Project 686: Plastic contamination in agricultural soils – Interactions with earthworms

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Introduction

Organic fertilizers such as digestates are a source of plastic contamination in agricultural soils. Earlier research (Zhang et al. 2018) suggested that earthworms drag weathered, composted or untreated plastic strips into the soil. However, little is known about the interactions of anecic earthworms with plastic fragments from digestate. Here we focused on the effect of fermentation on the interaction between *Lumbricus terrestris* and plastic strips.

Choice experiment

Recovery experiment

Highlights

Fermented plastics were pulled in **equally** to the **leaves**. **Compared** to **leaves**, **non-fermented** plastics were **less attractive**.

Plastic strips were recovered from soil depths of up to 30 cm and it was found that fermented plastic strips were dragged in deeper into the soil by earthworms compared to non-fermented plastics.

Hypotheses & Research questions

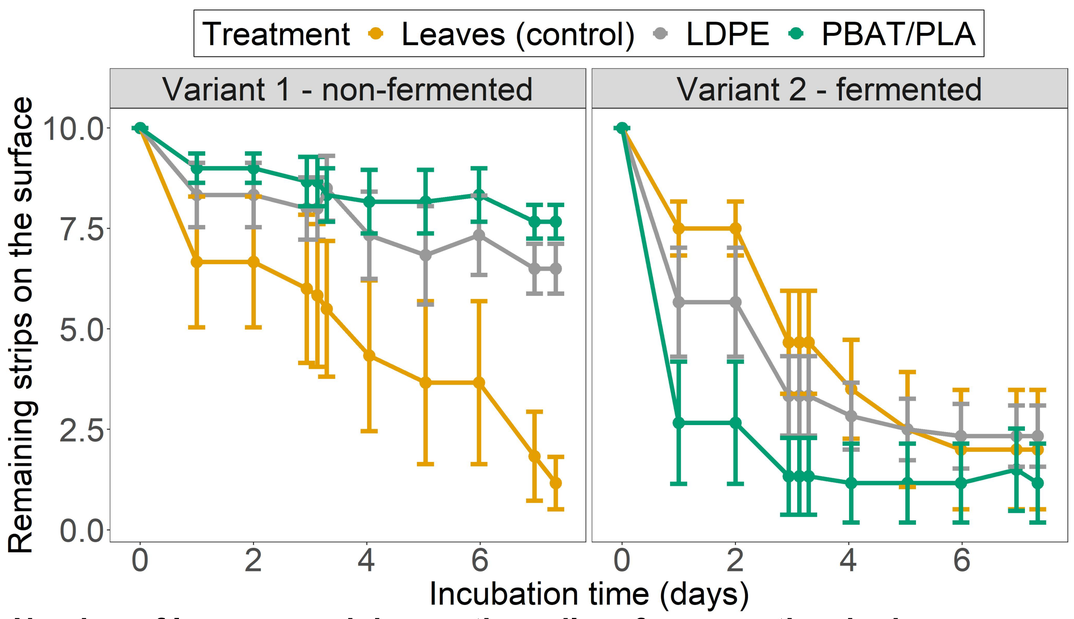
We hypothesized that earthworms:

- **H1 confound plastic strips** with their **natural food** and **drag** them into their burrows.
- **H2 prefer biodegradable plastics** (PBAT/PLA*) to conventional plastics (LDPE**)
- **H3 prefer fermented** plastics to **non-fermented** plastics

Research question:

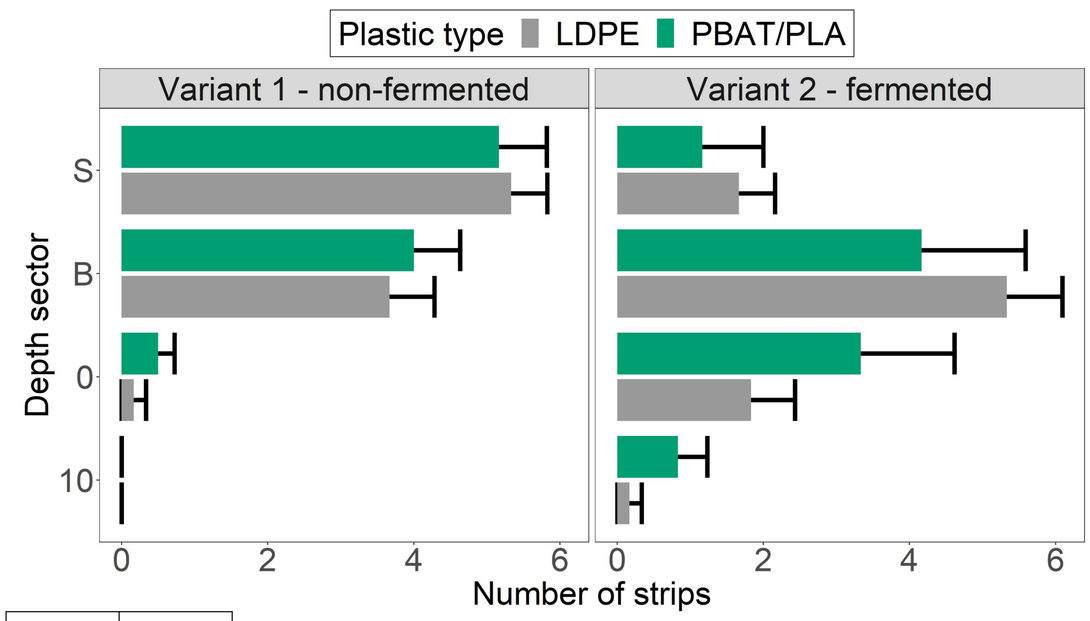
1. To what depth are plastic strips transported by earthworms?
2. Is there a difference between fermented and non-fermented, biodegradable and conventional plastic strips?

Results



Number of leaves remaining on the soil surface over time in days

- **No** significant **difference** between **plastic types** was found**.**
- Compared to **leaves**, **non-fermented plastics** were **less attractive.**
- **No** significant **difference** between **fermented plastics** and **maple leaves** was found**.**



S	**=0 cm**
B	=10 cm
0	=20cm
10	=30cm

Plastic strips were **transported** by **earthworms** into soil depths up to **30 cm**. We found significantly **more fermented** plastic strips in a depth **of 10-30 cm (34 total**) compared to **non-fermented plastics (4 total). Maple** leave strips could **not** be **recovered/identified** at the end of the **experiment**.

Materials & Methods

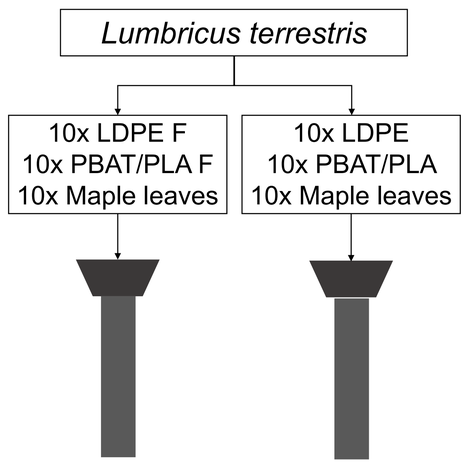
Choice experiment

Selection of plastics:

1. LDPE** (low-density-polyethylene) is a highly abundant conventional, non-biodegradable plastic. Often used in Packaging, plastic bags etc.
2. PBAT/PLA* (poly-butylene co-adipate-terephthalate and polylactide) is a blend of two biodegradable polymers, often used as a replacement of LDPE for compostable plastic bags

Treatments:

- Treatment 1: LDPE and PBAT/PLA Plastic strips (5x20mm) fermented for 30 days at 42°C inside of a laboratory fermenter alongside grass silage at pH7.6.
- Treatment 2: LDPE and PBAT/PLA Plastic strips (5x20mm) left untreated



In two variants (each n = 6), we either placed fermented or non-fermented 5 * 20 mm - sized LDPE and PBAT/PLA plastic strips (n = 10) together with maple leaf strips (natural food source) in separate sectors on the soil surface and put one specimen of *L. terrestris* into the center.

The plastic strips remaining on the soils surface were monitored and counted over the course of eight days. After the end of the choice experiment the burrowed plastic pieces were recovered by sieving through the soil in sections.

Experimental setup before start of experiment

Plastic strips remaining on the soils surface after two days.

Retrieval

Retrieval of plastic:

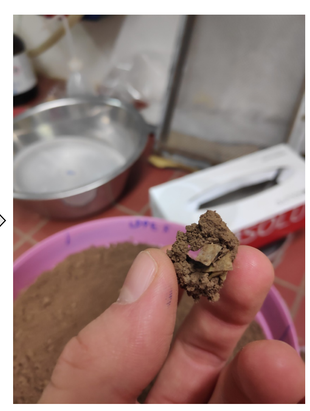
1. Preparation of tubes for filling

2. Filling of tubes to standardized weight, monitoring of water content

3. Finished experimental setup

1. Opening of PVC tubes with a table mounted circular saw

2. Sectioning of tube and sieving of each section



3. Recovery and recording of recovered plastics

References:

Zhang, L., Sintim, H., Bary, A., Hayes, D., Wadsworth, L., Anunciado, M., & Flury, M. (2021). Interaction of Lumbricus terrestris with macroscopic polyethylene and biodegradable plastic mulch. Retrieved 17 August 2021, from https://www.sciencedirect.com/science/article/abs/pii/S0048969718312117

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