

# Effects of microplastics on earthworms in agricultural soil: comparison of traditional and biodegradable plastics

Use of plastics is commonplace in modern agriculture, but degradation of plastics in soil is a slow process <sup>(1)</sup>. Biodegradable plastics have been proposed as a solution for this problem, but little is known of possible effects of plastics, either biodegradable or conventional, to the soil organisms. The aim of our research is to find out possible effects of different types of plastics in soil to earthworms. As important keystone species and ecological engineers<sup>(2)</sup> which have been widely used in ecotoxicological experiments<sup>(3)</sup>, earthworms studies can give us valuable insight about possible harmful effects of microplastics in soil and differences of different plastic types.



Fig. 3. *Eisenia fetida* earthworm, -Salla Selonen



Fig. 1. Earthworm test jars -Vili Saartama



Fig. 2. Agricultural plastics, -Salla Selonen

## Laboratory experiments: Standard ecotoxicological tests

We performed standard (ISO DIS 11268-2 (E) 2011-03) ecotoxicological tests using *E. fetida* earthworms with two different types of plastics (PE and biodegradable plastic type.) with seven different concentrations (0 %, 0,005 %, 0,05 %, 0,1 %, 0,5 %, 1 %, 5 % of soil weight). We measured survivability, growth and reproduction of the earthworms. We also took some for analysis of microplastics and plastic additives in the earthworms.

## Results

- There were no notable differences in survivability of earthworms between different plastic concentrations and types
- There were differences in the growth of the earthworms between different plastics and concentrations. (Fig. 5.) Some decrease in growth was detected in largest PBAT-concentrations, but this decrease didn't follow plastic concentrations directly.
- In reproduction there was clear difference between plastic types (Fig. 4.), but this difference was also present in the control group and thus unlikely a result of different effects of plastic types.

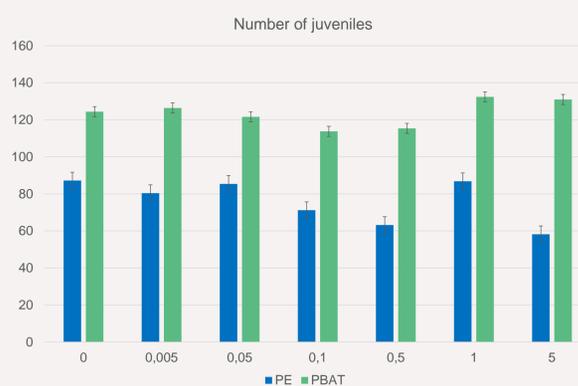


Fig. 4. Difference in the number of juveniles between plastic types and concentrations

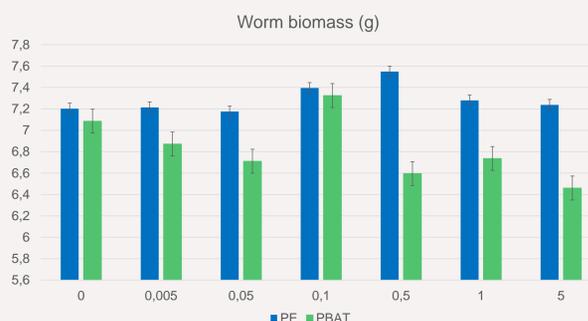


Fig. 5. Difference in the biomass of worms in the end of the experiment between plastic types and concentrations

## Laboratory experiments: Long-term exposure tests

In addition of short term exposure tests we also performed long term tests with juvenile earthworms. In these tests we used the same types of plastics and same concentrations as we did in standard tests. We used juvenile earthworms taken from the previous tests and we put the juveniles in new growth jars contaminated with different types and concentrations of plastics. Thirteen earthworms were placed in each jar instead of the standard ten, because in a several months long study there are more stress factors and disturbance and we didn't want to loose too large percentage of worms. Worms were weighed and counted monthly to measure growth and survivability. We also want to observe when worms are fully grown, fertile and able to reproduce and find out does growing from juvenile to adult in plastic contamination effect worms development to maturity. We record when worms in different concentrations and plastic types start to develop clitellum and when new juveniles and cocoons are found. The research is still ongoing. We have observed slight decrease in growth with highest concentrations of PE, but data is still preliminary.

<sup>1</sup>1. Hale R. C, Seeley M. E, La Guardia M. J, Mai L. & Zeng E. Y. 2020: A Global Perspective on Microplastics -*Journal of Geophysical Research: Oceans*, Vol 125, 2. Bhaudauria T & Saxena K. G 2009: Role of Earthworms in Soil Fertility Maintenance through the Production of Biogenic Structures -*Applied and Environmental Soil Science* Vol 2010, 3. 8 Peijnenburg W. J. G. M & Vijver M. G 2009: Earthworms and Their Use in Ecotoxicological Modelling -*Ecotoxicology Modelling* (pp. 177-204) Funding: Maj and Tor Nessling Foundation, Finnis Environmental institution (SYKE), PAPILLONS.