

Biological Insecticide - Entomopathogenic Nematode in Mushroom Hothouse Industry of Georgia

Mariam Chubinishvili*, Manana Kakhadze*,
Tsisia Chkhubianishvili*, Iatamze Malania*,
Rusudan Skhirtladze*, Irine Rizhamadze*, Mikola Butirin**

*L.Kanchaveli Institute of Plant Protection, Agricultural University of Georgia, Tbilisi, Georgia

**LTD Mushpro Company, Kaspi, Georgia

(Presented by Academy Member Giorgi Kvesitadze)

ABSTRACT. The champignon mushroom (*Agaricus bisporus*) production is growing in Georgia due to its high nutritional value. In recent years the soil habitat harmful insects, fungus gnats - *Lycoriella* and *Bradysia* spp. (Diptera: Sciaridae) were detected in the mushroom hothouse industry. They feed on mushroom mycelium causing great damage to the national economy. To get the ecologically pure mushroom yield it is strongly recommended to protect from harmful insects by using the safe means for human and environment. Studies were conducted on introduced commercial nematode preparation NEMYCEL®300 *Steinernema feltiae* (Germany, Company e-nema GmbH) titer (2×10^5) using to *Sciaridae* larvae, in the area (3500 sq.m) of LTD Mushpro Company (Kaspi, Shida Kartli), through the irrigation system. The biological efficacy of nematode preparation was 90-95%. © 2018 Bull. Georg. Natl. Acad. Sci.

Key words: champignon, fungus gnats, entomopathogenic nematode

The champignon mushroom (*Agaricus bisporus*) hothouse production is growing in Georgia due to its high nutritional value. In recent years the soil habitat harmful insects, fungus gnats - *Lycoriella* and *Bradysia* spp. (Diptera: Sciaridae) in the mushroom industry were spread. They feed on mushroom mycelium causing great damage to the national economy. *Sciaridae* flies reproduce extensively in organic substrate. The *Sciaridae* are a family of flies, known as dark-winged fungus gnats, commonly found in moist environments, they are known to

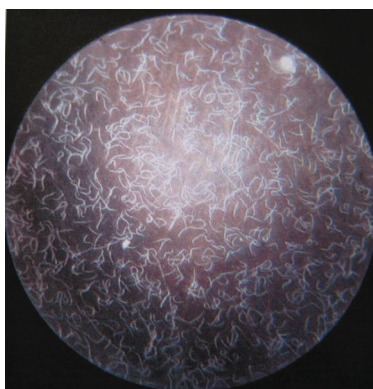
be a pest of mushroom farms. The life cycle of *Sciaridae* only a few species has been studied in any detail, mainly those which are pests of commercially grown mushrooms. Adult females (Fig.1) lay about 200 eggs (each about 1 mm long) into moist soil. After about a week, the larvae hatch. Almost 90% of the larvae are female. Up to 2,500 individuals can be found per sq.m; pest larvae pupate at the same place. The adults only ingest liquids and live only long enough to mate and produce eggs. They die after five days. In commercial mushroom houses,



Fig. 1. Sciaridae Adult stage.

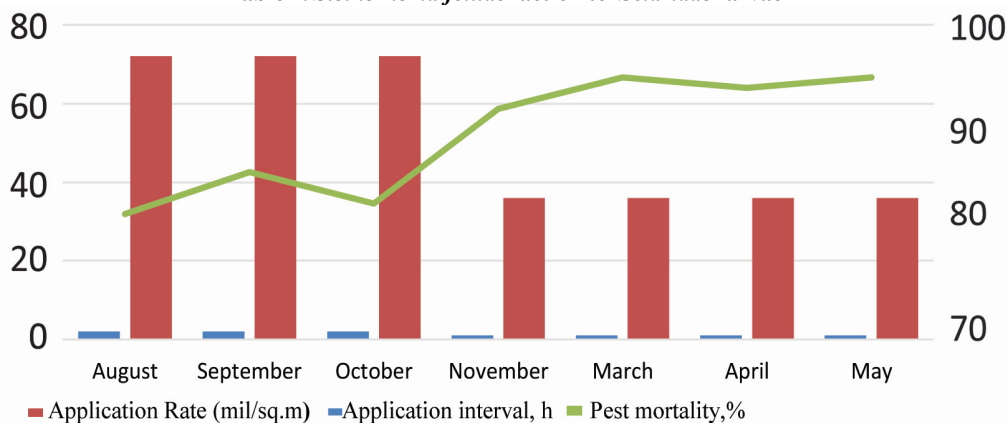


Fig. 2. Sciaridae larval stage.

Fig. 3. nemysel®, *Steinernema feltiae*.

Sciaridae fly larvae tunnel into the stalks of the mushrooms, and feeding damage can sever developing mycelium, causing mushrooms to become brown and leathery. As a pest of plants, *Sciaridae* larvae (Fig. 2) feed on the root system. In both industries, adult *Sciaridae* flies are a nuisance pest that can result in crop rejection if high numbers are present in the growing area. It

is known that the representative of *Sciaridae* family are the main pest insects of mushroom [1]. It becomes necessary to protect the most part of mushroom yield from pest insects by the environmentally safe biological means, such as entomo-pathogenic nematodes EPNs [2,3]. Nematodes are effective biological agents for wide range pest insects control both, closed and

Table 1. *Steinernema feltiae* action to *Sciaridae* larvae

open environment, their broad host range, high safety non-target organisms make them one of the most promising control agents. In general, the extensive use of EPNs is an optimal way to protect mushroom-cropping system from *Sciaridae* flies [4-6].

The main goal of present investigation was to study the interrelationship between the fungus gnats (*Sciaridae*) and EPN, *Steinernema feltiae*.

Material and Methods

The investigations were conducted on the action of introduced commercial nematode preparation nemycel®300 *Steinernema feltiae* (Germany, Company *e-nema* GmbH) titer (2×10^5) using to *Sciaridae* larvae, in the area (Fig.3) (3500 sq.m) of LTD Mushpro Company (Kaspi, Shida Kartli, Georgia) in 2017. During the first three months nematode suspension (2×10^5) was applied by the irrigation system [7] at intervals of every 3 days when the most pest larvae reached to second or third instars. After the application rate of EPNs and spraying interval were changed to 1×10^5 nematodes/sq.m in every 36 hours. The degree of mushroom crop damage was determined by scoring system and the pest population density was observed by direct counting on the sq.m. The biological efficiency of nematode suspensions in mushroom hothouse production was calculated under common procedure [8].

Results and Discussion

The relatively high moisture content of the mushroom-growing substrate, optimum temperature, conducive to fungus gnats development,

offers a unique potential for exploiting EPNs. EPNs are likely to specifically target certain insect life stages, whereas chemicals tend to affect a broad range of life stages. Nematodes were applied when fly larvae reached the second or third instars. According to Rinker *et al.* [9] the nematode infective juveniles actively search the pests, destroy the insect follicular membrane and decrease copulation and oviposition. Additionally nematodes, liberated as second instars, search and infect new hosts. The results of experiments on the action of test preparation to *Sciaridae* larvae are presented in Table 1. The pest mortality reached to higher index - 95%, entire biological efficacy was 90-95%. As the results of investigations the pests density reached below the economic threshold on the experimental plot. In addition, the microscopic examinations (light and inverted microscope with magnification $10 \times 22 \times 5.6$) of pathological material were carried out to determine presence of *S.feltiae* in *Sciaridae* cadavers. The preliminary investigations suggest that commercial nematode preparation nemycel®300 *Steinernema feltiae* is considered as one of the best biological agent for controlling the *Sciaridae* larvae in the champignon growing system, as guaranteed getting ecologically pure mushroom products in Georgia.

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ბიოტექნოლოგია

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მ. ჩუბინიშვილი*, მ. კახაძე*, ც. ჩხუბიანიშვილი*, ი. მალანია*,
რ. სხირტლაძე*, ი. რიჭამაძე*, მ. ბუტირინი**

* საქართველოს აგრარული უნივერსიტეტი, ლ.ყანჩაველის მცენარეთა დაცვის ინსტიტუტი, თბილისი, საქართველო

** კომპანია შპს "Mushpro", კასპი, საქართველო

(წარმოდგენილია აკადემიის წევრის გ.კვესიტაძის მიერ)

შამპინიონის, ანუ ქამა სოკოს (*Agaricus bisporus*) მაღალი კვებითი ღირებულების გამო საქართველოში მისი წარმოება სულ უფრო ფართოვდება. ბოლო წლებში ქამა სოკოს ინდუსტრიაში აღინიშნება ნიადაგში ბინადარი მავნე მწერების, სოკოს კოლონების - *Lycoriella* და *Bradysia* spp. (Diptera: Sciaridae) გავრცელება. ისინი იკვებებიან სოკოს მიცელიუმით და ამით დიდ ზიანს აყენებენ სახალხო მეურნეობას. ქამა სოკოს ეკოლოგიურად სუფთა მოსავლის მისაღებად მკაცრად რეკომენდებულია მავნე მწერებისაგან კულტურის დაცვა ადამიანისა და გარემოსათვის უსაფრთხო საშუალებების გამოყენებით. გამოკვლევები ჩატარებულია ინტროდუცირებული (გერმანია, კომპანია *e-nema GmbH*) კომერციული ნემატოდური პრეპარატის NEMYCEL®300 *Steinernema feltiae* (ტიტრი - 2×10^5) გამოყენებაზე *Sciaridae*-ის მატლების მიმართ, კომპანია შპს Mashpro Company (კასპი, შიდა ქართლი) ტერიტორიაზე 3500 კვ.მ, საირიგაციო სისტემის საშუალებით. ნემატოდური პრეპარატის ბიოლოგიური ეფექტურობა 90-95%-ს აღწევდა.

REFERENCES

1. Menzel F. (1998) Sciaridae, Diptera. *Handbook for the identification of British insects*, **12**, Part 1: 20-24.
2. Grewal P.S., Ehlers R.U., Shapiro-Ilan D.I. (2005) *Nematodes as Biocontrol Agents*, 505, CABI Publishing, Wallingford, UK.
3. Jess S., Schweizer H., Kilpatrick M. (2005) Mushroom Applications In: *Nematodes as biocontrol agents* (Ed. Grewal P.S., Ehlers R.U., Shapiro-Ilan D.I.), 191-213.
4. Georgis R., Gaugler R. (1991) Predictability in biological control using entomopathogenic nematodes. *Journal of Economic Entomology*, **84**:713-720.
5. Gaugler R. (2002) *Entomopathogenic Nematology*, 169-187, CAB International, Wallingford, UK.
6. Ehlers R-U. (2007) Entomopathogenic Nematodes: from Science to Commercial Use, In: *Biological Control a Global Perspective*, 136-152 (Ed. Vincent C., Goettel M.S., Lazarovits G.) CAB, International, Wallingford, UK.
7. Wright D.J., Peters A., Schroer S., Fife J.P. (2005) Application Technology, 91-106, In: *Nematodes as biocontrol agents* (Ed. Grewal P.S., Ehlers R.U., Shapiro- Ilan D.I.). CAB, International, Wallingford, UK.
8. Franz S.M. (1968) Zur Berechnung des Wirkungsgrad einer Microbiologischen Bekämpfung von Schadinsekten. *Anzeiger für Schadlingkunde*, **41**: 65-71.
9. Rinker D.L., Olthof T.H.A., Dano J., Alm G. (1995) Effects of entomopathogenic nematodes on control of a mushroom-infesting sciarid fly and on mushroom production. *Biocontrol Science and Technology*, **5**: 109-119.

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