WAGENINGEN UR
For quality of life

Feeding pattern during the nesting phase of the European earwig *Forficula auricularia*

Authors: Karin Winkler, Sytske de Waart, Herman Helsen
Wageningen UR, Applied Plant Research, P.O. Box 200, 6670 AE Zetten, the Netherlands

Background

The European earwig *Forficula auricularia* L. (Dermaptera: Forficulidae) is a generalist predator that plays an important role in the natural control of orchard pests such as woolly apple aphid (*Eriosoma lanigerum* Hausmann) and pear sucker (*Psylla pyri* L.). Densities of earwigs in Dutch orchards were found highly variable, which raised questions about the underlying factors. So far, orchard conditions in early spring, when the mothers raise their young in a nest in the soil, have received little attention. In this work we investigate the effects of food availability and feeding behaviour of the earwigs during the nesting phase on their growth and survival, in order to be able to optimise orchard soil conditions for earwigs.

Which food is available in the orchard?

To investigate the available soil biota, samples were taken in ten pear orchards. Soil cores were taken from the upper 5 cm of the soil beneath the trees. Soil biota were extracted using Berlese funnels, and analysed under the binocular.
Acari and collembola formed 97 % of the sample content (Figure 1). Variation between orchards was considerable .

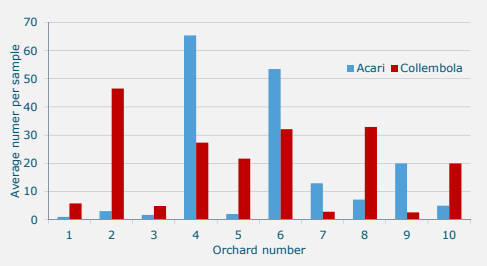

Figure 1. Number of collembola and mites per soil core found in soil samples in ten different pear orchards.

What do earwig mothers and their young actually eat in the orchard?

Artificial earwig nests with mother and first instars were placed in apple and pear orchards in March and April 2016. After a minimum of two days the nests were collected again, and DNA analysis was done on the stomach content by using polymerase chain reaction (PCR) assays for 6 animal prey taxa: Collembola, Gamasina, Cacopsylla pyri, Isopoda, Oribatida and Diptera. We also tested for plant material and fungi.

Table 1. Individual mothers or groups of nymphs tested positive for DNA of different potential food items (sample size in parentheses).

	Earwig mother	1st and 2nd instar offspring
Collembola	3 (16)	4 (50)
Isopoda	4 (16)	5 (50)
Oribatid mites	2 (16)	8 (50)
Fungi	7 (7)	16 (16)
Plant material	0 (7)	5 (16)

What is the effect of food type on the growth of young earwigs?

To investigate the suitability of different diets on survival, development rate, weight and pronotum of earwig nymphs during their first two instars, individuals were offered one of the following seven diets ad libitum:
mites, collembola, algae, earwigs, isopods, standard diet (consisting of carrots, pollen, bird food) and natural diet (consisting of diets 1 to 5). One day after individuals reached their third instar dry weight and pronotum size was determined.

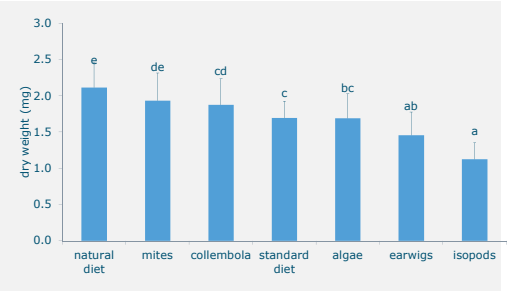

Figure 2. Average dry weight of third instar earwig nymphs after being held on different types of diet.

Conclusions

- Acari and Collembola are the dominant taxa in Dutch pear orchard soils. Density of soil biota varies considerably between locations.
- We were able to introduce artificial nests in the orchard and recover the earwigs. PCR analysis was used successfully used for analysis of the stomach content of first and second instar earwigs and their mothers.
- First and second instar earwigs feed on a wide range of food sources in the field, including Collembola, mites and Isopods and plant material.
- Differences in diet had a significant effect on body weight (and other parameters).
- These results can be used as a starting point to adapt orchard soil management, optimise the conditions for nesting earwigs and maximise insect biocontrol in orchards.

Acknowledgements

This work was initiated by the Dutch Fruit Growers Organisation NFO and is funded by Topsector Horticulture & Starting materials, NFO, Bayer CropScience NL, Syngenta Crop Protection, Fruit Consult and CropSolutions.

Wageningen University and Research
Flower Bulbs, Nursery stock & Fruits
P.O. Box 200, 6670 AE Zetten
Contact: herman.helsen@wur.nl
T + 31 (0)488 47 37 54, M +31 (0)6 12 34 56 78
www.wageningenUR.nl