VARSTVO GOJENIH GOB PRED MUŠICAMI ŽALOVALKAMI Z UPORABO ZAJEDALSKIH OGORČIC

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IZVLEČEK

Pri pridelovanju gob vrste *Agaricus bisporus* se srečujemo s številnimi povzročitelji bolezni in škodljivci. Najpomembnejše in najbolj pogosto odkriti škodljivci so mušice žalovalke, kot so na primer vrste *Lycoriella auripilla, L. solani, L. mali* in *Bradysia tritici*. Na prirejenih substratih gojene glive težko varujemo pred škodljivimi organizmi, ker so organski substrati, ki jih uporabljamo za gojenje gliv pripravljeni iz dozorelega komposta idealna hrana tudi za škodljive organizme. Gojene gobe se zelo hitro razvijajo, kar ovira uporabo kemičnih fitofarmacevstkih sredstev za zatiranje škodljivih organizmov. Povsod po svetu za varovanje gojenih gob pred škodljivimi organizmi uporabljajo in raziskujejo tudi metode biotičnega varstva. Ena od takšnih metod je tudi uporaba zajedalskih ogorčic (entomopatogene nematode), ki živijo v sožitju z bakterijami in se hranijo z zuželkami. Tema tega prispevka je uporaba zajedalskih ogorčic za zatiranje mušic žalovalk. Leta 2004 smo na Fakulteti za kmetijstvo Georgikon Faculty of Agriculture, University of Veszprém izvedli poskuse v katerih smo preučevali uporabo zajedalskih ogorčic vrste *Steinernema feltiae* apliciranih v obliki pripravkov Nemasys M in *Steinernema feltiae* C. Zajedalske ogorčice vrste *S. feltiae* po tem, ko jih apliciramo na gojitveni substrat poiščejo ličinke mušic žalovalk in skozi njihove naravne odprtine prodrejo vanje. Ob tem telo ličink žalovalk okužijo s specifičnimi bakterijami, ki so simbionti ogorčic, hkrati pa so patogene za ličinke žalovalk in povzročijo njihov pogin. Oba pripravka smo preučevali v različnih odmerkih izraženo s številom ogorčic v raztopini. Tako smo oba pripravka aplicirali na površje gojitvenega substrata v treh odmerkih (1, 1,5 ali 2 milijona ličink na liter aplicirane tekočine). Z uporabo rumenih lepljivih vab smo spremljali populacijo žalovalk in tako ugotavljali učinek uporabe obeh biotičnih pripravkov. Med pripravkoma ni bilo značilnih razlik v učinkovitosti zatiranja žalovalk. Na lepljive plošče obešene nad gojitvenimi kontejnerji (vrečami), kjer smo aplicirali ogorčice se je ujelo manj žalovalk, kot nad kontejnerji, kjer pripravkov nismo uporabili. Uporaba pripravkov ni imela vpliva na ulov drugih žuželk (predstavniki iz družin Phoridae, Drosophilidae in Psychodidae), ki pogosto spremljajo pridelavo gob. Na podlagi tega lahko sklepamo, da uporabljena vrsta ogorčic ne zajeda ličink teh vrst žuželk. Žalovalke so pomembni prenašalci povzročiteljev bolezni zato velikost njihove populacije vpliva na obseg okužb gob z boleznimi.

Ključne besede: *Agaricus bisporus*, gojenje gob, mušice žalovalke, biotično zatiranje, *Steinernema feltiae*, zajedalske ogorčice

ABSTRACT

PROTECTION AGAINST MUSHROOM-FLIES USING ENTOMOPATHOGENIC NEMATODES

In the mushroom- production (*Agaricus bisporus*) we meet lots of pathogenic organisms and pests. The most important and mostly found pests are the Sciarid-flies, like for example

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Lycoriella auripilla, L. solani, L. mali and *Bradysia tritici*. The produced mushrooms are hard to protect, because the production needs lots of organic ingredients and suitable ripe compost and these organic materials also feed the different pathogenic organisms. The mushroom lifecycle are very fast, that is why the chemical protection are limited in the production. All over the world people examine and use biotical protection in the mushroom- production. One of the possibilities the use of entomopathogenic nematodes, which live together with entomopathogenic bacteria. Our essay subject is about the biotical protection against the Sciarid-flies with the help of nematodes. In August, 2004. experiments were carried out at University of Veszprém, Georgikon Faculty of Agriculture. *Steinernema feltiae* species of entomopathogenic nematodes were used our experiment. We examined the effects of two biopesticides, one of them is Nemasys M and the other is Steinernema feltiae C. The active ingredient in these products is a naturally occurring, insect parasitic nematode (*Steinernema feltiae*) that seeks out Sciarid-larvae, enters their natural body openings and releases symbiotic bacteria which kill pests. Both biopesticides were tested in three different concentration. The solution contained 1, 1.5 or 2 million larvae, which we applied on the soil surfaces. We examined the effects by placing isolators above every compost bag and we also used yellow fly-paper on which we counted the insects. No difference could be observed in the efficiency of the two pesticides. The results show that there were less Sciarid-flies on the fly-papers of the protected bags than on the control bags. Together with the Sciarid-flies there were also Phoridae and unimportant Drosophilidae and Psychodidae, which the nematodes did not take effect. The mushroom-flies are also important in spreading different mushroom diseases. In the experiment after the second half of the production period we also noticed, that there were not any healthy mushroom on the compost.

Key words: *Agaricus bisporus*, mushroom production, Sciarid-flies, biotical control, antomopathogenetic nematodes, *Steinernema feltiae*

1. INTRODUCTION

In the mushroom- production (*Agaricus bisporus*) we meet lots of pathogenic organisms and pests. The most important and most common pests are the Sciarid-flies, like for example *Lycoriella auripilla, L. solani, L. mali* and *Bradysia tritici*.

The produced mushrooms are hard to protect, because the production needs lots of organic ingredients and suitably ripe compost and these organic materials also feed the different pathogenic organisms. The lifecycle of the mushroom is very fast, that is why the chemical protection is limited in the production.

All over the world people experiment with and use biological protection in the mushroom-production. One of the possibilities is the use of entomopathogenic nematodes, which live together with entomopathogenic bacteria (POINAR 1979).

Three groups of the Diptera order ravage the mushrooms. Sciarid-flies pose major problems: reduce yield and transmit mushroom pathogens. Phorid-flies appear just seasonal, in the hot summer months. Cecidomiidae flies are extraordinary, they appear rarely in the mushroom production.

The direct damage is caused by the Sciarid- larvae, which are 5-6 mm long and they have black head. That is why you can discern them from Phorid- larvae (SZILI 1994). If we do not take care against Sciarid-flies, they could be the most dangerous pests. The larvae ravage the mushrooms' mycelium in the compost and in the soil. The most important damage is that the flies spread the mushroom diseases and the parasites (SZARKA 1993).

The Sciarid- flies mean a permanent problem in the mushroom production; they appear in the whole year without interruption in the cellar, where the production takes place. They are not explicitly mushroom-pests, they appear everywhere where organic matter is.

Under natural circumstances Sciarid-flies live and multiply in undomesticated mushrooms, all sorts of compost and in the manure. The smell of the manure attract the Sciarid-flies in the cellar, where they lay down their eggs in the compost (FLETCHER *et al.*, 1994).

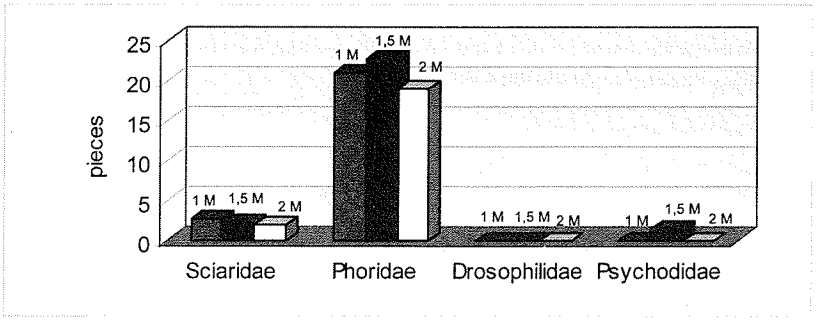
Against Sciarid-flies people try to use lots of biopesticides, for example *Bacillus thuringiensis* bacteria, predator (*Hypoaspis* spp.) mites, plant extracts, etc.
The reason for the application of the biological protection is, that there are limited number of pesticides, which are used against Sciarid- larvae. Besides, the flies become resistant against the applied active ingredients, and so decrease the efficiency of the treatment. Some pesticides caused yield loss and on the part of the consumers and enviromentel protection there is an increasing demand for reducing the amount of chemicals used in food production.
The enthomopathogenic nematodes associate with insect pathogenic bacterias of the genus Xenorhabdus. The symbiosis is not an obligate one, nevertheless, this coexistence mean a very close cooperation and the success of the „nematode-bacteria complex" depends on the efficiency of the two components. Inside the complex the tasks are shared. The nematodes search for the insect larvae they penetrate into them and they bridge the unfavourable periods. The bacteria paralyse the insect larvae, they kill them and they process the carcass.
(GREWAL 1996). The dauer larvae of the nematodes penetrate through the natural body-openings of the insect larvae. In the intestines of the nematodes there live the bacteria, which do not disturb the development of the nematodes (BOEMARE 1996).

2. MATERIAL AND METHODES

In August, 2004. experiments were carried out at the University of Veszprém, Georgikon Faculty of Agriculture. Under the main building there is a cellar, where running successful mushroom production has been carried out in the past few years. The cellar was empty in the summer, so we could do the experiment undisturbed.
We got the compost from Champion Union Inc., we had 30 bags, which means 400 kilograms compost. *Steinernema feltiae* species of entomopathogenic nematodes were used in our experiment. We examined the effects of two biopesticides, one of them is NEMASYS M and the other is STEINERNEMA FELTIAE C. The active ingredient in these products is a naturally occurring, insect parasitic nematode (*Steinernema feltiae*) that seeks out Sciarid-larvae, enters their natural body openings and releases symbiotic bacteria which kills the pests.
Both biopesticides were tested in three different concentrations. The solutions contained 1, 1.5 or 2 million larvae, which we applied on the soil surfaces. We examined the effects by placing isolators above every compost bag and we also used yellow fly-paper on which we counted the insects.
At the end of experiment we removed the yellow fly-papers and we counted the adult mushroom-flies under the microscope. Together with Sciarid-flies there were also Phorid-flies, which are dominant in the experiments, and there were also the unimportant Drosophilidae and Psychodidae, too.

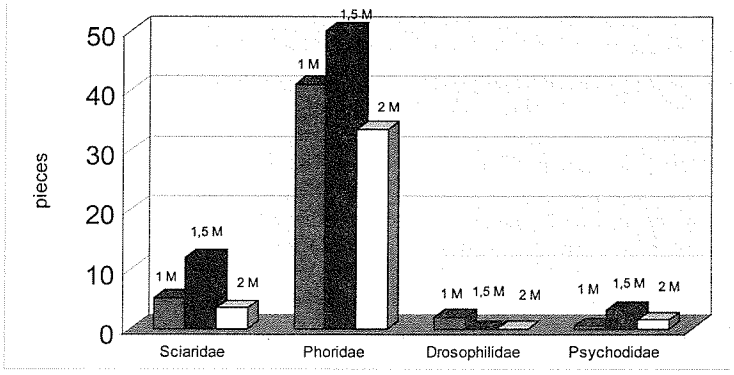
3. RESULTS AND DISCUSSION

The entomophatogenic nematodes are a promising device of enviroment - friendly plant protection. Looking at the results, we can say, that *Steinernema feltiae* entomopathogenic nematodes greatly reduce the population of mushroom-flies.
The nematodes killed 92-97% of Sciarid-flies, and 74-88% of Phorid-flies.
There were small amount of Drosophilidae and Psychodidae flies and their results were uncreditable, but we suppose, that the nematodes killed them too.



$LSD_{5\%} = 1,26$

Fig.1: The use of NEMASYS M in four repetitions



$LSD_{5\%} = 5,66$

Fig. 2: The use of STEINERNEMA FELTIAE C in four repetitions

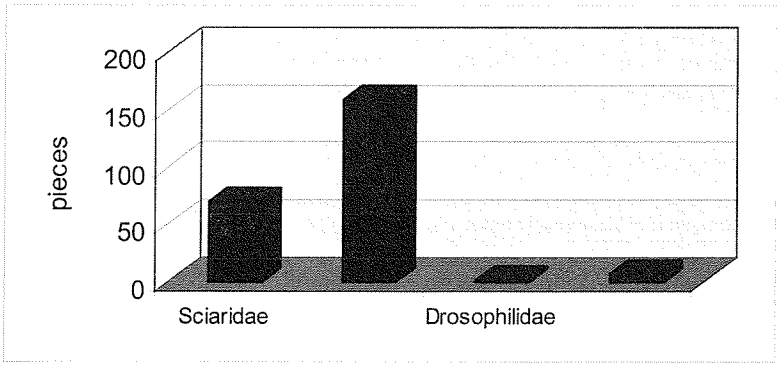


Fig. 3: The unprotected bags in four repetitions

The mushroom-flies are also important in spreading different mushroom diseases (*Pseudomonas tolasii, Mycogene perniciosa, Verticillium fungicola* var. *fungicola, Cladobotryum dendroides).*
In the experiment after the second half of the production period we also noticed, that there were not any healthy mushroom on the unprotected compost.
On the protected bags were healthy mushrooms at the and of the production. This fact prove, that mushroom- flies spread the deseases.

4. CONCLUSIONS

Biotical control offers a tremendous opportunity to supply agriculture with effective tools for the development of production techniques which minimize impacts of the human health and the environment. Entomopathogenic nematodes represent one important part of the spectrum of biocontrol agents. They are already used to control insect pests in high value crops, and they could potentially be used on a large scale in integrated pest management, organic farming and sustainable agriculture system to control soil borne pests in the near future.
The Sciarid- flies mean a permanent problem in the mushroom production; they appear in the whole year without interruption in the cellar. The direct damage make the larvae, they ravage the mushroom mycelium in the compost. They also spreading the different kind of mushroom diseases.
Against Sciarid-larvae people try to use lots of biopesticides. Entomopathogenic nematodes are one of the practical solving. The nematodes associate with insect pathogenic bacteria.
In our experiment we were testing two biopesticides with *Steinernema feltiae* entomopatogenic nematodes.
The nematodes, which are belonging in Steinernema family, they are able to kill the Sciarid – larvae, and some according to other references, they also kill the Phoridae.
The results of the experiment prove, that the use of entomopathogenic nematodes in the mushroom production is worthy. Bio-production is becoming more and more important and the elimination of the pesticides can become an essential aspect. One of the main motives for that is the short life cycle of mushroom, which means that the use of chemicals in its production is not allowed.
The nematodes multiply inside the dead insects, so they extend the effect-term of the protection totally to the end of the production-period. They have lots of healing properties, which make them suitable for the mushroom production, for example, they feel themselves good in the humid environment, their optimal temperature is the same with mushroom optimal temperature. They do not have harmful effects for the quality of the crops and also for the workers neither.

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