

*Zoology*

## Nematodes Associated with Bark Beetle *Ips Typographus* in Borjomi Gorge

Medea Burjanadze\*, Manana Lortkipanidze\*\*, Archil Supatashvili\*,  
Gia Kajaia\*\*

\* Department of Forest Protection, Agricultural University of Georgia, Tbilisi

\*\*Department of Entomopathogenes, Institute of Zoology, Ilia State University, Tbilisi

(Presented by Academy Member Irakli Eliava)

**ABSTRACT.** The spruce bark beetle *Ips typographus* L. (Coleoptera: Scolitidae) causes considerable damage in stands of oriental spruce trees (*Picea orientalis* Link) and is very common throughout Borjomi gorge forests in Georgia. Investigation of bark beetle populations were carried out with focus on the natural occurrence of insect pathogenic and parasitic nematodes. During the survey carried out in 2009-2011 in different sites of forests of Borjomi gorge the following nematodes were isolated from *Ips typographus*, *Contortylenchus typographi*, *Contortylenchus* sp., *Bursatylenchus* sp., *Parasitorhabditis* sp. © 2015 Bull. Georg. Natl. Acad. Sci.

**Key words:** *Ips typographus*, *Contortylenchus typographi*, *Contortylenchus* sp., *Parasitorhabditis* sp., *Bursatylenchus* s.p.

Spruce bark beetle *Ips typographus* L. (Coleoptera: Scolitidae) causes considerable damage to stands of oriental spruce (*Picea orientalis* Link) and is very common throughout Borjomi gorge forests of Georgia. The outbreaks of this pest insect often develop after cutting, wind or snow breaks, followed by warm and dry climatic conditions.

In the last years numerous investigations were focused on the parasitic nematodes' complex of bark beetle and their influence on insect population dynamics. The pathogen process a great potential biological control agents due to their ability

to develop strong epizootics. That is the result of natural regulation of *Ips typographus* populations.

A list of *Ips typographus* invasion by entomopathogenic nematodes with reference to the original discovery was given by different authors [1-4]. Information about *Ips typographus* parasite nematodes *Rhabditidae* and *Tylenchidae* is found in studies of Georgian scientists [5-6].

The goal of the present work was to investigate natural occurrence of specific nematodes associated with *Ips typographus* and their role in the number regulation of this insect. Special attention was given to the entomopathogenic nematodes.

## Materials and Methods

The survey for nematodes associated with *Ips typographus* was carried out in autumn 2009 and spring 2011. Adults of bark beetle were collected by hand or by cutting infested log sections from spruce trees from two different sampling plots (Tsagveri – 1000 m above sea level and Libani – 1100 m above sea level) from Borjomi gorges.

Investigations on the populations of bark beetle were carried out with the focus on the nematodes associated with *Ips typographus*. The beetles were collected from trap trees and pheromone- traps. The material was studied using generally accepted methods in insect nematology [7].

Adult samples of *Ips typographus* were collected by hand in different time of the year. Dissection of beetles in a Petri dish with Ringer's solution under stereomicroscope was carried out by hand using anatomy methods [8, 9].

Number of nematodes found in the body after anatomy dissection were conditioned with the following: 1-20 were considered "few" (+), number 20-100 "middle" (++), 100 and "more" (+++).

For the preparation of permanent slides the collected nematodes from insects from galleries were fixed in 70% Alcohol, transferred to lactophenol for clearing, then put into Berlese [10] or glycerin and measured with an ocular micrometer. Specimens were viewed with differential interference of optic.

## Results and Discussion

The present paper demonstrates that *Ips typographus* can be found in systemic surveys. 985 bark beetles worked out during 2009-2011 were taken from bark or pheromone traps. Table 1 gives overview results according to a number of infected individuals.

In 2009 a number of infected bark beetles by nematodes was 18.3 - 32.6%, in 2010 19.6 -32.9%; in 2011 the number was 13.3-26.7%.

Various species of nematodes assisted with *Ips typographus* were settled under bark in one biotope. Isolated nematodes were all identified as Rhabditida and Tylenchida.

As a result of investigation 4 species of nematodes were revealed. They were found in fat tissue, in gut, on surface of the body and under elytra of *Ips typographus*, also in the galleries of spruce bark. They are the following:

***Contortylenchus typographi*** (Tylenchida: Tylenchoidae)

Among the infected insects the highest number of nematodes yielded. They were found in host fat tissue up to 3 - 500 samples in a single beetle. The parasitoid kills its host and emerges from it in the gallery. The gut of bark beetle invised by J3 of this nematode, it is an obligate parasite with great active ranges having great value in pest number regulation.

The number of invised beetles was 35-60% (Fig. 1, 2).

**Table 1. A number of Nematodes in populations of *Ips typographus* in Borjomi gorge**

№	Geographic location	Area (plot)	Nematodes %			Number of investigated beetles	Years
			Min.	Max.	Aver.		
1	Borjomi Gorge 1000-1400 m a.s.l	Tsagveri, district-12	11.2	25.0	18.3	215	2009
2	„-„	Tsagveri, district-9	28.6	40.0	32.6	102	„-„
3	„-„	Mzetamze	21.2	44.5	19.6	135	2010
4	„-„	Tsagveri, district-9	20.0	23.8	21.9	105	„-„
5	„-„	Kechkhobi	21.2	44.5	32.9	176	„-„
6	„-„	Tsagveri, district-10	7.3	19.3	13.3	164	2011
7	„-„	Tsagveri, district-9	14.2	39.2	26.7	88	„-„

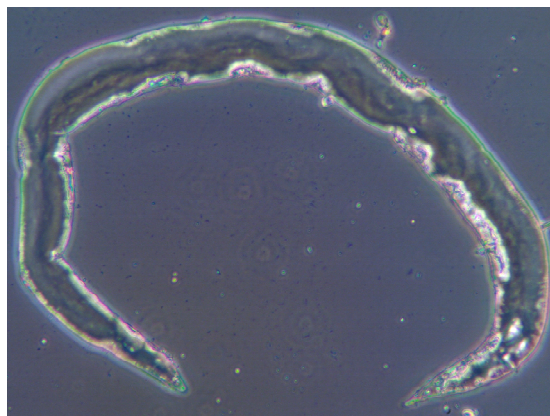


Fig. 1, 2. *Contortylenchus typographi*



Fig. 3, 4. *Bursatylenchus* sp.

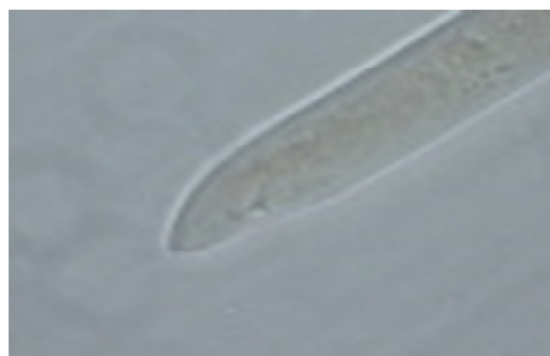
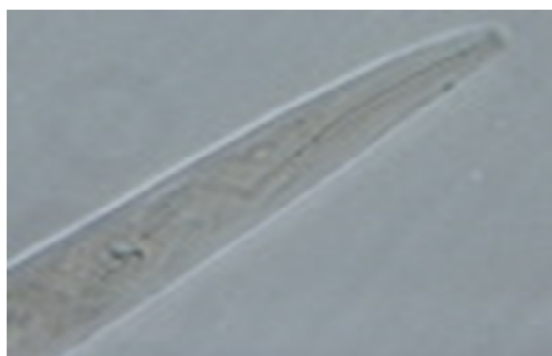


Fig. 5, 6. *Parasitorhabditis* sp. ♀

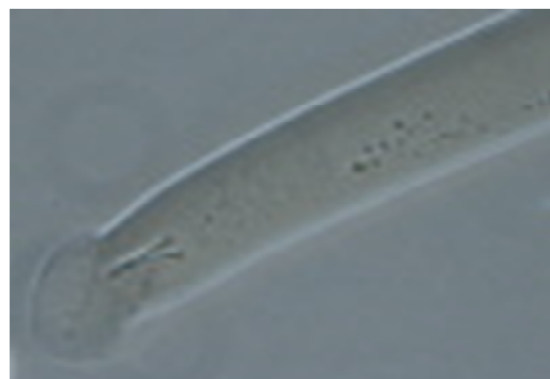


Fig. 7, 8. *Parasitorhabditis* sp. ♂

Table 2. Parasitic nematodes of *Ips typographus* and conditional number

Nematodes species	Sites of location	Region	Number of nematodes
<i>Contortylenchus typographi</i>	midgut, fat tissue hemolymph	Borjomi	+ + +
<i>Contortylenchus sp.</i>	tissue, hemolymph	“-“	+
<i>Bursatylenchus sp.</i>	under elitra	“-“	+ + +
<i>Parasitorhabditis sp.</i>	hemolymph	“-“	+

***Contortylenchus sp.*** (Tylenchida: Tylenchoidae)

This is endoparasitic nematode feeding on fat tissue and hemolymph. The parasite stays for survival in the host for long time. The gut of bark beetle was invised by J3 of this nematode. One or two species were observed usually, rarely 3-4 exemplars in one bark beetle were observed.

***Bursaphelenchus sp.*** (Tylenchida: Aphelenchoididae)

It is established that this species of nematode parasites under elytra. Over 50 samples and 70-90% of bark beetles settled by this species were under each elytra. They are facultative ectoparasites. The searching action was observed in tail part of II stage larvae (Fig. 3, 4).

***Parasitorhabditis sp.*** (Rhabditida: Rhabditidae).

J2 and J3 nematodes invise through gut and hemolymph of bark beetle. Sex mature forms were

found in the gallery of spruce bark, observed in the months (November, December) of the year (Fig. 5, 6, 7, 8).

Table 2 shows the parasitic nematodes of *Ips typographus* and conditional number.

It is established that the representatives of Rhabditid commonly invade 26% of bark beetles, Tylenchid 40-90%. A number of Rhabditid on the surface of insect body and in gut reached from 1- to 30-50 samples. Tylenchid up to 2-4 to 300-400 samples.

Complex of the parasitic nematodes of *Ips typographus* was the target of specific studies.

Nematodes isolated from the populations of bark beetles are very important to study in full spectrum of natural enemies, which would be considered as the environmentally safe means for biological forest protection.

## ზოოლოგია

მბეჭდავ ქერქიჭამიასთან *Ips typographus* ასოცირებული ნემატოდები ბორჯომის ხეობაში

მ. ბურჯანაძე\*, მ. ლორთქიფანიძე\*\*, ა. სუპატაშვილი\*, გ. ქაჯაია\*\*

\* საქართველოს აგრარული უნივერსიტეტი, ტყის დაცვის განყოფილება, თბილისი

\*\*ილიას სახელმწიფო უნივერსიტეტის ზოოლოგიის ინსტიტუტი, ენტომოპათოგენების ლაბორატორია, თბილისი

(წარმოდგენილია აკადემიის წევრის ი. ელიავას მიერ)

შესწავლილი იყო 2009-2011 წწ. ბორჯომის ხეობაში გავრცელებული ტყეების საშიში მავნე მწერის – მბეჭდავ ქერქიჭამიასთან *Ips typographus* L. ასოცირებული ნემატოდების შემდეგი სახეობები: *Ips typographus*, *Contortylenchus typographi*, *Contortylenchus sp.*, *Bursatylenchus sp.*, *Parasitorhabditis sp.* მავნე მწერს მასობრივი გამრავლების დროს შეუძლია მნიშვნელოვანი ზიანი მიაყენოს ტყეებს და გამოიწვიოს დიდი ეკონომიური ზარალი. მწერი ფარულად მცხოვრებია და მის წინააღმდეგ ბრძოლის ღონისძიებების გატარება რთული და ძვირად ღირებულია. აქედან გამომდინარე, საკვლევი ობიექტის მბეჭდავი ქერქიჭამიას – ბიოლოგიური აგენტების ძიება, გამოვლენა და შესწავლა მეტად აქტუალურია, რადგან ისინი არეგულირებენ მწერის რიცხოვნობას და მომავალში შესაძლებელია მათი გამოყენება ტყის ინტეგრირებულ დაცვის ღონისძიებებში.

## REFERENCES

1. Fuchs G. (1915) Die Naturgeschichte der Nematoden und einiger anderer Parasiten; I. Des *Ips typographus* L.; des *Hylobius abietis* L. Zool. Jahrbuch. 38:109-222.
2. Rhüm W. (1956) Die nematoden der Ipiden. Parasitol. Schriftenreihe. Jena, H.6, 425.
3. Lazarevsakaia S.L. (1965) Trudy Gel'm. lab. AN SSSR, v. XV.
4. Buthon H. (1991) Bark beetle hazards following storm damage. Kolloquium in Braunschweig, Berlin, 111-117.
5. Kurashvili B.E., Kakulia G.A., Devdariani C.G. (1980) Paraziticheskie nematody koroedov Gruzii. Tbilisi, 170 p.
6. Kakulia G. (1989) Parazity nasekomykh i biologicheskii metod bor'by. Tbilisi, 210 p.
7. Kaya H.K. and Stok S.P. (1997) Manual of Techniques in Insect Pathology (eds. Lawrence, A., L. Lacey) Acad. Press, San-Diego: 281-324.
8. Woodring J.L., Kaya H.K. (1988) *Steinernematid* and *Heterorhabditid* nematodes: a handbook of techniques. Southern Cooperative Series Bulletin. 331. Arkansas Agricultural Experiment Station Fayetteville.
9. Pavlovsky E.N. (1957) Metody ruchnogo anatomirovaniia nasekomykh. M., 3-85 (in Russian).
10. Humason G.L. (1972) Animal Tissue Techniques, 3<sup>rd</sup> ed. W.H. Freeman, San Francisco, California.

Received February, 2015