SHREDDER ACTIVITY OF CAGED *GAMMARUS ROESELI* MEASURED *IN SITU* - A NEW FUNCTIONAL ENDPOINT?

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Introduction

Fig. 1: *Gammarus roeseli*

Fig. 2: Cage with gammarids and straw

Imidacloprid is a neonicotinoid insecticide used in plant protection products against sucking insects. It blocks the N-acetylcholine receptor in animals and induces neurotoxic symptoms. Imidacloprid, which is very mobile in soil, can enter surface waters due to spray drift and run off events and can harm non-target aquatic invertebrates. The freshwater crustacean *Gammarus* sp. (Fig. 1) is a key species in stream systems and known to influence the carbon cycle in streams. They shredder leaf material which is than further decomposed by microorganisms. In this study, the effects of short term imidacloprid pulses on gammarids were investigated at environmental relevant concentrations by exposing caged gammarids (Fig. 2) in the stream mesocosms of the Federal Environment Agency (UBA, Germany; Fig. 3 and 4). The following questions were supposed to be answered:

- Is the cage design by Schaller et al. (2010) a potential method for investigating feeding rates and population development of *Gammarus* in mesocosm systems?
- Do different food substrates like straw and alder leaves influence the population development of gammarids? Straw was used as substitute for alder leaves in the stream mesocosms of the UBA (Poster Session ET05, TU 147 Mohr et al.)
- Does imidacloprid affect the feeding rate (functional parameter), mortality and reproduction rate (structural parameter) of *Gammarus roeseli*?

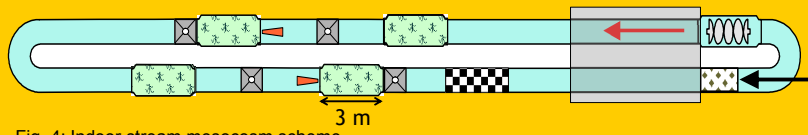

Fig. 4: Indoor stream mesocosm scheme

Fig. 3: Cages in mesocosm

Methods

Experimental design

- Repeated 12 h pulses of 12 µg/l imidacloprid were set from April-July in two series of three pulses (Fig. 5)

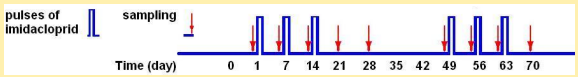

Fig. 5: Sampling and pulse pattern

Indoor stream mesocosms:

- 8 streams operated in a circlular mode (4 x imidacloprid, 4 x control, Fig. 4)
- Flow velocity of 0.1 m/s
- Water temperature 17 °C (Min. 12°C, Max. 23°C)
- Further information: Mohr et al., 2005

Cages

- Modified eggbeaters encased with gauze (250 µm mesh size; Fig. 2)
- Cages with 10 adult *G. roeseli* each were placed in the stream mesocosms (Fig. 2, 3 and 4)
- Pre-conditioned leaf litter from *Alnus glutinosa* (dry weight: 8.5 g) and straw (dry weight: 10.5 g) as food for *G. roeseli*

Sampling and statistics

- Weekly sampling (Fig. 5) of cages: mortality of gammarids (number of individuals) and dry weight of different leaf litter fractions (< 2000 µm; 2000 µm > x > 250 µm)
- Wilcoxon-Test (program "R", version 2.9.2)

Results

During the investigation period of 70 days, numbers of gammarids increased in all cages. There was no significant difference between the controls and the imidacloprid treatments ($p \geq 0.05$; Fig. 6). There was also no significant difference between alder and straw as substrate with regard to numbers of gammarids.

Mean reproduction rates of *G. roeseli* alder and straw were 14.8 d^{-1} (10.4 – 21.4 d^{-1}) until day 28. Later it decreased.

Significant differences ($p \leq 0.05$) were detected for the degradation rate between straw and alder leaves (Fig. 7: after day 28)

However, there were no significant differences in the degradation rate between imidacloprid treatments and their controls (represented by fraction > 2000 µm shown in Fig. 7).

Fig. 8: Different degradation stages of Alder leaves

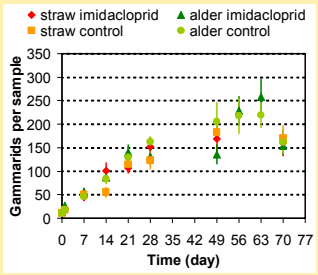

Fig. 6: Mean number of gammarids per sample (n=4)

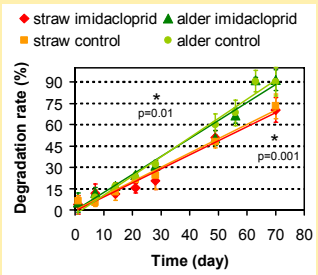

Fig. 7: Mean degradation rate of leaf fraction > 2000µm (n=4)

Discussion & Conclusion

The experiment showed that repeated 12 h pulses of imidacloprid (12 µg/l) had no effect on the shredder activity of gammarids. This was unexpected, because imidacloprid is known to decrease activity and to induce drift (Berghahn et al., SETAC Sevilla 2010, Abstr.: ET05-1).

Cages were suitable to examine the feeding rate and population development of gammarids in mesocosm streams.

The decreasing reproduction rate at the very end of the experiment might be due to food and space limitation.

Straw seems to be an adequate substitute for alder leaves as food substrate for gammarids. However, the pre-conditioning time was twice as long as for alder leaves.

The differences in the degradation rate between straw and alder leaves can be explained by the different lignin concentration and silicate content.

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