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Zoology

Influence of Ecological Factors on the Formation of Nematode Fauna of Bark Beetles (*Coleoptera*: *Scolitidae*)

Medea Burjanadze*, Manana Lortkipanidze, Oleg Gorgadze****

* *V.Gulisashvili Forest Institute of the Agrarian University of Georgia, Tbilisi*
** *Institute of Zoology of Ilia State University, Tbilisi*

(Presented by Academy Member Irakli Eliava)

ABSTRACT. Bioecology of nematodes invading host beetle is studied in order to identify prospective species of nematodes to be used against pests as biological methods.

The influence of ecological factors on the composition and quantity of nematode fauna of bark beetles is considered. *© 2012 Bull. Georg. Natl. Acad. Sci.*

Key words*: nematodes, bark beetle, Taphrorychus bicolor, Ips typographus.*

Today nematodes present biologically evolutionary species of fauna. They have occupied the whole biosphere and dwell in all biotopes. Free-lived and parasitic nematodes are known. Free-lived nematodes dwell in seas, fresh water and soil; parasitic nematodes live in organisms of men, vertebrate and invertebrate animals, and plants.

The relationship between pests and nematodes can be various, but mainly a pest is a host for all nematodes. The tissue of beetle's organs is a life medium for nematodes. Entering a pest through its body openings a parasite entonematode actually infests and kills it, feeding on its tissue or cadaver. When the food resource within the dead pest comes to end, nematodes exit and begin searching for a new host.

Such a lifestyle of nematodes allows us to use them against pests damaging significantly forests and gardens. It should be noted here that bark beetles of the family *Scolitidae* order *Coleoptera* are more harmful among the pests.

Formation of nematode fauna of bark beetles is influenced by both abiotic and biotic factors.

In order to establish the influence of abiotic factors, such as temperature and humidity, on the composition and quantitative changes in nematode fauna an experiment was carried out under natural conditions. During the experiment we used the so-called decoy-trees populated with bark beetles. Observations were made under various temperature and humidity conditions. Temperature as one of the main ecological factors, first of all, affects the activity

Table 1. Temperature influence on species and quantity of nematodes of typographer bark beetles *Ips typographus*

Nematodes	Quantity of nematodes					
	Tbilisi Daily average temperature t=15.7 ºC			Gombori Daily average temperature t=7.8 ºC		
	Small (unit)	Medium (unit)	Big (>50)	Small (unit)	Medium (unit)	Big (>50)
Bursaphelenchus teratospicularis	-	-	+	+	-	-
Parasitorhabditis bicoloris	-	-	+	+	-	-
Parasitaphelenchus bicoloris	-	+	-	+	-	-
Cryptaphelenchus bicoloris	-	+	-	+	-	-
Panagrolaimus scheucherae	-	-	+	-	+	-

Table 2. Temperature influence on species and quantity of nematodes of typographer bark beetles *Ips typographus*

Nematodes	Quantity of nematodes					
	Decoy tree at the forest edge. Daily average temperature t=30-35 ºC			Decoy tree in the forest heart. Daily average temperature t=24-26 ºC		
	Small (unit)	Medium (unit)	Big (>50)	Small (unit)	Medium (unit)	Big (>50)
Parasitorhabditis obtusa	+	-	-	-	+	-
Ektaphelenchus typographi	+	-	-	-	+	-
Cryptaphelenchus macrogaster	+	-	-	-	-	+
Bursaphelenchus eidmani	+	-	-	-	-	+
Micoletzkya buetschlii	-	+	-	-	+	-

of a host-beetle, which in turn conditions the biological activity of nematodes of specific and transition groups (commensals, ecto- and endoparasites). Temperature acts indirectly on nematodes related to beetles, and acts directly on nematodes living in wormhole dust. In order to study the temperature effect on quantitative dynamics of nematodes we researched nematode fauna of two-coloured beech bark beetle (*Taphrorychus bicolor*) under various temperature regimes. With this aim in May, 2011, simultaneous observations were made in Tbilisi and Gombori (Eastern Georgia). Daily temperature was 15.7 ºC in Tbilisi and 7.8ºC in Gombori. The study of nematode fauna registered in egg and larvae galleries (wormhole dust) showed that in Tbilisi, where the temperature was optimal for the activation of beetle, the quantity of nematodes in wormhole dust was much more than that in Gombori (Table 1).

The result obtained showed that under optimal conditions latent larvae existing in beetle's organism became active and go through beetle galleries.

Influence of temperature on host-beetle in respect of quantitative dynamics of nematodes was studied on typographer bark beetles (*Ips typographus*). Decoy-trees populated with bark beetles used in experiments were at first placed at the forest edge in sunlight where maximal temperature was 30-35 ºC. After a certain period of time the tree was replaced into the forest heart, where the maximal temperature was 24-26 ºC. In 2-3 weeks study of egg and larvae galleries (wormhole dust) of host-beetle showed that quantity of nematodes was more on decoy-tree in the forest heart than at the edge of the forest. This fact shows that environmental conditions for vitality and more activity of nematodes are better in the forest heart (Table 2).

Table 3. Influence of humidity on species and quantity of nematodes

Nematodes	Quantity of nematodes					
	Beetles habitation on the decoy tree in sunlight. Humidity 48-50%			Beetles habitation on the decoy tree in the shadow. Humidity 78-80%		
	Small (unit)	Medium (unit)	Big (>50)	Small (unit)	Medium (unit)	Big (>50)
Bursaphelenchus carpus	-	+	-	-	-	-
Sychnolylenchus intricati	-	-	+	+	-	-
Goodeus scolity	-	-	+	-	-	-
Parasitorhabditis malii	-	-	+	+	-	-
Sticktylus pseudobtusus	-	+	-	+	-	-
Panagrolaimus regidus	-	-	+	+	-	-
Panagrobelus coronatus	-	-	-	-	-	+
Panagrelus redivivus	-	-	-	-	-	+
Pabdontolaimus haslacheri	-	-	-	-	+	-
Rhabditis sp.	-	-	-	-	-	+

The result obtained confirms that temperature has a significant effect on the quantity of nematodes of bark beetles and no effect on the species content of nematode fauna.

Another important ecological factor is humidity [3]. We have studied the effect of humidity on apple bark beetles (*Scolytus mali*) in Gori district. During the experiment an apple-tree populated with apple bark beetles was used as decoy for beetles.

The quantity of nematodes in egg and larvae galleries (wormhole dust) was controlled simultaneously under various humidity conditions. We studied wormhole dust on the decoy-tree at the sunny side where the humidity was 48-50% and at the shady side, where the humidity was 78-80%. In the first case ecto- and endoparasites of specific and transition groups (*Bursaphelenchus, Goodeyus, Stictylus, Sychnotylenchus, Parasitorhabditis*) were found in the wormhole dust made by apple bark beetles. Nematodes of nonspecific group were not detected here. In the second case, when humidity was rather high, ecto- and endoparasites of specific group completely disappear, nematodes of transition group were left in single examples, but nematodes of nonspecific group were reproduced (Table 3).

Thus, changes in humidity causes nematode change in species composition and their quantity. Quantity of nonspecific nematodes increases with the increase of humidity due to the fact that they live in saprobe habitat. At places where moisture needed for the formation of microflora is abundant, decay process goes on more intensively, but such conditions are not advantageous for specific nematodes.

It should be noted that the increase of nematode quantity depends on the sum of effective temperatures and on resources nematodes feed on.

Just nonspecific nematodes adapt themselves well to that microflora which is formed in beetle galleries (wormhole dust) under the wood bark and at different places of nematodes' habitat under equivalent optimal temperature and humidity conditions.

ზოოლოგია

ეკოლოგიური ფაქტორების გავლენა ქერქიჭამიების (*Coleoptera: Scolitidae*) ნემატოდოფაუნის ფორმირებაზე

მ. ბურჯანაძე*, მ. ლორთქიფანიძე, ო. გორგაძე****

** საქართველოს აგრარული უნივერსიტეტის ვ. გულისაშვილის სატყეო ინსტიტუტი, თბილისი*
*** ილიას სახელმწიფო უნივერსიტეტის ზოოლოგიის ინსტიტუტი, თბილისი*

(წარმოდგენილია აკადემიის წევრის ი. ელიავას მიერ)

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