Pesticide effects on stream fungi in a realistic apple-crop exposure scenario

Steffen Carl[1], Silvia Mohr[2], Mark O. Gessner[3], René Gergs[2], Christiane Baschien[4]

Contact: s.carl@gmx.de

Fließ- und Stillgewässer-Simulationsanlage
www.umweltbundesamt.de/fsa

Introduction

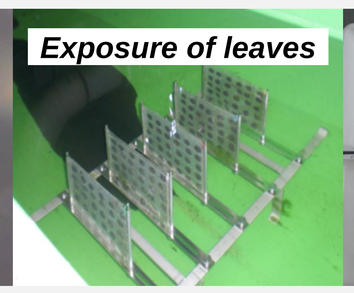
Pulses of pesticide mixtures applied in agriculture can affect important ecosystem processes in streams [1]. This includes leaf-litter decomposition, a process in which fungi play a key role [2]. However, very little is known on the effects of realistic pesticide application regimes on either fungal decomposers or the decomposition process.

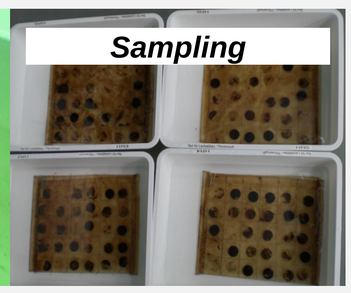
Questions

1) Are the approach and the selected fungal species suitable to detect pesticide effects under realistic exposure conditions?
2) Are stream fungi affected by the tested exposure scenario?

Experimental approach

- **Lab colonization** of alder leaf disks with 3 fungal species (*Neonectria lugdunensis*, *Cladosporium ramotenellum* and *Tetracladium marchalianum*)
- Exposure of disks in 4 **control** and 4 **treated** stream mesocosms in an indoor experimental facility at the German Environment Agency (UBA)
- Treatments: **8 pulses** of up to 4 fungicides in 'regulatory acceptable concentrations' (RAC), i.e. at low, environmentally relevant doses
- **5 sampling dates** over 62 days plus samples before exposure
- **qPCR** with taxon-specific Taqman® probes to determine abundances of the 3 fungi (Fig. 1)
- **Ergosterol** as a measure for fungal biomass (Fig. 3); extraction and HPLC analysis according to [3]

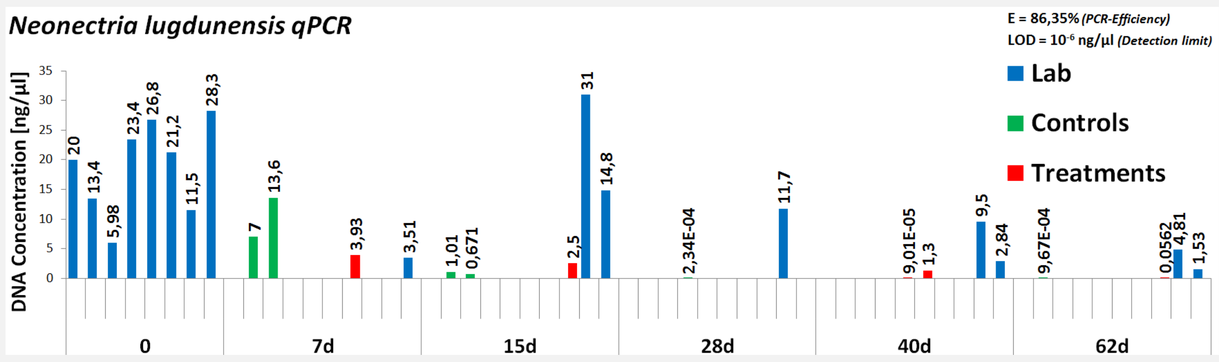


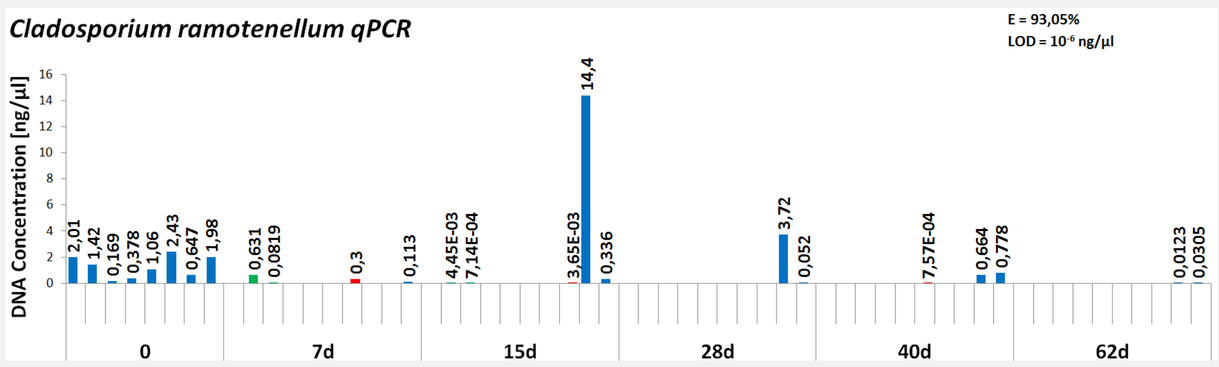


Results

Figure 1: DNA concentrations of the 3 stream fungi in leaf disks as determined by quantitative real-time PCR

- Fungi primarily retrieved in laboratory samples
- *Neonectria lugdunensis* most abundant
- Detection of selected species in mesocosm samples very low





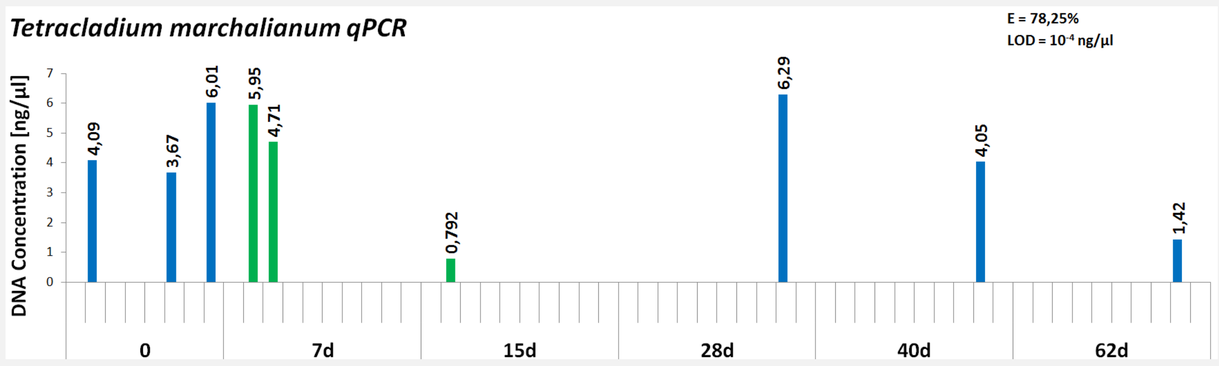


Figure 2: Leaf mass loss

- Decrease of leaf mass with time
- Significant difference between treatments and controls (ANCOVA, p = 0.02*)

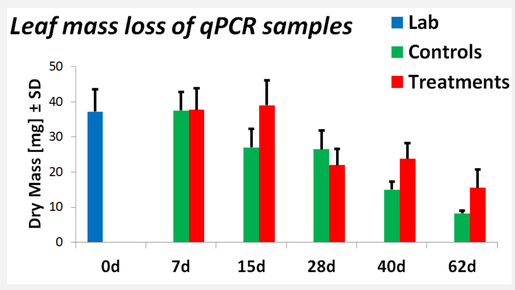
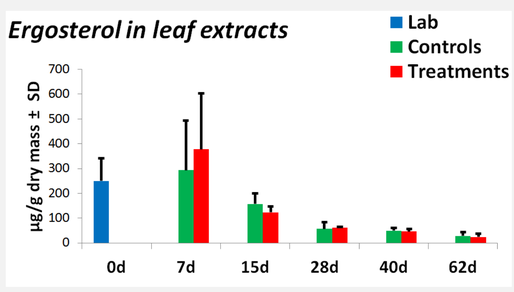


Figure 3: Fungal biomass in leaves

- Decrease in fungal biomass (ergosterol) with time
- No significant difference between treatments and controls



Outlook

- Use of *N. lugdunensis* as a potential species for detailed lab experiment
- High-throughput rDNA sequencing to determine fungal community structure on leaf disks
- Comparison of fungal diversity values on leaf disks to gain the knowledge for further experiments

Conclusions

1) Under the chosen experimental conditions, lab-cultured fungal species were not suitable as indicators of pesticide exposure in stream mesocosms (Fig. 1)
2) Slower mass loss of leaves exposed to pesticides was most likely caused by macroinvertebrates (Fig. 2) because pesticide exposure did not suppress fungal biomass (Fig. 3)

Affiliations:

[1]Goethe University, Frankfurt a. M.
[2]German Environment Agency FG IV 2.5, Berlin
[3]IGB Berlin and TU Berlin, Stechlin and Berlin
[4]Leibniz-Institute DSMZ, Braunschweig

References:

[1] Fernández, D., Voss, K., Bundschuh, M., Zubrod, J. P., Schäfer, R. B. (2015): Effects of fungicides on decomposer communities and litter decomposition in vineyard streams. Science of the Total Environment, 533 (2015), 40-48.

[2] Tsui, C. K. M., Baschien, C., Goh, T.-K. (2016): Biology and Ecology of Freshwater Fungi. In: Li, D.-W. (Ed.): Biology of Microfungi. Springer, 285-315.

[3] Gessner, M. O. (2005): Ergosterol as a measure of fungal biomass. In: Graca, M. A. S., Bärlocher F., Gessner, M. O. (Eds.): Methods to study litter decomposition: a practical guide. Springer, 189-196.