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COMBINING BIOMASS ENERGY OF ENATOMOPATHOGENIC NEMATODES AND BACTERIAL PREPARATIONS AGAINST PEST INSECTS

Introduction

Entomopathogenic nematodes (EPN) (Steinernema and Heterorhabditis app.) are well suited for pest control of harmful insects because they attack a broad range of pests and can be easily applied with conventional spray equipment [1,2]. Insect-pathogenic nematodes occur naturally in almost all soil and reproduce only in insect hosts, which they have killed. More than 30 species have been discovered worldwide. Due to the ease of nematode mass-production, several nematode-based products have been developed for use in the microbial control of agricultural and forest pests. Nematode species and strains differ in their activity against different insect pests. These differences are partially due to differences in the searching behaviors of nematodes, and partially to the type and number of symbiotic bacteria carried by the infective juveniles [3].

The intensive use of chemical insecticides has promoted rapid evolution of resistance, why alternative control measures are developed. Bacterial preparation Gomeline, Dendrobacillina, Lepidocide, Thuringiensis-2, Bitoxibacillina (Bib) and etc. and EPNs have shown potential to control for various harmful insects.

But the efficacy of bacterial preparations can be reduced [4] due to intensive spraying and subsequent resistance development. For resistance management other biocontrol agents are necessary. We therefore focused on the combined biological management for Operophtera brumata and Erranis defoliaria, in order to avoid resistance development and enhance the efficacy of the biological agents.

For the experiment we used III-IV instar worms of Operophtera brumata and Erranis defoliaria. Both species of pest insects, which are polyphagous. They can damage more than hundred plants [5] and they are particular pests for those trees, which started vegetation early [6].

Material and Methods

We collected pest insects for laboratory experiments in different regions of East Georgia, from privat plots of orchard (an apple, pear, plum and nut) and from foliaceous trees (oak, hornbeam, maple etc.).

The collection of materials was made with packets and traps. The materials were placed in special cotton sacks, in jars and sorted them by species.
The establishment of specific consistence carried out in the Institute of Zoology and in the Institute of Zoology and in the of Forest in Georgia.

The cultivation of entomopathogenic nematodes S. carpocapsae and S. thesami that exist in our laboratory was carried by the offered methods of Bedding and Veremchuk [7,8], for in vivo feeding media we used Galleria mellonella and Tenebrio molitor.

Both in Laboratory and field conditions for control of Operoptera brumata and E. Def. was applied S. carpocapsae and S. thesami nematodes suspension with concentration 350-1000 nem/ml separately and with bacterial preparations combining Bitoxibacillinae and Thuringin-2) calculation of mortality the insects in laboratory experiments was carried out after 5 days of invasion with Abbott formul[9] and in field after 7 days by Franz method [10].

The titre of the nematodes suspension an concentration of the bacteriapreparation in liquid was determined by accepted methods of Popov [11]. For experimental plant we used trees of low hornbeam. Experiment were held in the second decade of May under the temperature 19-24°C, moist 85-89%. The plants were treated in the evening hours of cloudy weather.

Result and discussion

As it seems from the table 1, while using low concentration of S. carpocapsae suspension 57,5-55,5 O. brumata and E. defoliaria worms died. Using the high concentration of (700 nem/ml) the same pests its affected increased 95,5%. Similar results and effectiveness were accepted by using S. thesami suspension.

In the case of using combinated suspension (S. carpocapsae -350 nem/ml + Btb 1.0 kg/h) the high percent (86,5%) of mortality was marked. Using the increased (700 nem/ml + Btb 1kg/h) concentration of the nematode suspension the mortality of worms was 100%.

Using the different combination (S. carpocapsae-350 nem/ml+Thuringin 2 and S. carpocapsae-700nem/ml+Thuringin2) the affect was high though a little low in comparsion with the noted experiments.

Using S. thesami both with the same the same bacterial preparations (Btb and Thuringin-2) and the same dose of (350-700 nem/ ml) against Operoptera brumata high results were obtained. It is cleared up that increasing the nematode concentration (700 nem/ml) mortality of pests considerably increase.

The marked combined preparation action appeared to be rather affective while using them against Erannis defoliiaria. Doses of preparations and succession were the same as in experiments carried out on O. brumata. Erannis defoliiaria using the combined suspension of (S. carpocapsae -350 nem/ml +Btb 1.0 kg/h) mortality of Erannis defoliiaria was 91,5%, but as a result of using nematode suspension of high concentration (S. carpocapsae 700 nem/ml+Btb 1.0 kg/h) mortality raced 100% (Fig. 1,2).
Using nematodes together with the other bacterial preparations (S. carpicapsae-350 nem/ml + Thuringin-2 1.0 kg/h) *Erranis defoliaria* worms were killed, but increasing the quantity of nematodes in the combined suspension (700 nem/ml) 100% mortality of pests was marked (Fig. 1, 2).

**Fig. 1.**

Combining EPNs and Btk in control of Operoptera brumata and Erranis defoliaria (Lab. condition)

Using *S. thesami* together with the bacterial preparations (350 nem/ml+Btk 1.0 kg/h) we accepted 94.0% mortality of pests. By increasing nematode concentration in the same combined consistance (700 nem/ml) 100% mortality of *Erranis defoliaria* was marked.

Using *S. thesami* together with Thuringin-2 (350 nem/ml) 82% of pests died. Increasing the quantity of nematodes in the same combination (700 nem/ml+Thuringin-2 – 1.0 kg/h) mortality *Erranis defoliaria* was 100%.

Proceeding from the results of the experiments carried out in laboratory we can conclude, that the affectiveness of the nematode suspension considerably increase (30-35%) in case of using them combined together with bacterial preparations.
Using only *S. carpocapsae* in the field experiments (700 nem/ml) 58-59% of *O. brumata* died, but under the action of *S. thesami* mortality of pests accordingly reached 60,5-64,5% (table).

**Combined affectiveness of genus *Steinernema* nematodes and Bacterial preparations against III-IV age *Oropodiphora brumata* and *Erranis defoliaria* (Field conditions)**

<table>
<thead>
<tr>
<th>The different combinations</th>
<th>Oropodiphora brumata</th>
<th>Erranis defoliaria</th>
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<tbody>
<tr>
<td></td>
<td>Before proc.</td>
<td>After proc.</td>
</tr>
<tr>
<td><em>S. carpocapsae</em> + <em>agristos</em> - 700</td>
<td>40.5 ± 2.33</td>
<td>16.5 ± 1.00</td>
</tr>
<tr>
<td><em>S. thesami</em> - 700</td>
<td>35.0 ± 2.66</td>
<td>13.0 ± 0.66</td>
</tr>
<tr>
<td><em>S. carpocapsae</em> + <em>agristos</em> - 1000</td>
<td>34.5 ± 1.33</td>
<td>9.0 ± 0.66</td>
</tr>
<tr>
<td><em>S. thesami</em> - 1000</td>
<td>37.2 ± 2.33</td>
<td>10.5 ± 0.33</td>
</tr>
<tr>
<td><em>S. carpocapsae</em> - 1000 + Btb 1.0</td>
<td>29.5 ± 2.00</td>
<td>5.0 ± 0.33</td>
</tr>
<tr>
<td><em>S. thesami</em> - 1000 + Btb 1.0</td>
<td>22.5 ± 1.33</td>
<td>5.0 ± 0.33</td>
</tr>
<tr>
<td>1.0</td>
<td>33.5 ± 9.33</td>
<td>2.5 ± 0.33</td>
</tr>
<tr>
<td><em>S. thesami</em> - 1000 + Btb 1.0</td>
<td>17.0 ± 1.33</td>
<td>3.5 ± 0.33</td>
</tr>
<tr>
<td><em>S. thesami</em> - 1000 + Btb 1.0</td>
<td>30.5 ± 1.33</td>
<td>29.5 ± 1.33</td>
</tr>
</tbody>
</table>

As a result of increasing number of nematodes in the suspension (1000 nem/ml) the affectiveness of the preparation increased. E.g. Using *S. carpocapsae* 69,5% of *O. brumata* and 72,0% of *E. defoliaria* died, while using the same dose of *S. thesami* accordingly 71-74% were killed. While combining nematodes and bacteriopreparations (*S. carpocapsae* - 1000 nem/ml +Btb 1,0 kg/h) mortality of *O. brumata* increased on 12% but of *E. defoliaria* 24,5%.

Combining *S. thesami* bacterial preparations with to Thuringin-2 mortality percentage in *O. brumata* increased 15,5%, but in *E. defoliaria* 85% accordingly.

The obtained results showed that by adding bacteriological preparations on nematodes in small dose the mortality of pests fluctuated from 8 to 24%. As a result of carried out researches it is concluded that the affectiveness of the nematode bioeffectiveness against pests increase while using combined bacteriopreparations. We think it's necessary to continue researches in this direction.

Proceeding from the carried out experiments we can could that nematodes suspension efficacy significantly increases (approximately 30-35%) together with bacteriological preparations used in combine form.

The results may offer a powerful and reliable tool for *Oropodiphora brumata* and *Erranis defoliaria*.
REFERENCES


5. ჯობელგი შ. ნერვენა Steinernema thailandica და S. carpocapsae-ს (Steinerematidae) გრაფება არატრაქტიფიური ყელის ბატონას (Hyphantria cunea Drury) ვერსალანდა/ნა მოქმ. ქვაძ. ქართ. მეცნი. ბებია. 2000. 57, XX.


8. Веремчук Г. В. Методические рекомендации по лабораторному культивированию на пчелной огнёвке (Galleria mellonella) и применению энтомопатогенных нематод. Л.:1986.

