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## Control of the woolly apple aphid (*Erisoma lanigerum* Hausm.) by releasing earwigs (*Forficula auricularia* L.) and support oil applications - an interim report of first year results

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### Abstract

The woolly apple aphid (*Erisoma lanigerum* Hausm.) has been recognised for some years as a serious pest in organic fruit growing where they may cause severe economic damage due to a lack of control strategies. Based on preliminary results a new project has been started in 2007 testing combinations of releasing earwigs and oil applications in order to develop an on-farm control strategy. In this paper we present preliminary results of the first year of the project's field trials. They showed good efficacies for applying oil preparations by brush. The efficacy of releasing earwigs depended on the infestation intensity.

**Keywords:** woolly apple aphid (*Erisoma lanigerum* Hausm.) – earwig (*Forficula auricularia* L.) – oil application – feed damage

### Introduction

Several experiments trying to regulate the woolly apple aphid (*Erisoma lanigerum* Hausm.) by the parasite *Aphelinus mali* were performed in the last years but supplied no satisfying results for a practical fruit growing strategy (Hetebrügge 2006). The common earwig (*Forficula auricularia*) is endemic and widespread throughout Central Europe. It is a nocturnal omnivore feeding on animals and plant materials. Earwigs are therefore important natural antagonists of the woolly apple aphid, and they should be encouraged as beneficial organisms in organic orchards. In addition, the application of oil by brushing will be evaluated as a supporting measure to retard woolly apple aphid population growth prior to the release of earwigs.

The project is funded by the Federal Office for Agriculture and Food (Bundesanstalt für Landwirtschaft und Ernährung, BLE) within the "Bundesprogramm ökologischer Landbau" until the end of 2009 (Number of project: 06OE325).

The trials have been established in cooperation with several partners: At the "DLR Rheinpfalz, Kompetenzzentrum für Gartenbau" in Ahrweiler, at the "Kompetenzzentrum Ökoobstbau Niedersachsen" (KÖN) in cooperation with the "Ökoobstbau Norddeutschland Versuchs- und Beratungsring e.V." (ÖON) in Jork, and at the "Kompetenzzentrum Obstbau Bodensee" (KOB).

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Additionally round-robin tests in practical growing situations were started in 2007 under coordination of the "Beratungsdienst Ökologischer Obstbau". The health states of the earwigs from all sites are examined in the laboratory of the "Biologische Bundesanstalt" (BBA) in Darmstadt.

### Material and methods

In three different orchards in Germany trials with five different variants have been established (Tab. 1). In variants 2 and 3 a defined number of earwigs which differed between the three sites depending on their availability were released in the orchards in June 2007 (Tab. 1). In variants 4 and 5 two different oil preparations, Promanal Neu and TS-forte, respectively, have been applied pure by brush in April 2007 (between BBCH 57 - 65) in combination with releasing the same number of earwigs as in variant 2 (Tab. 1). A brush whose bristles were cut in half to exploit also the mechanical effect was used to apply the oils. Rolls of corrugated boards (Ahrweiler, Altes Land) and coffee filters with wood wool (Bodensee) were hung into the trees and have been controlled after a few days to determine the earwig population before the release of new earwigs in the orchards. To offer attractive hideouts for the earwigs to outlast the days the rolls and coffee filters were left in the trees throughout the whole summer and were used to estimate the population monthly by counting the individuals in the hideouts. The infestation with woolly apple aphid colonies has also been determined monthly by investigate the infestation in cm<sup>2</sup> per tree. Shortly before harvest the apples from the different variants were tested for pollution by earwigs excrements and feed traces to detect possible economic damage done by the released earwigs in the orchards.

Table 1: Overview of variants and number of released earwigs in all sites, 2007

variant ID	title	number of released earwigs		
		Ahrweiler	Altes Land	Bodensee
1	control	0	0	0
2	earwig 1	50	20	50
3	earwig 2	100	40	100
4	TS-forte + earwig 1	50	0	50
5	Promanal Neu + earwig 1	50	0	50

### Results and Discussion

First experiences from 2007 showed good success of the different hideouts for earwigs. The majority of released earwigs could be found in the hideouts at Ahrweiler (Fig. 1).

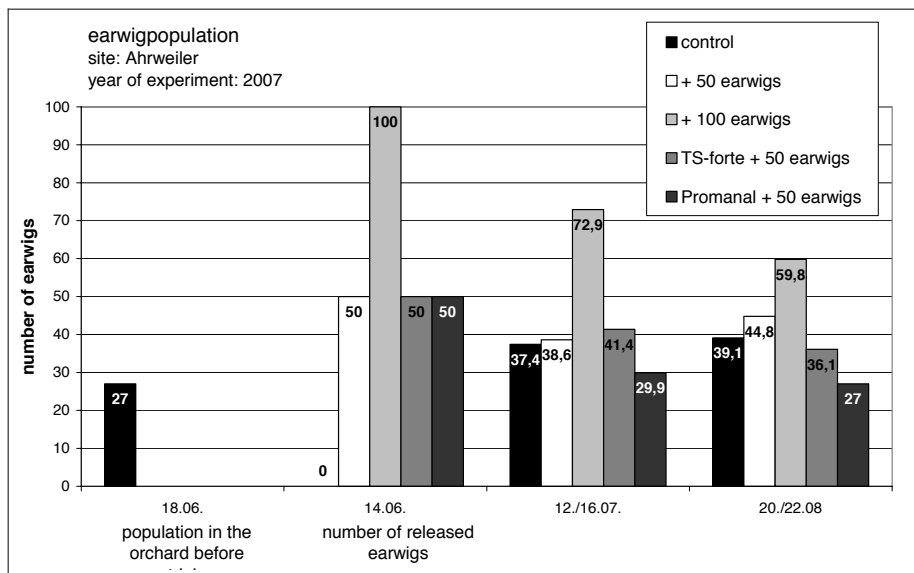


Fig. 1: Population before trials, number of released earwigs and earwigs found in the hideouts after release in Ahrweiler, 2007

The oil application reduced the woolly apple aphid infestation on all sites. Efficacies (ABBOTT) were around 50 % for TS-forte and around 70 % for Promanal Neu in Ahrweiler (Fig. 2) and around 90 % for both preparations at Bodensee (Fig. 3). Until the end of June the woolly apple aphid colonies increased especially in the orchard in Ahrweiler to a massive infestation. Here a decreasing effect to the woolly apple aphid colonies by earwigs did not manifest in the orchard (Fig. 2). A single adult earwig may devour up to 130 aphids per night (Lohrer 2003). Despite of this high eating effort and although the main number of earwigs did not migrate the amount of released earwigs seemed not to be sufficient to control the massive infestation in Ahrweiler. At Bodensee the trees are younger and less voluminous and thus the woolly apple aphid infestation was less pronounced and an effect of the earwig predation as the single measure against the woolly apple aphid colonies could be determined (Fig. 3). The efficacies (HENDERSON & TILTON) were 42 % and 52 % for 50 earwigs in variant 2 and 100 earwigs in variant 3, respectively.

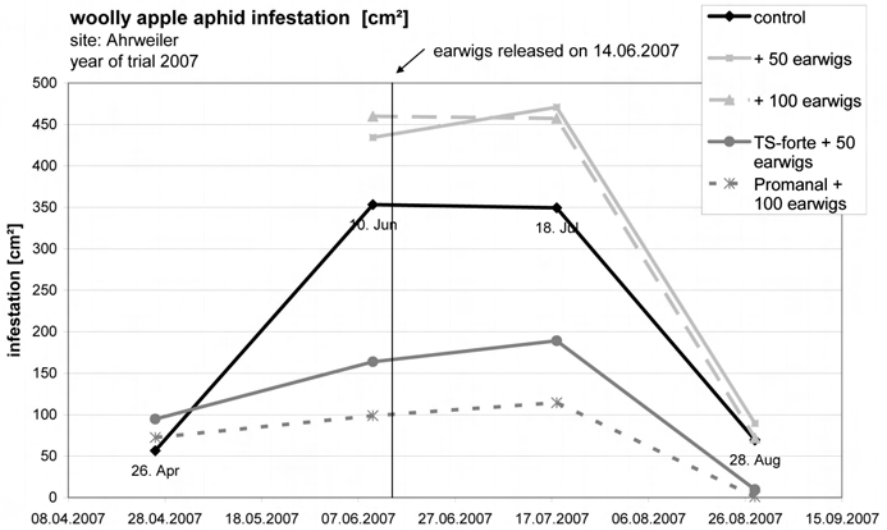


Fig. 2: Woolly apple aphid infestation in the different variants at Ahrweiler, 2007

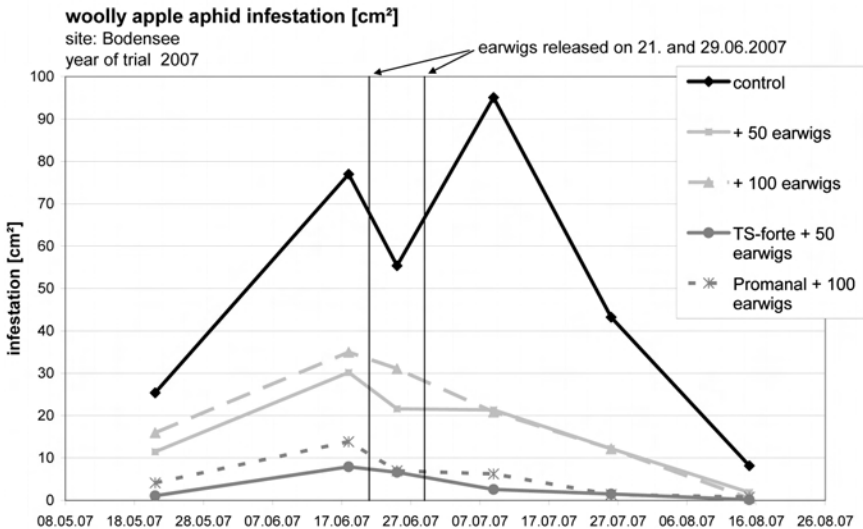


Fig. 3: Woolly apple aphid infestation in the different variants at Bodensee, 2007

Just a few number of apples were polluted by earwig excrements at Ahrweiler and Bodensee (Fig. 4). The amount of dirty apples at Altes Land was higher (Fig. 4) which may have been due to the cultivar Holsteiner Cox whose short stem apples build a attractive space system for earwigs hiding over the day. The apples with earwig feed damage always had other primary damage caused by reasons other than eating by earwig e.g. feed damage by mice or birds, deep entry of codling moth larva or bursted sunburn necrosis.

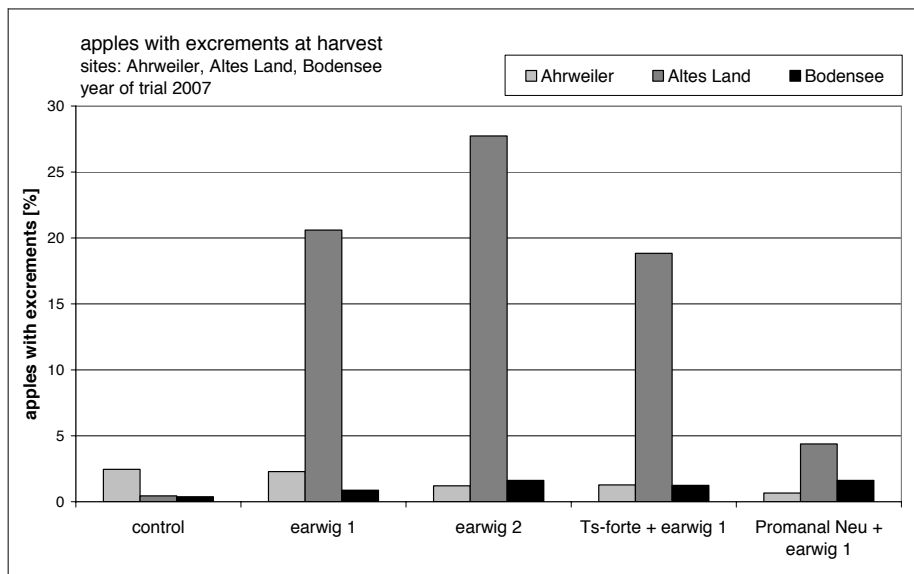


Fig. 4: Proportion of polluted apples at harvest in all sites, 2007

## Outlook

Based on the first year results the field experiments will be continued in 2008 and 2009 and expanded e.g. by a comparison of conventional oil application and application of oil by brush to establish a profitable on-farm strategie to control the woolly apple aphid in organic fruit growing. Earwigs overwinter in the ground, thus influence of ground management on earwigs should be determined, too. Further some detail trials will be established to investigate the influence of predator-prey-ratios between earwig and woolly apple aphid.

## References

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