

Holistic approach for an effective control of white grub of European cockchafer (*Melolontha melolontha*) in organic strawberry plantations in Poland

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Abstract

In recent years, in Poland, it has been registered an increasing threat to crops, particularly organic ones, from the white grub of European cockchafer (*Melolontha melolontha* L.) and forest cockchafer (*Melolontha hippocastani* L.), with strawberry plantations being among the most vulnerable. Due to the pests' biological cycle, which make difficult the control, we have developed a holistic strategy aiming at the control of these soil-borne pests which includes the use of various biocontrol agents (BCA) and agronomical methods (physical and rotation). For biocontrol, agents such as entomopathogenic fungi (*Beauveria bassiana*, *Beauveria brongniartii*, *Metarizum anisopliae*) and entomopathogenic nematodes (*Heterorhabditis bacteriophora*) allowed to reduce the soil population of grubs. The strategy has resulted in a high efficacy in controlling the grubs.

Keywords: biological control, holistic strategy control, *Melolontha melolontha*

Introduction

In recent years, in Poland, it has been registered an increasing threat to crops, particularly organic ones, from the white grub of European cockchafer (*Melolontha melolontha* L.) and forest cockchafer (*Melolontha hippocastani* L.). Very big losses of plants and, indirectly, of yield have been recorded in some areas due to the feeding grubs, with strawberry plantations being among the most vulnerable. For many years, research has been carried out to control white grubs in the soil using entomopathogenic fungi (*Beauveria bassiana*, *Beauveria brongniartii*) and nematodes (*Heterorhabditis bacteriophora*) (Keller, 2000; Kessler *et al.*, 2004; Łabanowska & Olszak, 2003; Łabanowska & Bednarek, 2011). Although the use of these BCAs reduced the white grubs, their use has not always given satisfactory results. We have thus tested a strategy using several treatments tested in different combinations: soil steam disinfection, pre-planting use of phytosanitary plants, mechanical cultivation and application of BCAs. We present here data on combined use of mechanical cultivation and application of BCAs.

Material and Methods

Experiments were carried out on organic strawberry plantations cv Senga Sengana, in the south-eastern part of Poland in 2014-2015. The experiment was set up in randomized block design with 4 replications (plots of 100 m²) on plantation of strawberries Senga Sengana. In the spring, before planting strawberries, the soil was mechanically cultivated to physically reduce the grubs population. Throughout the growing season, four times at monthly interval, entomopathogenic fungi and nematodes were applied in association with (whenever needed) mechanical weeds control in both rows and interrows. In the spring of 2015 damaged plants were replaced and the same treatments were applied.

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The following BCAs were used: *B.bassiana* (10 kg/ha), *B. brongniartii* (10 kg/ha), mixture of the two species (5+5 kg/ha), *Metarizum anisopliae* (50 kg/ha) and *Heterorhabditis bacteriophora* (either 5 or 10 ml/m²). The assessment of the treatments was carried out by counting healthy and damaged plants. The evaluation was performed twice - in autumn 2014 and late spring 2015. Data were analysed statistically by ANOVA after Bliss transformation, and means separated by Tukey test at $p \leq 0.05$.

Results and Discussion

The results of the assessment of the damage from white grubs on plants are summarized in Table 2.

Table 2. Influence of biological control agents applied for control of white grubs before plantation and during the growing season on damage of strawberry plants cv. Senga Sengana. Means in columns with same letter do not differ for $p \leq 0.05$.

Treatments	Damage plants (%)		Efficacy according to Abbotts formula (%)	
	September 2014	June 2015	September 2014	June 2015
Untreated	21,0 b*	5,3 b	-	-
<i>B.bassiana</i>	9,0 a	1,5 ab	57,1	71,4
<i>B.brognartii</i>	12,0 a	2,0 ab	42,8	61,9
<i>B.bassiana</i> + <i>B.brognartii</i>	10,0 a	1,3 ab	52,4	76,2
<i>Metarizum anisopliae</i>	11,0 a	1,0 a	47,6	81,0
<i>H. bacteriophora</i>	9,0 a	0,3 a	57,1	95,2
<i>H. bacteriophora</i> double dose	8,0 a	0,5 a	61,9	90,5

It emerged that about 5 % of plants were damaged in untreated plots while on treated plots they were only 1-2 %. However, on the plots where the pathogenic nematodes were applied, even less than 1% of the plants were damaged by grubs. These data point to an efficacy of about 62 to nearly 95 % in the second year of observation. It is concluded that the combination of mechanical soil cultivation and regular application of BCAs can result in a good control of *M. melolontha* grubs.

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