

A new screening approach for testing natural soil communities in the laboratory



A. Toschki, J. Oellers, N. Willius, M. Hammers-Wirtz

gaiaac – Research Institute for Ecosystem Analysis and Assessment, Aachen, Germany
contact: toschki@gaiaac.rwth-aachen.de

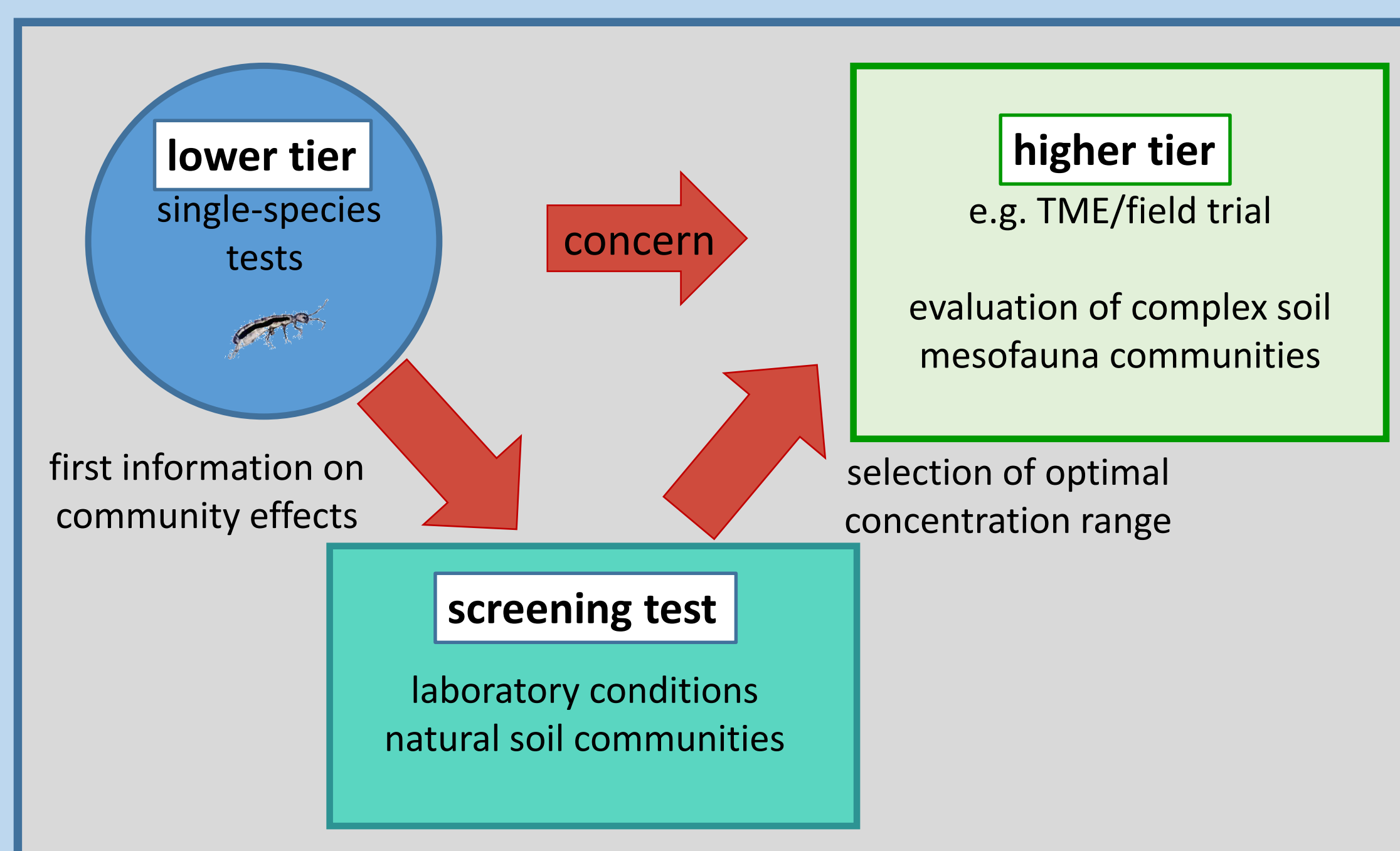


Introduction

The current risk assessment for soil organisms is structured in different tiers. In the first tier, the impact of a substance on single species is investigated in the laboratory, whereas in the highest tiers communities can be tested in a complex field study. The former one can be controlled in the lab while realism is low, the latter one is close to realism while the methodology has to be adapted to counter-balance the high natural variability. In the project Nanomobil sponsored by

the German Federal Ministry of Education and Research (BMBF) the effects of silver nanoparticles on the soil mesofauna are examined in terrestrial model ecosystems (TME). To set up the long term study it was useful to get first information on the community effects in order to select an optimal concentration range for all species groups involved. Therefore a new and easy short-term screening method with natural soil communities was developed.

Soil risk assessment



Test substances

- AgPURE: silver nanoparticles, antimicrobial additive, used e.g. in hospitals for the disinfection of surfaces or for implantation materials, and in agriculture for the improvement of plant growing (www.ras-ag.com)
- AgNO₃: toxic reference

Methods

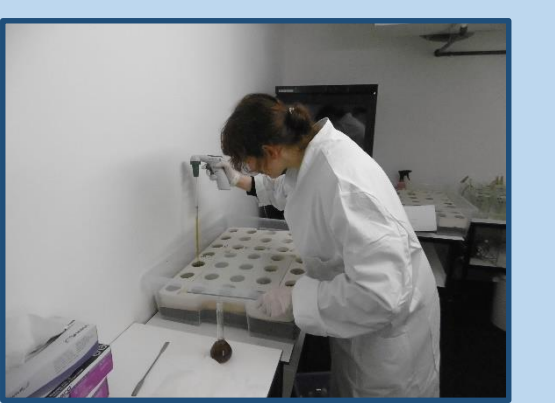
Sampling

- Natural grassland (Northern Eifel, Germany)
- 70 soil cores (5 cm diameter, 5 cm height)
- April 2016



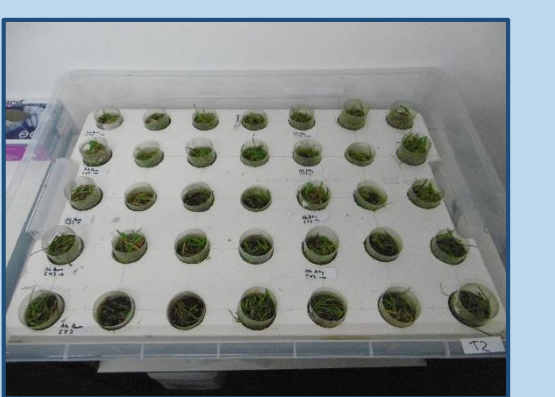
Application

- AgPURE: 5 concentrations, 3 replicates 3.3/ 10/ 33/ 100/ 330 mg Ag/kg
- AgNO₃: 4 concentrations, 3 replicates 3.3/ 10/ 33/ 100 mg Ag/kg (tox. ref.)
- Control: n = 8



Incubation

- laboratory conditions (20° C)
- T1: 14 d, T2: 28 d



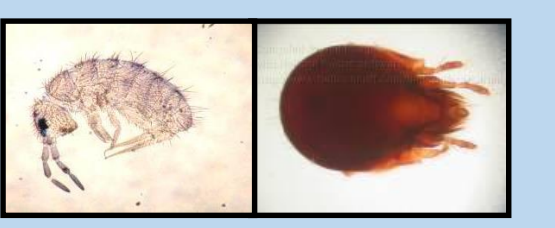
Extraction

- MacFadyen extractor, 14 d (ISO 23611-2)
- temperature and moisture gradient

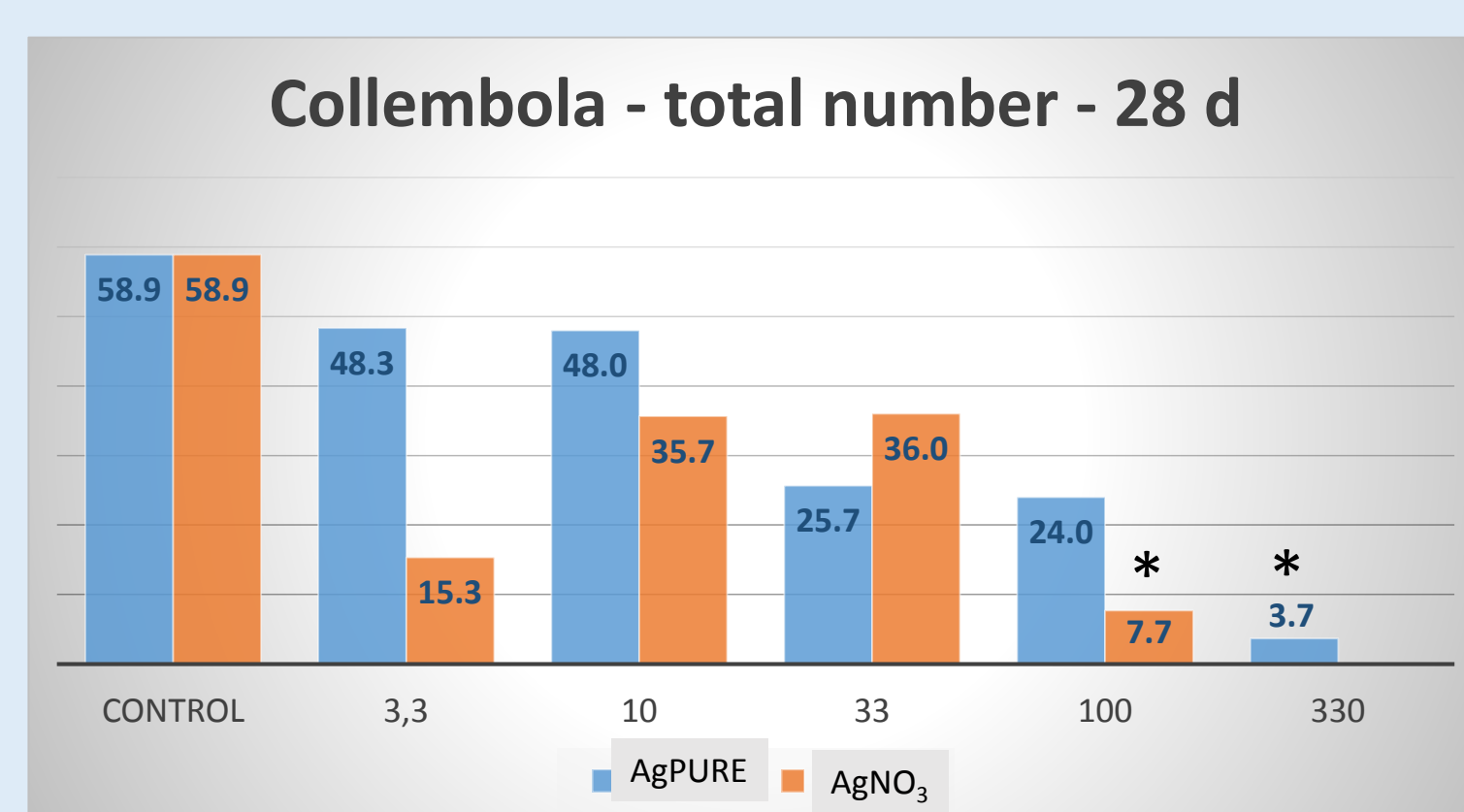
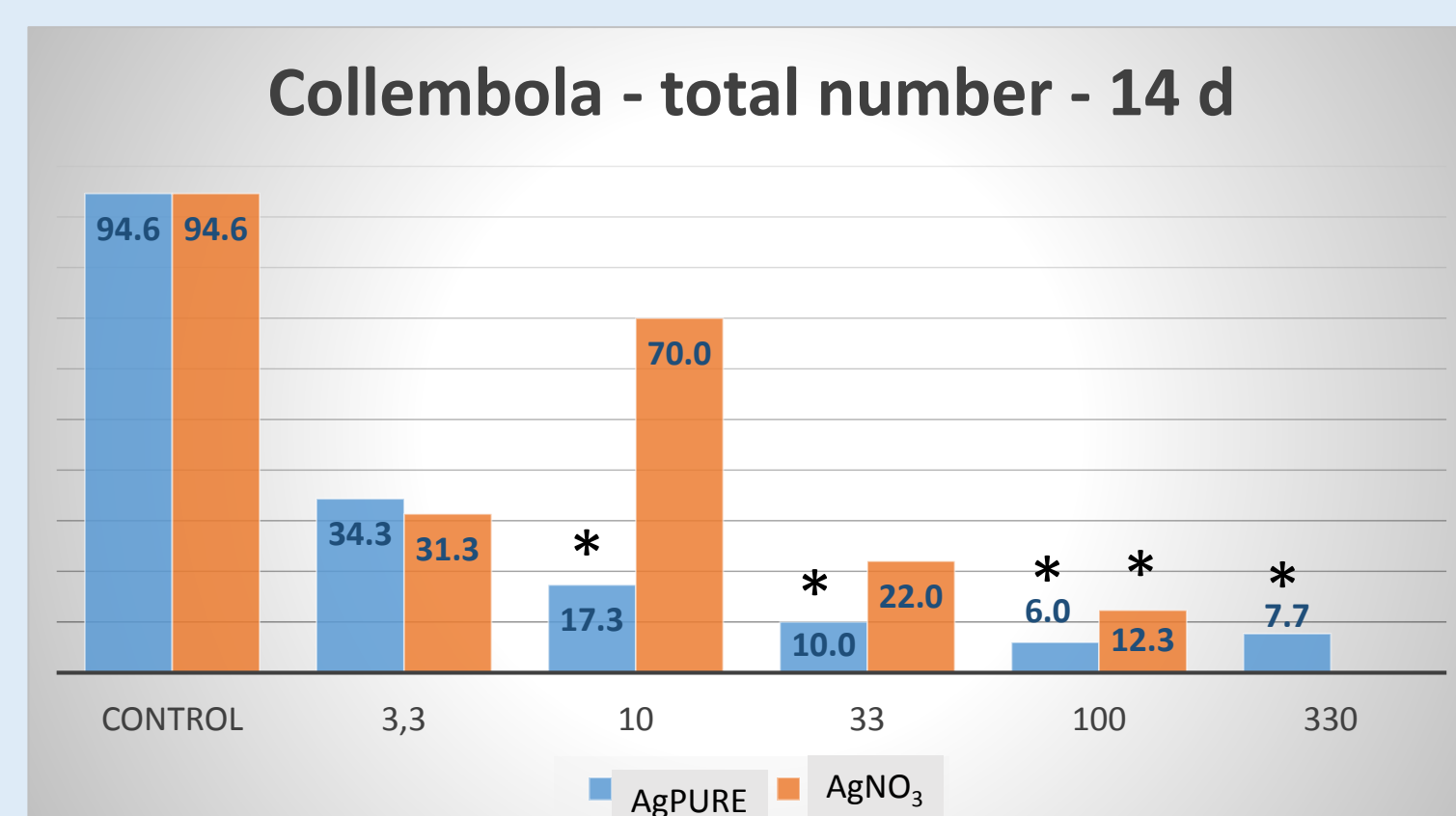


Determination

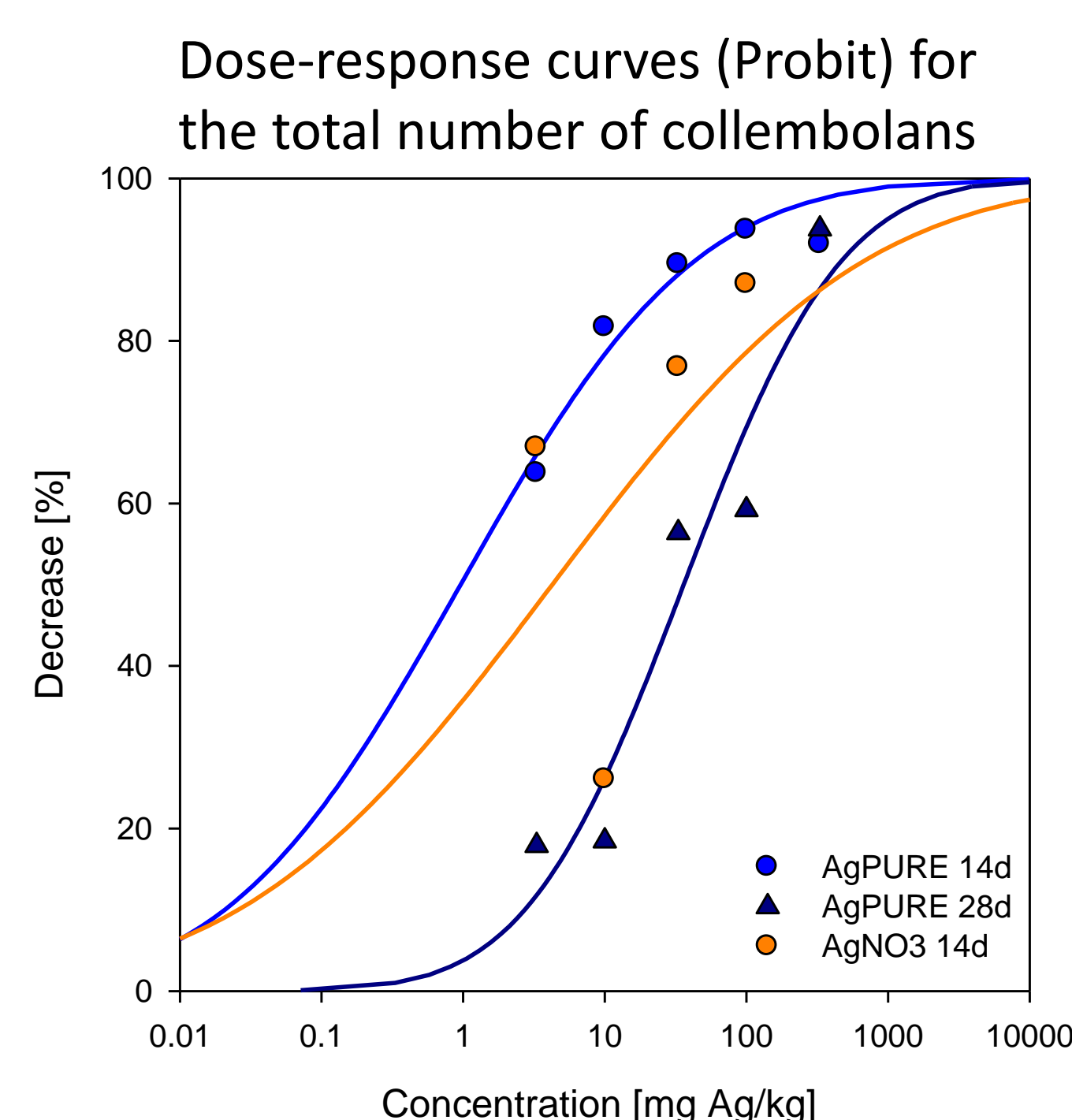
- Collembola and Oribatida
- Counting and determination to species level



Results



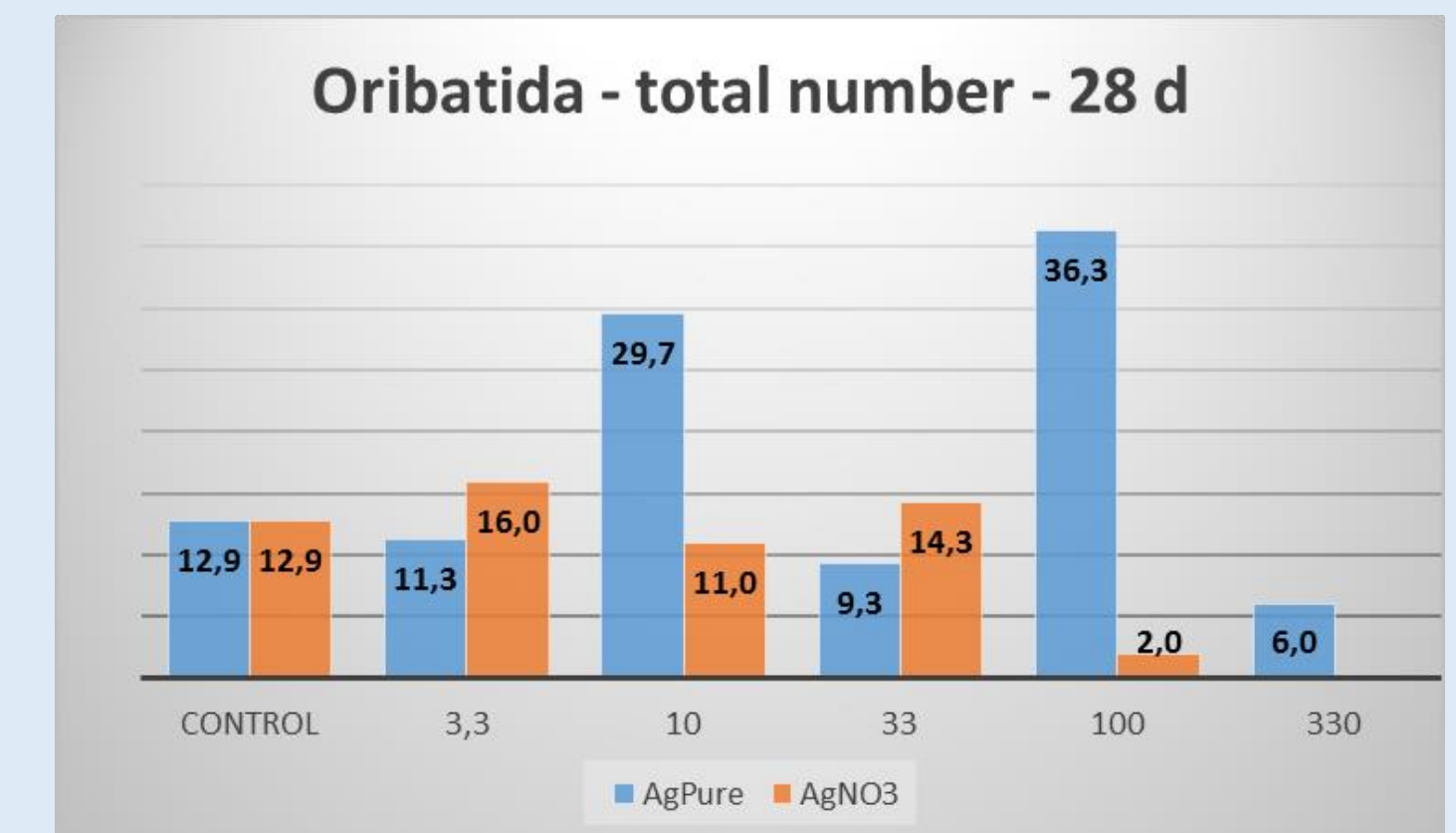
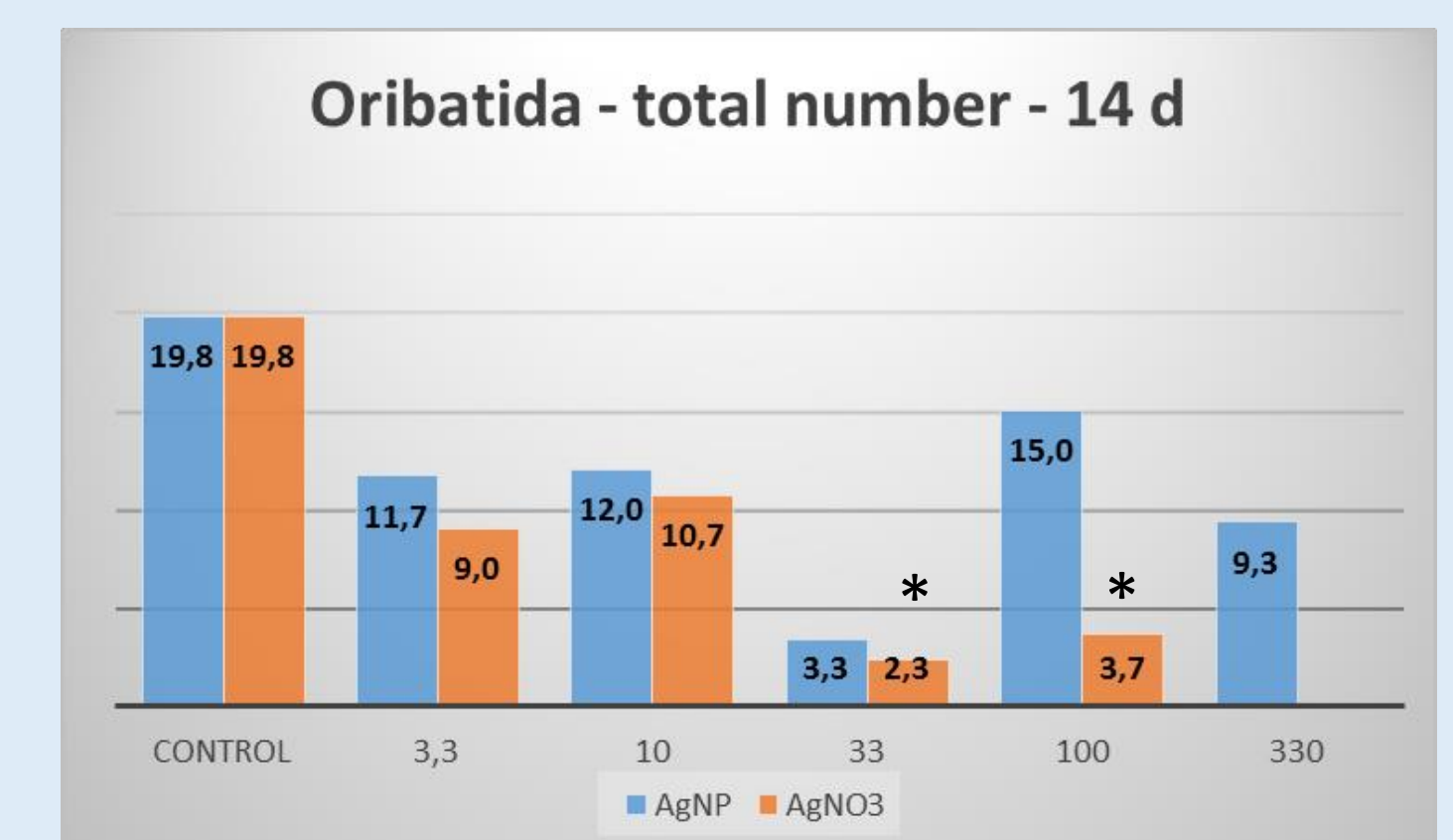
Total number of collembolans (means) after 14 and 28 days of incubation; concentrations in mg Ag/kg; *: significant decrease compared to the control (Welsh-t-test; Williams t-test; Step-down Jonckheere-Terpstra test, p=0.05)



EC50s, NOECs and LOECs for total numbers of collembolans

| Treatment | after 14 days | | |
|-------------------|-----------------|-----------------|-----------------|
| | EC50 [mg Ag/kg] | NOEC [mg Ag/kg] | LOEC [mg Ag/kg] |
| AgPURE | 0.96 | 3.3 | 10 |
| AgNO ₃ | 4.26 | 33 | 100 |

| Treatment | after 28 days | | |
|-------------------|-----------------|-----------------|-----------------|
| | EC50 [mg Ag/kg] | NOEC [mg Ag/kg] | LOEC [mg Ag/kg] |
| AgPURE | 36.1 | 100 | 330 |
| AgNO ₃ | n.d. | 33 | 100 |



Total number of oribatid mites (means) after 14 and 28 days of incubation; concentrations in mg Ag/kg; *: significant decrease compared to the control (Welsh-t-test; Williams t-test; Step-down Jonckheere-Terpstra test, p=0.05)

Conclusions

- Statistically significant effects of AgPURE and AgNO₃ on the total number of collembolans after 14 and 28 days of incubation were observed and EC50s, LOECs and NOECs could be calculated.
- According to the results of this screening test, suitable silver concentrations for the TME long term study could be derived (see poster presentation: Hammers-Wirtz et al.: Investigating effects of silver nanoparticles on the soil community – An outdoor TME study, TU121).
- The screening method is a suitable test system to close the gap between lower tier laboratory and higher tier TME/field studies.

Outlook

- A more detailed evaluation of the results on species level will follow
- Further testing of this easy short-term screening approach with other test substances is planned

SPONSORED BY THE



SETAC Europe 27th Annual Meeting,
07.-11.05.2017, Brussels