Control of black vine weevil *Oiorhynchus sulcatus* (F.) using entomopathogenic fungi and nematodes

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Abstract

In Poland the most damaging species of Curculionidae for different crops are Otiorhynchus sulcatus *(F.) and* O. ovatus *(L.), whose larvae feeding on the roots can even cause plant death. Tests were carried out to assess the effectiveness of black vine weevil control (of adults, larvae and eggs) by entomopathogenic fungi (*Beauveria bassiana *and* B. brongniartii*) as well as nematodes (Heterorhabditis bacteriophora and Steinernema kraussei). The results indicate that both entomopathogenic fungi and nematodes can effectively reduce the population of black vine weevil by interacting with all developmental stages of the insects. These results are currently verified under field conditions.*

Keywords: *Otiorhynchus sulcatus*, *Otiorhynchus ovatus*, biological control

Introduction

The larvae of strawberry root weevil (*Otiorhynchus ovatus*) and the black vine weevil (*O. sulcatus*) are damaging strawberry plantations in Poland and in Europe by feeding on the roots. The aim of this work was to assess the possibility of controlling black vine weevil with different BCAs since there are no registered products to control these pests.

Material and Methods

The experiments were performed in Petri dishes with filter paper discs on which were placed the beetles of *O. sulcatus* (4 replicates, 5 weevils/dish). One strawberry leaf per Petri dish was put as a food for the pest. Test I (started on May 15) - the beetles were dipped for 30 s in aqueous suspensions of BCAs and deposited in the petri dishes with some BCA suspension. Test II (started on June 11) - beetles and the Petri dish were sprayed with BCAs. The list and dosage of the BCAs used are presented in Tab.1.

The efficacy of the treatment was assessed by counting live beetles, deposited eggs and hatched larvae, two and four weeks after the treatment in Test I and Test II, respectively. Data have been analysed statistically using the nonparametric Kruskal-Wallis H test to compare the medians with $p \leq 0.05$.

Table 1: List and doses of biological control agents used in the trials.

Biological control agents	Rate in kg/ha (calculated) in tests I and II	
	I	**II**
B. bassiana	20	20
B. brongniartii (growth on soil medium)	20	20
B. brongniartii (growth on liquid medium)	20	20
H. bacteriophora	1 ml/m^2	1 ml/m^2
S. kraussei	1 ml/m^2	1 ml/m^2

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Results and Discussion

Table 2: Effects of biological control agents on the survival of black vine weevil beetles and the number of eggs and hatched larvae. Means in columns with same letter do not differ for $p \leq 0.05$.

Treatments	Number of tested beetles	Number of alive beetles (median)	Number of eggs (median)	Number of hatched larvae (median)
Test I				
Untreated control	20	2.5 a	12.5 b	15.0 a
B. brongniartii (growth on soil medium)	20	2.0 a	9.5 ab	3.0 a
B. brongniartii (growth on liquid medium)	20	0.5 a	4.0 ab	1.5 a
B. bassiana	20	2.0 a	5.0 ab	5.5 a
H. bacteriophora	20	1.0 a	0.5 ab	0.0 a
S. kraussei	20	0.0 a	0.0 a	0.0 a
Test II				
Untreated control	20	4.5 a	475.0 a	13.5 a
B. brongniartii (growth on soil medium)	20	5.0 a	280.0 a	29.5 a
B. brongniartii (growth on liquid medium)	20	5.0 a	375.5 a	24.5 a
B. bassiana	20	4.0 a	287.0 a	31.0 a
H. bacteriophora	20	4,0 a	275.0 a	30.5 a
S. kraussei	20	4.0 a	212.5 a	14.0 a

The biological control agents have shown the best performance and were most effective in Test I (Tab. 2). In the assessment of this test, a high mortality of beetles as well as a very low number of laid eggs and hatched larvae was observed in all combinations. On the other hand, in Test II the mortality of the beetles was very limited for all BCAs. In addition, a high number of eggs and hatched larvae were counted. Such result may suggest that the age of beetles has a significant impact on the efficacy of the BCAs, which can help defining a correct method for BCAs application. Indeed, Test I was performed on very young beetles, shortly after they came out of the soil, while in Test II the beetles were older. Trials with some entomoparasitic nematodes have shown their efficacy in controlling the black weevil (Burland *et al*., 1993). The change of efficacy in case of the tested entomopatogenig fungi might be due to the defence mechanisms which can be involved in protection against fungal infection, including physical barriers such as the insect's cuticle (Mazza *et al*., 2011).

References

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