introduced nematodes (Project USAID N CA22-007 – CDR), Israel strains – *Steinernema feltiae* (SFG) and *Heterorahabditis bacteriophora* (HP), which were cultivated from infective juveniles on the wax moth, *Galleria mellonella* larvae reared on nutritive medium at 25°C and 75% humidity according to method [2]. Briefly, 0.5 ml suspension of 100-200 IJs in water is applied onto filter paper plastic Petri dishes of 5 cm in diameter.

Five to ten *G. mellonella* larvae are transferred to each dish and the dishes are incubated. Commonly, 25 °C is a sufficient temperature, but some nematodes may require different growth temperatures. After insect mortality occurs (within 24- 48 h from infection), the cadavers are transferred onto white trap plates for further incubation. The papers become wet, but no extra water can be seen. After 10-14 days the new IJs migrate from the cadaver into the water surrounding the filter paper in the trap. The nematodes are then collected into tissue culture bottles and placed in storage. The storage temperature for Steinernematids is 4-6 °C and for Heterorhabditis 8-10 °C. After using a sieve, the nematodes can be used to infect insects in future.

The SFG suspension - 500 nematode/ml was used in tests and in the case of HP -1000 nematode/ml. Experiments were carried out in three replicated trials. As a

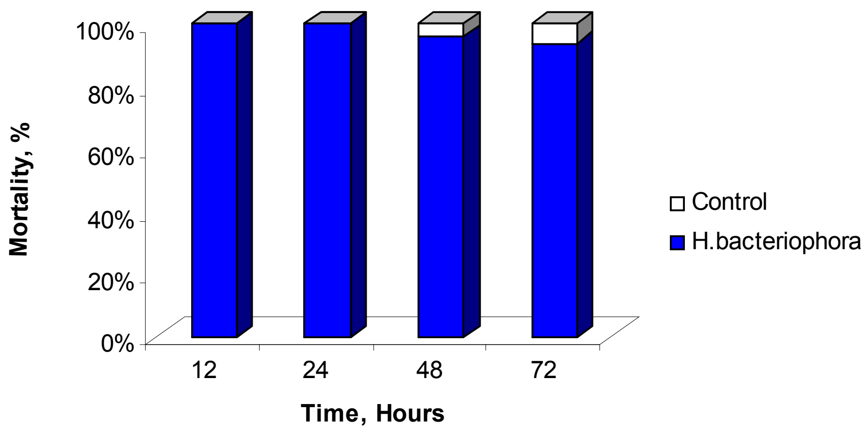

Fig. 2. Results of action of *H. bacteriophora* to the fall webworm

control distilled water was used. The count of invasion larvae was carried out every 12 hours, during 72 hours. The mortality of larvae was determined by Abbot's formula [3]. Investigations of the nematode pathology of the fall webworm were conducted by the generally accepted methods in insect's nematology [4].

The results on the invasion of the fall webworm by SFG are presented in Fig. 1.

The dynamics of mortality of the fall webwom larvae in days shows the susceptibility of the pest to the SFG. The results on the invasion of the fall webworm by the HP are presented in Fig. 2.

As a result of investigation the efficacy of the SFG and HP to the fall webworm has been established. These biological agents are considered to be the potential, environmentally safe means of plant protection.

ენტომოლოგია

ენტომოპათოგენური ნემატოდების მიმღებიანობა ამერიკული თეთრი პეპელას *Hyphantria cunea* Drury (Lepidoptera: Arctiidae) მიმართ

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ამერიკული თეთრი პეპელა *Hyphantria cunea* Drury (Lepidoptera: Arctiidae) საკარანტინო მავნებელია, აზიანებს 600-მდე სახეობის მცენარეს. მავნე მწერი გავრცელებულია დასავლეთ საქართველოს მთელ ტერიტორიაზე, მათ შორის აჭარის შავი ზღვის სანაპიროზე. მავნებლისაგან მცენარეთა დაცვისათვის საჭიროა გარემოსათვის უსაფრთხო საშუალებების გამოყენება. ამ მიზნით შესწავლილია ენტომოპათოგენური ნემატოდების — *Steinernema feltiae* (SFG) და *Heterorahabditis bacteriophora* (HP) მიმღებიანობა მავნებლის მიმართ. დადგენილია მწერის ინვაზია და სიკვდილიანობის მაჩვენებელი 96–93%, შესაბამისად. ეს ბიოლოგიური აგენტები განიხილება როგორც პოტენციური საშუალებები მცენარეთა დაცვისათვის.

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Received December, 2006