A SINGLE SPECIES TEST WITH THE FILAMENTOUS GREEN ALGAE *OEDOGONIUM* SP. FOR HIGHER TIER RISK ASSESSMENT

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Introduction

- Filamentous, free-floating and scum-forming algae (**metaphyton**) are often the largest contributors to total algal productivity, especially in nutrient-rich shallow ponds and ditches.
- Many **epiphytic algae and invertebrate communities** are **associated** with scums of metaphyton and differ from those present in the pelagial and on the sediments.
- The metaphyton might be important to consider in environmental risk assessment due to the partly **high sensitivity to pesticides**.
- In aquatic mesocosm studies, herbicides and fungicides were often found to cause not only pronounced **direct effects** on the metaphyton biomass, but also **indirect effects** on water chemistry as well as species composition of plankton and invertebrates.
- Despite its high ecological relevance, **guidance for biotests** with metaphyton is **lacking** until now.
- ***Oedogonium*** is one of the most common members of the metaphyton as well as the genus ***Cladophora*** (both Chlorophyta), which may also frequently detach from substrates to form floating scums.

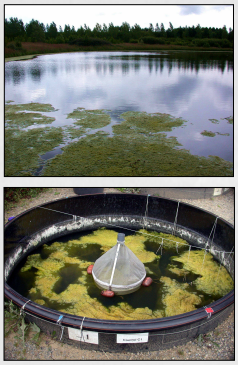

Fig. 1: Typical floating metaphyton clouds on the water surface of a eutrophic lake (top) and an untreated mesocosm (bottom)

Materials and Methods

We tested acute effects of a fungicide on two filamentous green algal species in a confidential industry study with and without sediment in the laboratory (one application, 5 concentrations, static conditions):

Control replicates	10
Treatment replicates	5
Light	50 µE m^{-2} s^{-1} (L:D 16:8)
Temperature	20 °C
Volume	800 mL
Algal nutrient medium	Bringmann & Kühn 1980
Sediment	natural, eutrophic (6 % TOC)

Oxygen, temperature and pH were measured at regular intervals, whereas the biomass of the floating algae was harvested only at the end of the study.

Fig. 2: Experimental test design at test start with *Oedogonium*.

Results

Tab. 1: Results of the tests of both species with and without sediment.

	Oedogonium sp.		*Cladophora* sp.	
	with sediment	without sediment	with sediment	without sediment
Test duration	10 days		14 days	
Initial weight at test start (n=5) [mg dw]	63.1 ± 9.7		162.0 ± 10.2	
Biomass in the controls at study end [mg dw]	229.8 ± 3.6	179.0 ± 24.0	483.9 ± 28.1	400.7 ± 77.0
Oxygen at test start [mg O_2/L]	6.3 ± 0.3	7.1 ± 0.1	6.8 ± 0.3	9.7 ± 0.1
Oxygen in the controls at study end [mg O_2/L]	38.0 ± 0.0	37.2 ± 1.1	22.6 ± 3.5	28.7 ± 3.2
pH at test start	7.3 ± 0.0	7.3 ± 0.0	7.4 ± 0.0	7.6 ± 0.0
pH in the controls at study end	11.0 ± 0.1	11.1 ± 0.1	10.4 ± 0.2	11.2 ± 0.2

Tab. 2: EC_{50} (relative test item concentration) for biomass and oxygen in *Oedogonium* sp. and *Cladophora* sp. (n.s.: no significant dose-response-relationship).

	Oedogonium sp.		*Cladophora* sp.	
Endpoint	with sediment	without sediment	with sediment	without sediment
Biomass increase (yield) [mg dw]	**160**	**51**	n.s.	n.s.
Biomass [mg dw] at study end	(> 333)	(> 333)	n.s.	n.s.
Oxygen [mg O_2/L] at study end	185	(> 333)	(> 100)	(> 100)

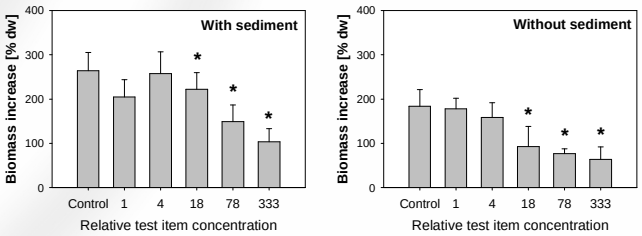

Fig. 3: Biomass increase (yield) in ***Oedogonium*** sp. with (left) and without (right) sediment (*: significantly different from the controls).

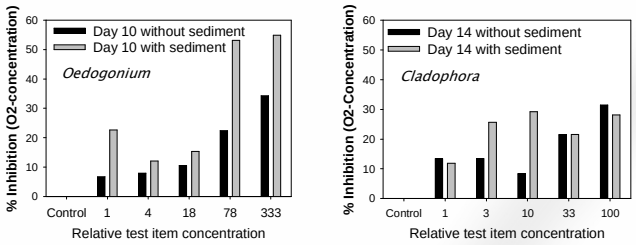

Fig. 5: % Inhibition in oxygen concentration in *Oedogonium* sp. (left) and *Cladophora* sp. (right). All treatments were significantly different from controls.

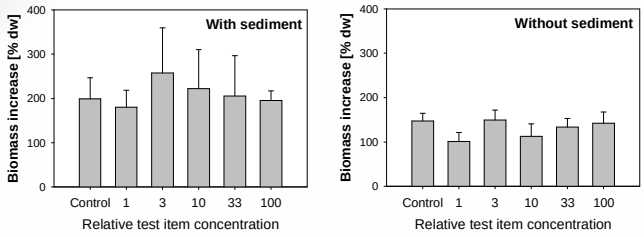

Fig. 4: Biomass increase (yield) in ***Cladophora*** sp. with (left) and without (right) sediment (no significant difference from the controls could be found).

➡ **Clear adverse effects on *Oedogonium* sp. biomass**

➡ **No adverse effects on *Cladophora* sp. biomass**

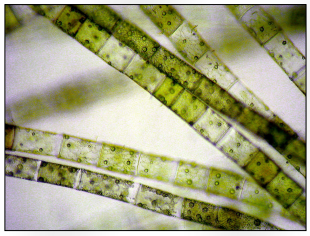

Fig. 6: Single filaments of *Oedogonium* sp.

Conclusions

1. Both metaphyton species showed a **sufficiently high growth rate** under the chosen test conditions (increase of biomass between 140 and 260 % in the controls over 10 resp. 14 days). Because of a slight promotion of the growth rate by the addition of eutrophic sediment, the algal medium should be optimized.
2. With regard to EC_{50}-values, **biomass yield** was the **most sensitive parameter** compared to final biomass, pH and oxygen in the *Oedogonium* test.
3. Both green algae, *Oedogonium* and *Cladophora* , show **different sensitivity** by at least a factor of ten to the fungicide tested.
4. In this specific case, the EC_{50} increased only slightly in the *Oedogonium* tests with sediment. Due to the low water volume/sediment area ratio of 80 L/m^2 compared to standard outdoor mesocosms (about 1000 L/m^2), the test design is suitable to analyse the **influence of sediments on the exposure.**