

How will the application of digestate affect ecosystem services?

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Why digestate?

Due to increased popularity for anaerobic digesters (AD), there will be an increased use of digestate, the by-product of AD, as a fertiliser. It is important to understand how digestate will impact on existing ecological balances, and how these will affect associated ecosystem services.

Why earthworms?

Earthworms are crucial for maintaining and improving soil fertility and productivity. If digestate negatively affects earthworm communities, their function of helping to provide supporting ecosystem services will be reduced. Their loss may also affect regulating and provisional services too.



Using AD for waste management and biogas generation

Earthworm species

There are three distinct ecological groups:

- 1) Litter dwellers (epigeic)** Commonly found in leaf litter and compost
- 2) Deep burrowers (anecic)** Produce casts and complex systems aiding soil drainage and aeration
- 3) Horizontal burrowers (endogeic)** Live permanently in the soil and feed on dead roots and micro-fauna/ flora

Each group improves soil fertility and condition within different spatial areas. When studying effects of digestate, it is important to consider different groups.

The Red Worm is commonly used in laboratory experiments. They are found in compost (epigeic), with limited agricultural relevance. This may bias findings regarding digestate.

The Lob Worm is a common anecic species found in grass and arable fields. It plays a major role in turning soil aiding

Bioassays using the Red Worm and the Lob Worm, and field trials on natural populations, were conducted to assess effects of digestate.

Digestate experiments

1) The Red Worm will leave an area with high slurry or digestate application (170kg N ha^{-1}), preferring soil on non-treated side of test chamber (Fig. 1)

Preliminary results suggest the Lob Worm has shown higher levels of mortality to these treatments

Also, method of application has an effect on behaviour (not shown here)

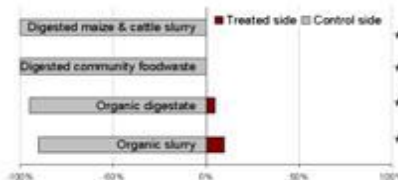


Fig. 1. Avoidance behaviour between clean and treated soils. $p < 0.001$

2) The Lob Worm prefer soils treated with slurry over digestate, and avoid areas treated with high levels of digestate and slurry (Fig. 2). They lost more weight if the fertiliser was newly spread and at a high concentration (Fig. 3).

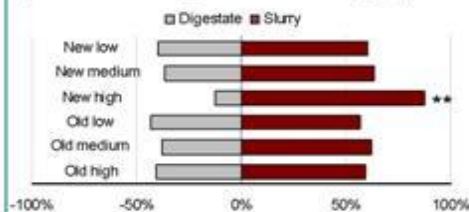


Fig. 2. Choices made between slurry and digestate soils $p < 0.01$

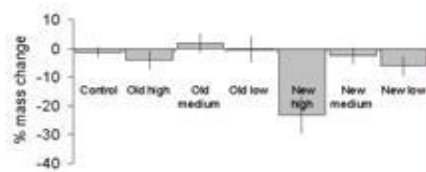


Fig. 3. Weight changes after 72 hrs of exposure. (Lines represent \pm SE).

Preliminary results suggest the Red Worm responses are more sensitive

3) Field plots showed a change in total earthworm population mass distribution, with more and larger individuals entering plots treated with digestate 7 days after fertilising. This may suggest more anecic species, highly beneficial for agriculture.

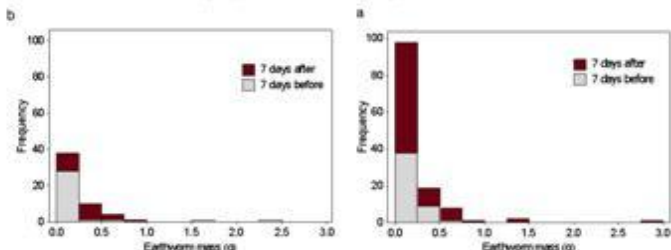


Fig. 4. Total earthworm mass for field plots a) treated with digestate, and b) no treatment.

Conclusion

- Existing protocols may not be suitable for analysis of digestate.

- Earthworm species show differences in their behaviours and therefore their functional roles for ecosystem services.

- Ongoing work is required to fully understand the impact digestate has on earthworm populations existing in agricultural fields.

Next stage

- Identify the lethal dose for both digestate and slurry on earthworms.
- Use data accumulated to provide recommendations for using digestate to reduce negative effects on earthworm communities.