Relationship Between Plastic Mulch Use on Farms and Microplastic Content in Soil

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Introduction

- Microplastics are small particles (<5mm) non-biodegradable plastic that contribute to the pollution of our environment and can damage our soil.
- Common sources in Kansas come from plastic mulching film
- Can damage soil structure and stunt plant development (Yuan et al. 2024), (Garfansa et al. 2025)

Research Objectives

- Is there a relationship between the usage of agricultural plastic mulch and the presence of microplastic concentration within the soil profile?
- Identify trends in microplastic distribution in Kansas soil samples under various microplastic conditions

Materials and Methods

Sampling Site Selection:

- Soil samples were collected from ten farms in the Kansas City and Lawrence area. Five of the farms used plastic mulch and five did not.
- Two soil samples were taken from the Konza Prairie Biological Site, which has no history of plastic use. These soil samples are expected to have no microplastics and will be used as controls in this experiment.

Microplastic Extraction:

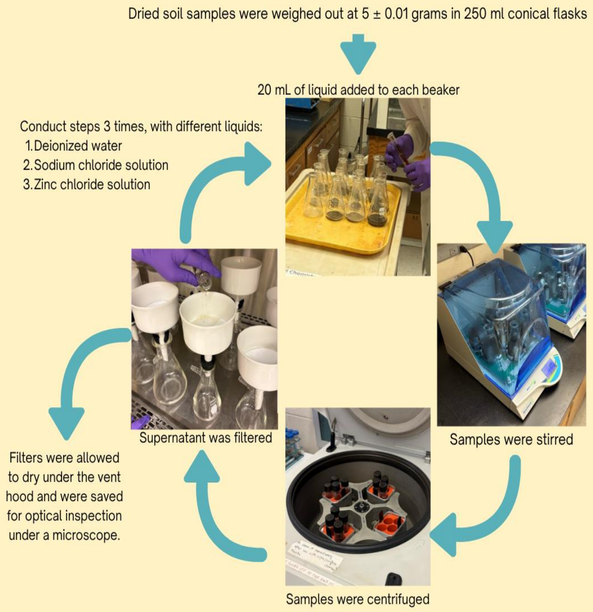
The microplastic extraction was done using a wet extraction procedure based on the methodology used in 2019 research by Corradini et al. This method aims to use floatation to separate the plastic particles from the soil samples, since soil particles are more dense than plastic particles.

Microplastic Analysis:

Visual analysis method using a microscope at 4x magnification. Images were taken of five spots on each filter and microplastic particles were counted for each image.

Statistical Analysis:

- For each sample, total microplastics were calculated, then averaged across replicate samples to generate a single value representing microplastic abundance per site
- Microplastic composition was also analyzed by type, where counts of each type were summed within each site and then averaged across each treatment group
- A non-parametric Wilcoxon rank-sum test was used to compare microplastic abundance between mulched and non-mulched treatments.



Results

Figures:

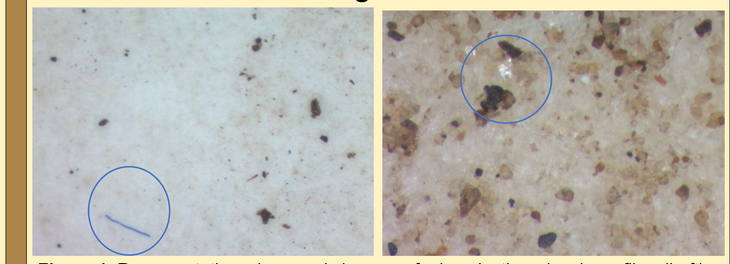


Figure 1. Representative microscopic images of microplastics, showing a fiber (Left) and a Film (Right). Images were captured during optical analysis at 4x magnification and were used to identify and count the microplastics in each sample.

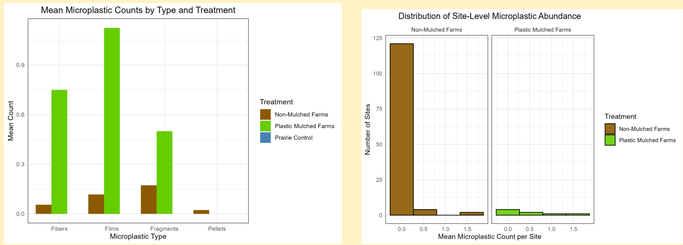


Figure 2. Bar plots showing mean counts of fibers, films, fragments, and pellets in soils from plastic mulched farms and non-mulched farms as well as distribution of total counts. Films, fibers, and fragments were consistently higher in mulched sites, while pellets were minimal or absent across treatments, showing that differences in total microplastic abundance were driven by multiple microplastic categories.

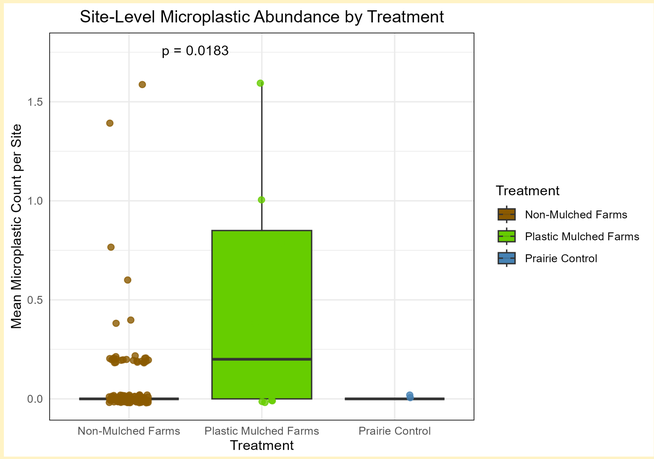


Figure 3. Boxplot showing mean microplastic abundance per site for plastic mulched farms, non-mulched farms, and prairie control soils. Plastic mulched arms showed higher microplastic abundance and greater variability compared to non-mulched farms and prairie controls. A Wilcoxon rank-sum test comparing mulched and non-mulched farms showed a statistically significant difference in microplastic abundance ($p = 0.0183$)

Implications

- Mulched treatments showed higher microplastic abundance when compared to non-mulched sites.
- Non-mulched sites had minimal MP counts while mulched sites displayed a wider range of MP counts
- Plastic mulched farms showed significantly higher microplastic abundance than non-mulched farms ($p = 0.0183$).

Conclusion and Future Studies

- Sites using plastic mulch showed higher microplastic abundance and variability compared to non-mulched sites
- Results support a direct relationship between plastic mulch use and microplastic contamination in soil
- Microplastics in soil can degrade soil structure
- Findings highlight the need for more sustainable agricultural practices and alternatives to plastic mulch use

Photo: Dubois Agrinovation

References and Acknowledgments

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