Impact of veterinary residues in keratin-rich amendments for agricultural soil management

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Introduction

Promoting soil health has become one of the biggest challenges of recent years. There is an increasing demand for reduction of artificial fertilizers and chemical pesticides, while maintaining a high agricultural productivity. Enhancing soil suppressiveness against plant pathogens is a promising strategy to control diseases and crop losses.

The application of organic materials is as a promising alternative strategy to chemical pesticides to enhance soil suppressiveness to reduce crop diseases and pests while maintaining a good soil health and structure. In a circular economy these organic materials can be animal by-products to use as soil amendment.

Keratin- and chitin-rich products are most efficient against soil-borne fungal pathogens[1,4]. Interesting by-products from animal-origin are for example hair meal, hoof meal, feather meal, wool, and bone meal. However, these matrices are also known to serve as an archive for residues (e.g. veterinary drugs).

For example, antibiotic residues were found in feather meal from chicken feathers[5] which can influence soil life, including soil microbes. From work on manure application we know such residues can influence soil life, including soil (micro)-biology[3,6-7].

Research question

What is the impact of veterinary drugs residues in animal derived soil amendments on soil microbial community composition and plant growth?

Discussion + collaboration interests

- Are there other interesting animal by-products and/or drug residues to target?
- Which residues may be introduced to soil when using (circular) amendments, and what is their impact on soil biodiversity and crop health?
- To which crops are these soil amendments applied?
- What is the effect of drug residues on soil disease suppressiveness?
- ...

Figure 1. Pictures from a study[4] with bioassays to assess disease suppression of soil borne pathogens with organic amendments: (A) damping off in cress by *Pythium ultimum*, (B) disease spread in sugar beet by *Rhizoctonia solani* AG2-2IIIB. Some of the organic amendments tested do reduce the disease spread.

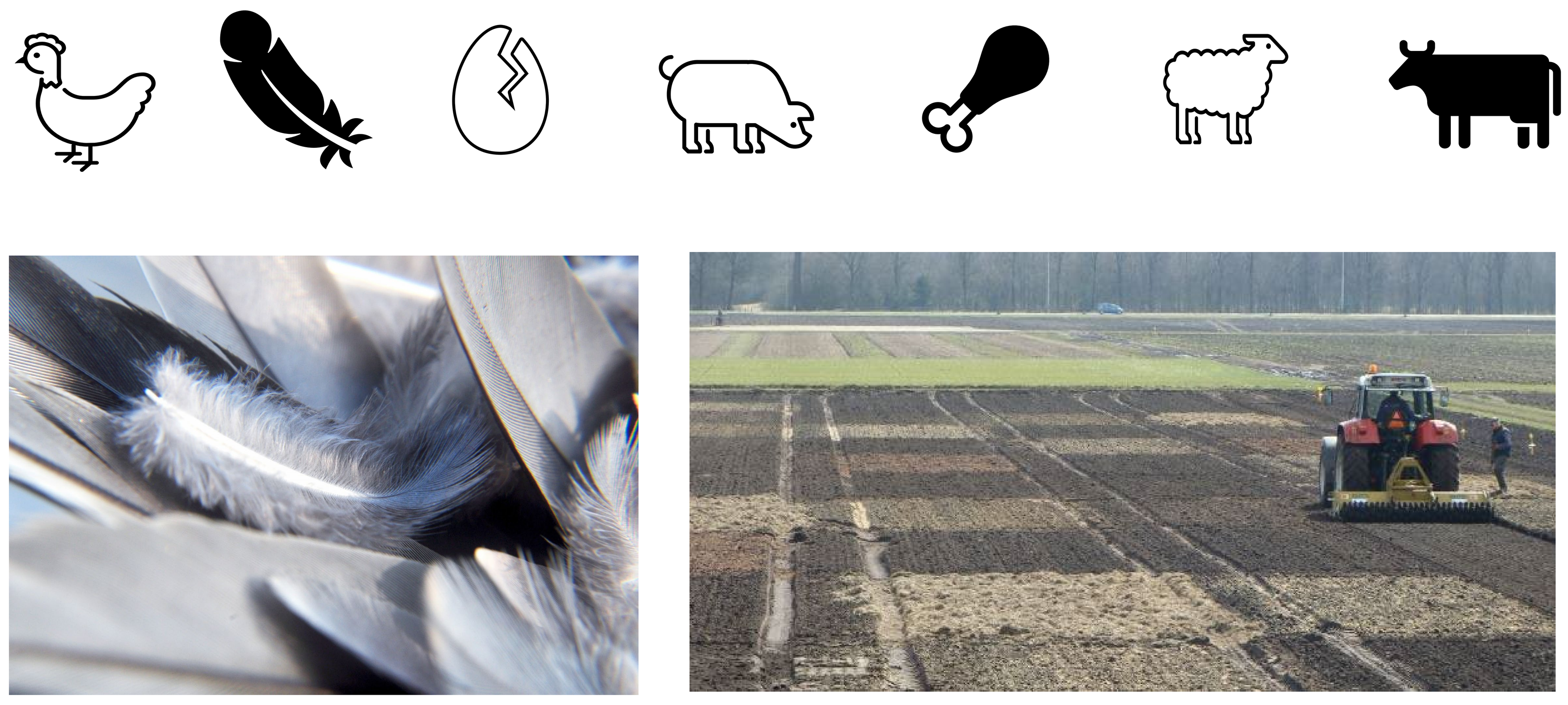

Figure 1. Examples of animals from which different matrices are used as organic amendments in agriculture i.e. feathers (chicken), bone meal (cow), hoof meal (pig). Right: picture from a long-term soil health experiment where different soil amendments are tested at a large scale, see Reference 2.

Experimental set up

We will conduct a pilot greenhouse pot study at WPR to test the effect of a keratin-rich by-product (most likely feather meal) on soil community composition and plant growth.

The feather meal will be spiked with a known concentration of 3 antibiotic drugs, commonly detected and used in livestock production. Antibiotics that differ in persistence will be selected.

Different concentrations, ranging from 0 (control) to realistic levels to a high level, will be tested. The combined effect of different residues will be tested as well for their effects on soil and plant health.

After the growing period, the soil microbiome (fungi + bacteria) will be analysed using amplicon sequencing, comparing the treated and control soils. Soil samples will be stored to later perform a full metagenomics analysis to investigate the impact on microbial polymer-degradation pathways and antibiotic resistances (AMR), depending on the presence of the different residues which will be determined by WFSR.

At WFSR levels of the added contaminants (native substance) and known degradation products will be quantified in the soil and plants. This experiment will be used as a pilot experiment to gather first results to be used in future acquisition activities.

Interesting studies

1. Andreo-Jimenez et al., 2021 - https://journals.asm.org/doi/epub/10.1128/AEM.00318-21
2. Kurm et al., 2023; Visser et al., 2023 - https://link.springer.com/article/10.1007/s00248-023-02215-9 ;https://edepot.wur.nl/585735
3. van Overbeek et al., 2023 - https://edepot.wur.nl/638611
4. Postma et al., 2022 - https://edepot.wur.nl/579469
5. Jansen et al., 2017 - https://link.springer.com/article/10.1007/s00216-017-0445-0
6. Yang et al., 2023 - https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4590886
7. Jongedijk et al., 2023 - https://research.wur.nl/en/publications/the-impact-of-hormones-on-below-ground-interactions

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