

# Earthworm short-term response to dairy wastewater applied to a *Salix* plantation

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## Background

Odour is one problem in the management of waste water from dairy, thus the organic Thise Dairy has developed an all year round solution releasing the waste water into underground tubes at 30 cm depth in a willow energy crop plantation established in 2013. The wastewater contains 0.3% dry matter, 150 mg L<sup>-1</sup> N, 2 g salt<sup>-1</sup> of mainly sodium chloride, and a COD of 1100 mg. L<sup>-1</sup>.

## Objectives

- Characterize the earthworm community in willow one week before, Oct. 10 '17, and two weeks after, Oct. 31 '17, receiving dairy waste water
- Create base-line data for future monitoring of the willow plantation
- Describe the spatial heterogeneity of soil properties and earthworm communities and analyse if the non-random block design is suitable for long-term monitoring
- Ecotoxicological questions
  - Can underground application of waste water affect the deep living earthworms and stimulate movement towards the soil surface?
  - Are endogeic and epigeic earthworms unaffected?

## Methods

Thousand m<sup>3</sup> wastewater ha<sup>-1</sup> was applied from Oct. 15 to Oct. 31, corresponding to 6.5 mm precipitation per day. Neighbour plots distant 20-30 m apart, one within the wastewater treated area and one just outside in the untreated control willow area, were established in Oct. 2017 and considered (non-randomized) blocks. In other words this was a Before-After-Control-Impact (BACI) design. Plots were sampled to estimate earthworm abundance one week before and one week after treatment (map link: [goo.gl/tvvMuF](http://goo.gl/tvvMuF)). The willow was surrounded by an agricultural field with a history of wastewater fertilisation subject to an exploratory sampling.



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Fig. 1 Overall earthworm mean fresh biomass m<sup>-1</sup> for the willow plantation and the surrounding field, sampled twice within a month, Oct. 2017.

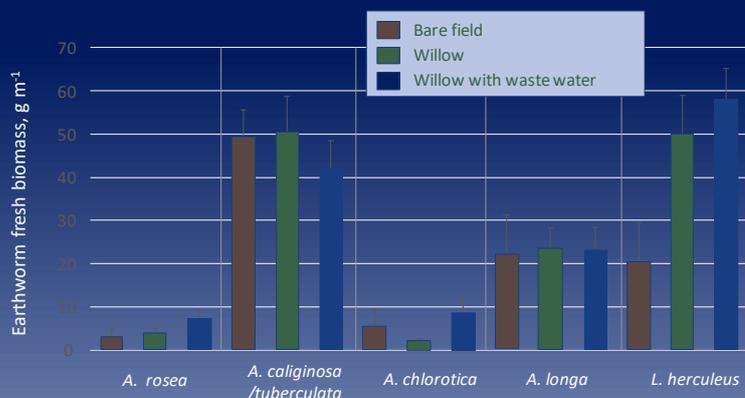
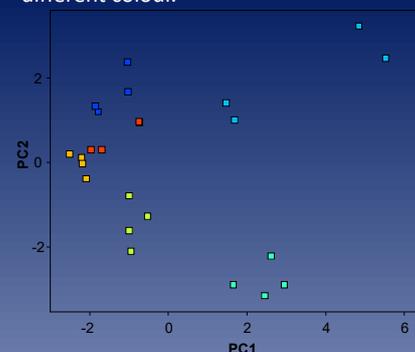


Fig. 2. A PCA multivariate analysis of soil properties and earthworms before wastewater application for all plot showing the grouping into comparable pairs except for block B (light blue). Each block has a different colour.



## Results and conclusions

We found seven species of earthworms in the willow and five in the agricultural soil. Juveniles of *A. tuberculata*, *A. caliginosa*, *L. herculeus*, *L. castaneus*, are morphologically intrageneric indistinguishable, so they were lumped together in their genus, e.g. *Lumbricus* sp. and *Aporrectodea* sp.

- The pairwise positioned plots were very similar except for one pair (Fig.2).
- A behavioural response after wastewater underground application was observed for *L. herculeus* with increased fresh biomass by 50% compared to the paired control plot (Fig. 3).
- In general no acute harmful effects was detected from wastewater application.
- The willow earthworm community since its establishment in 2013 had developed into a composition more typical for undisturbed soil and managed forests as it is favored by the absence of tillage in the willow (Fig. 1).

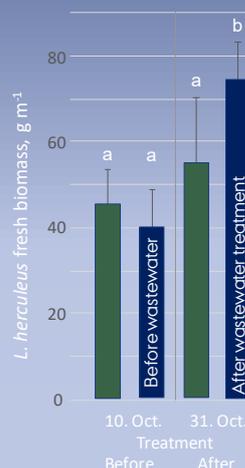


Fig. 3 *L. herculeus* mean fresh biomass m<sup>-1</sup> before and after application of wastewater. Different small letters above bars indicate sign. P<5% Tukey.

This study is part of the CBIO research area "Production and management of agricultural biomasses" addressing soil biodiversity and ecosystem services.



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