Depackaged Food Waste & Microplastics

Presenter:

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Fellow, Gund Institute for Environment

University of Vermont

Graduate students doing the hard work:

Kate Porterfield & **Sarah Hobson**

The University of Vermont

Work at UVM in this area is being led by two fantastic graduate students working in my lab

Sarah Hobson, M.S. Student in Natural Resources

Kate Porterfield

Ph.D. Student in Civil & Environmental Engineering

Funding provided by Casella

& the Gund Institute for Environment

Depackaging systems separate organics from non-organics

South San Francisco Scavenger Company installs depackaging system (pre- dry AD)

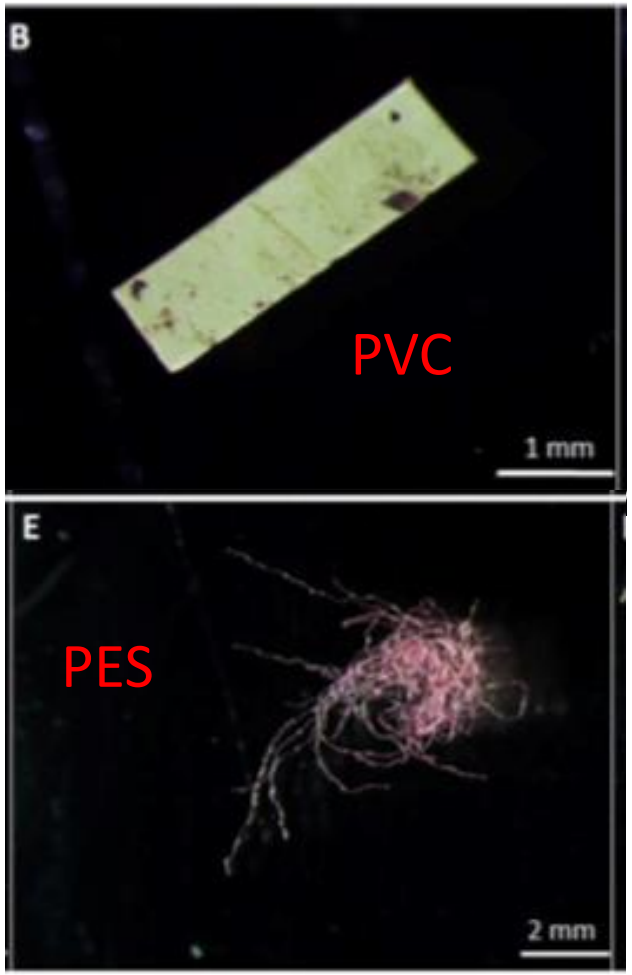
Packaged Food Waste

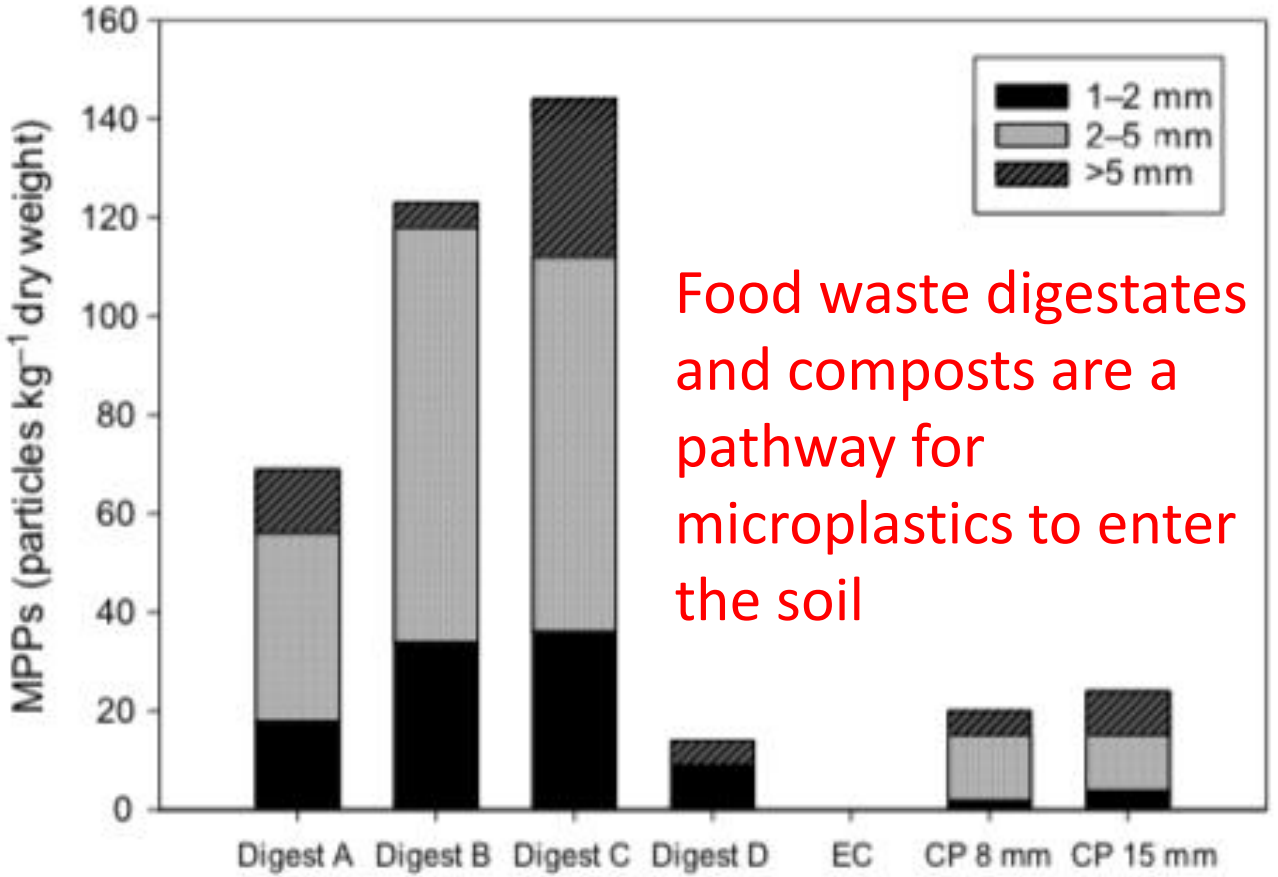
Organic “Mash”

Reject Contaminants

Nora Goldstein for Biocycle, May 2018

Land application of organic residuals derived from food waste can introduce microplastics into soil





Food waste digestates and composts are a pathway for microplastics to enter the soil

Fig. 1. Size fractions of MPPs in different fertilizers. Digests A/B/C/D, biowaste digester; EC, energy crop digester; CP 8 mm/15 mm, biowaste composting plant.

Weithmann et al. 2018

Microplastics Literature Review
Digestates and Composts derived from food waste

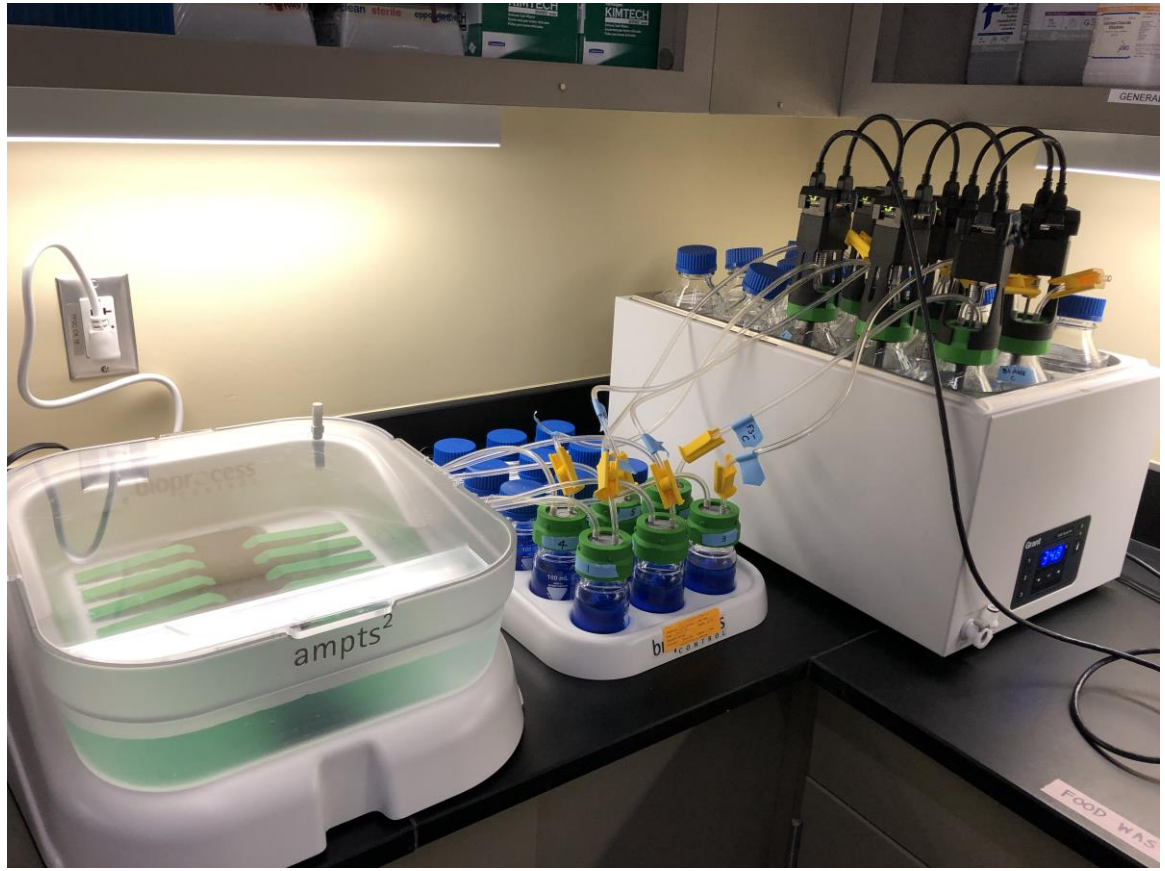
- 12 papers providing original data on microplastics in organic residuals were identified and reviewed
- Values for both composts and digestates typically ranged from ~20 particles to 2,800 particles per dry kilogram of material
- One study reports over 1,000,000 particles per dry kilogram of material for both composts and digestates
- Variability is likely driven by multiple factors, including feedstock, processing, and methods used to detect microplastics (e.g. size fractions included).
- **Note:** Our very early preliminary data suggest that our counts for digestate derived from feedstocks including depackaged food waste fall within typical range. More samples currently being analyzed.

Depackaged Food Waste Characterization (our UVM study in progress)

- **Pre-consumer and post-consumer food waste**
  - Packaged ice cream pints, food scraps
- **Anaerobic Digestion Suitability**
  - Biochemical Methane Potential (BMP)
  - Chemical Oxygen Demand (COD)
  - Total Solids, Total Volatile Solids, pH, Carbon, Nitrogen, Phosphorus, Sulfur
- **Microplastics Content**
  - Organic matter digestion (chemical v. biological)
  - Size distribution (0.5 – 1 mm, 1 – 5 mm, > 5 mm)
  - Plastic type (FTIR Spectroscopy)

Pre- and Post-Consumer Food Waste

Measuring Biochemical Methane Potential (BMP)



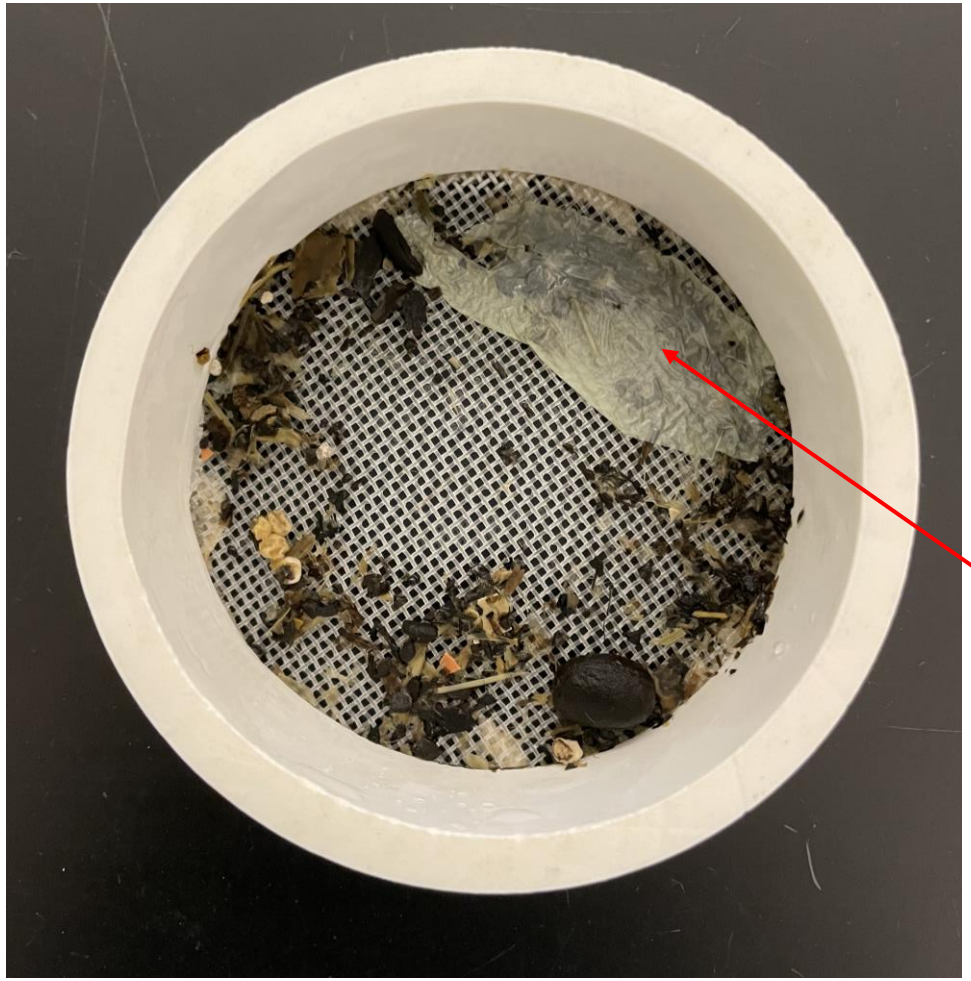
BIOCYCLE
THE ORGANICS RECYCLING AUTHORITY
SINCE 1960

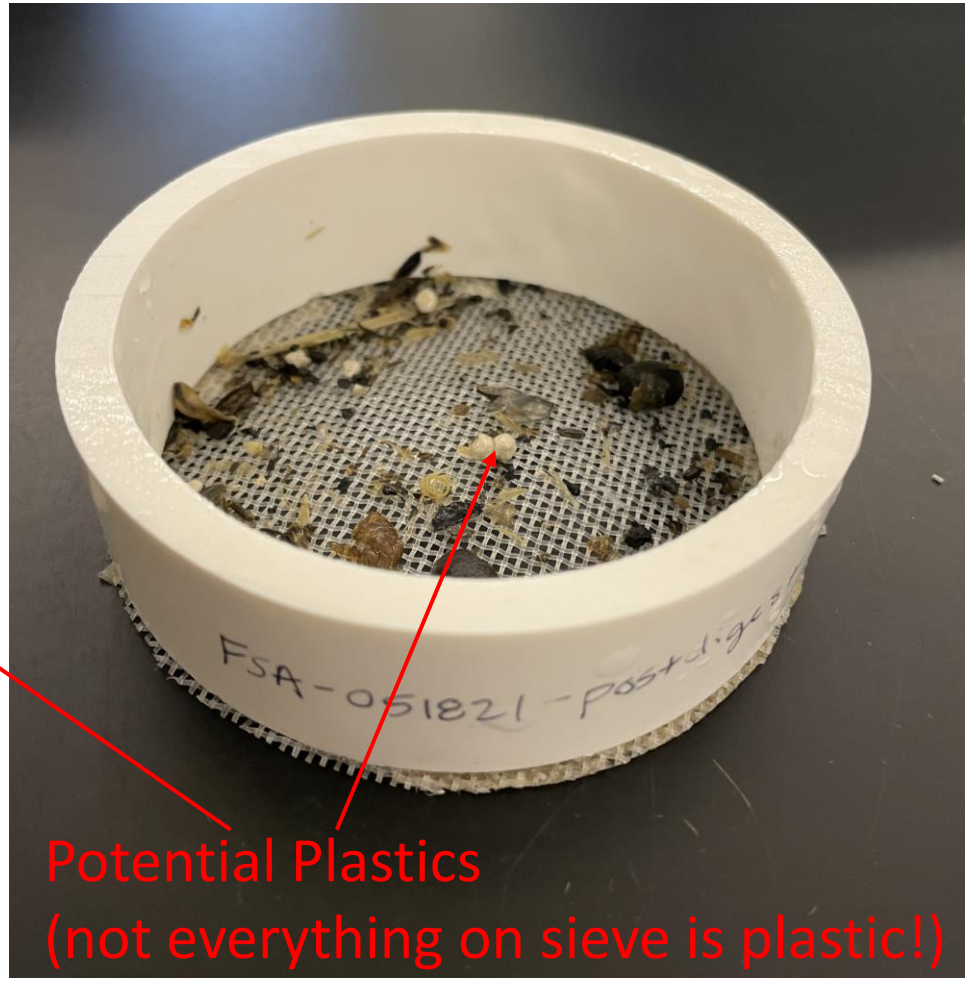
OCTOBER 19, 2021 | AD & BIOGAS, CONTAMINATION, FOOD WASTE

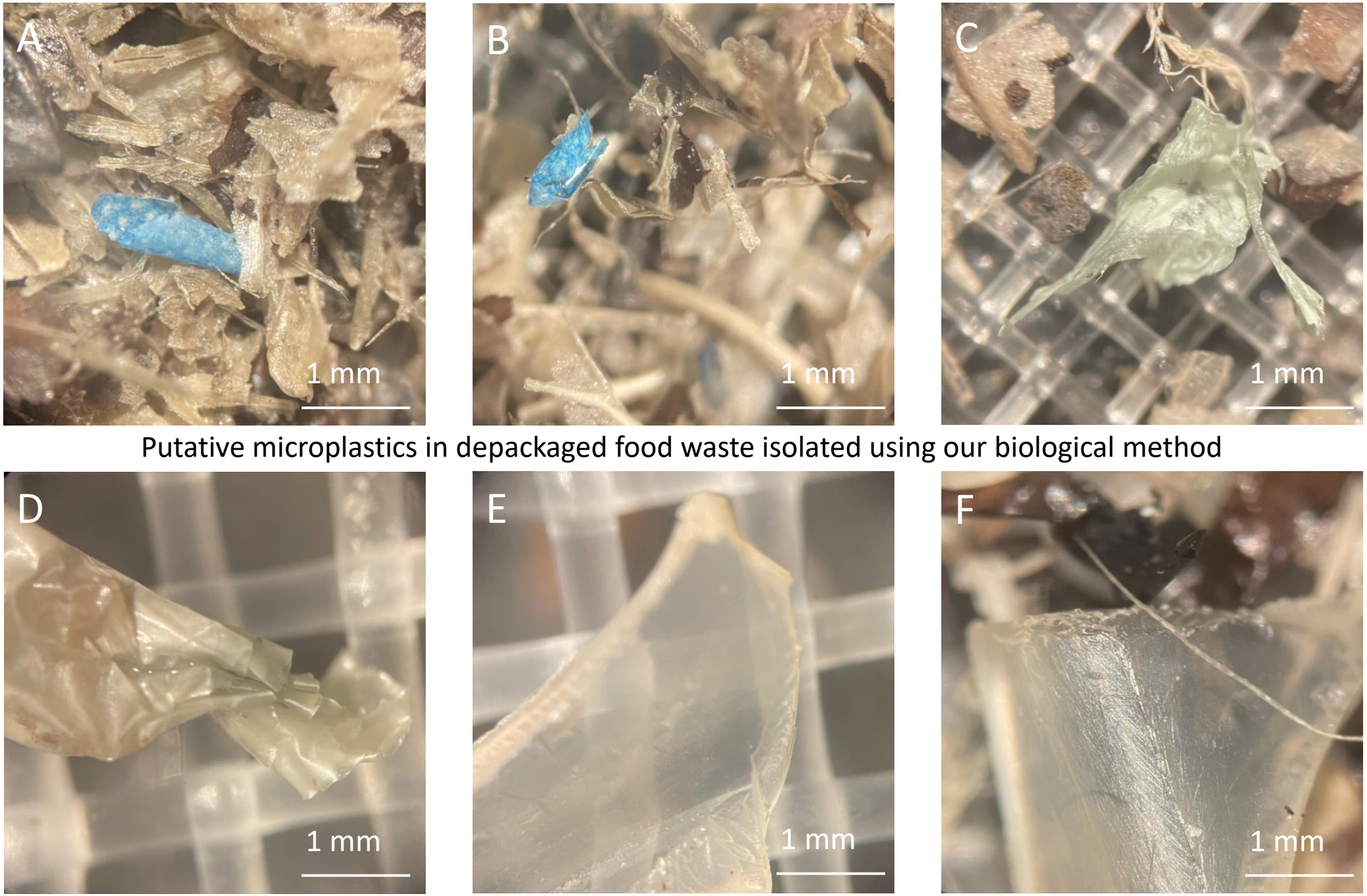
Measuring Microplastics

RELATED POSTS

Measuring Microplastics Content

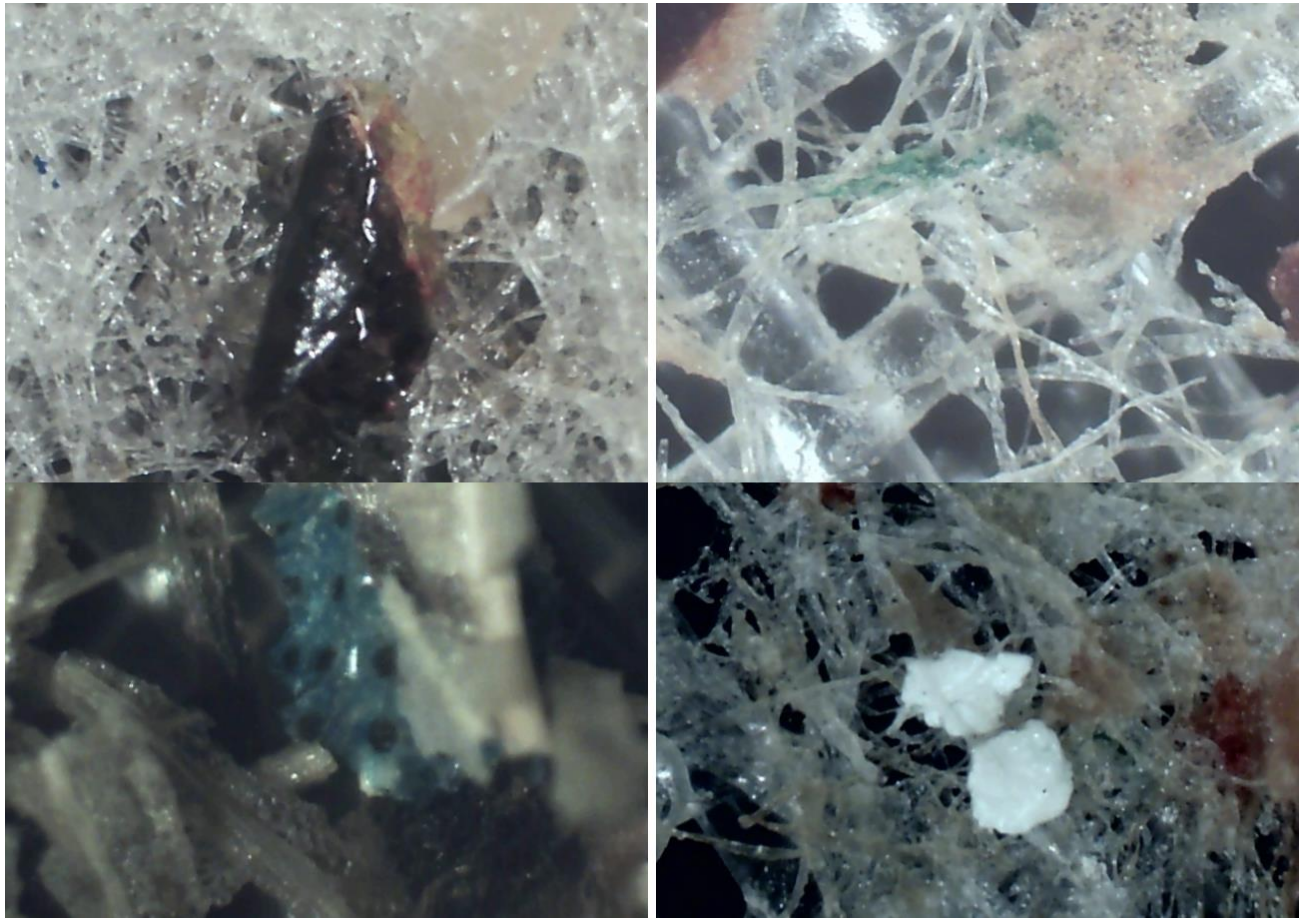






Putative microplastics in depackaged food waste isolated using our biological method

Traditional chemical method for soils/sediments (Fenton's reagent)
Putative microplastics in depackaged food waste



Microplastics in Soils: Sources and Abundance

Range of MPs in agricultural soil:

- Plastic mulched soils: 2.5 to 18,760 average particles/kg soil
- Non-plastic mulched soils: 0.34 to 880 average particles/kg soil

Sources:

- Plastic mulching
- Soil amendments (sludge, compost, fertilizer)
- Farm equipment
- Irrigation
- Atmospheric deposition
- Roads
- Litter

Knowledge gaps:

- Relative contribution of plastic by source
- Background level in soils
- Bioplastics behavior in soils
- Abundance of sub-micro plastics (nano and smaller)

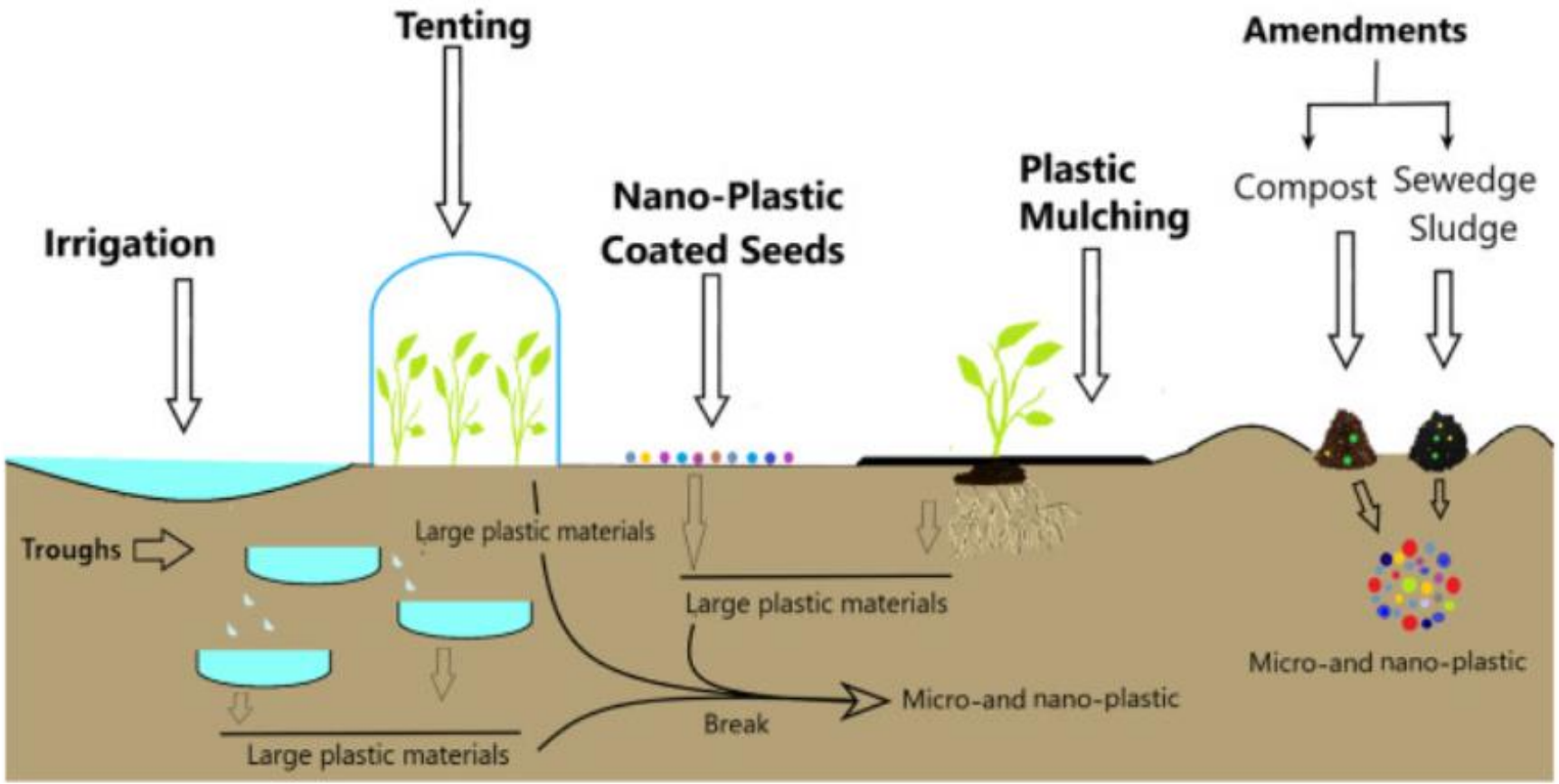
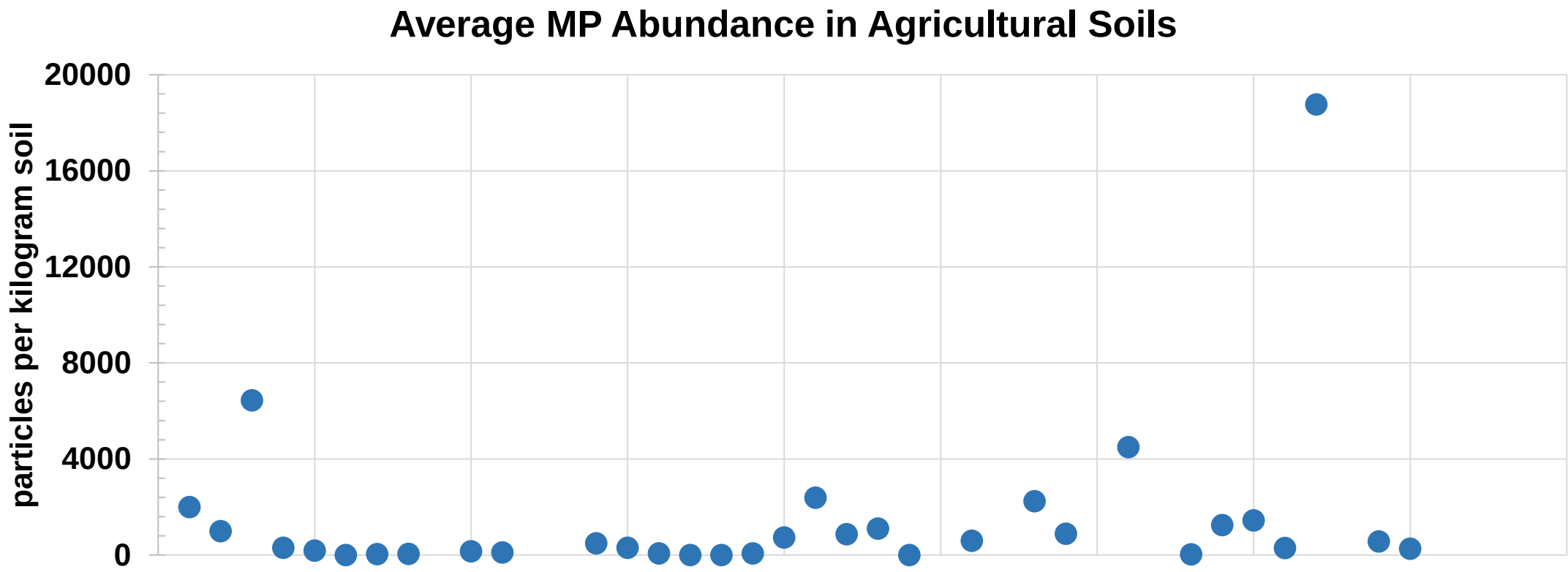


Figure 1:Image from (Iqbal et al., 2020). Inflows of plastic to agricultural soils

MP Abundance in Ag Soils: Previous Studies



Physical Effects: Fate and Transport

Increase Soil:	**Decrease soil:**
Aeration	Bulk density
Water repellence	Aggregate sizes
Porosity	Water holding capacity

Microplastics movement:

- Concentrate at surface
- Transport other chemicals

Knowledge gaps:

- MP fragmentation extent and conditions
- MP effects across soil types and other environmental variables
- Sub-micro sized particles fate and transport

Ecotoxicity of Microplastics

→Many studies found no effect, or no effect at real world application rates

→Environmental conditions matter (soil type, compaction, moisture, chemical make-up)

Observed effects:

- Root growth decrease (but 1 study found root growth increase)
- Transport other chemicals
- Change metabolic pathways
- Decreased biomass growth
- Smaller plastics= bigger effect
- Lower seed germination
- Oxidative stress
- Increase in biomass phytochemicals
- Earthworm oxidative stress, neurodegeneration, and inflammation
- Decreased microbial community diversity and functioning

Knowledge gaps:

- Transport of sub-micro plastics in organisms
- Timeline of MP biodegradation, assimilation, and mineralization
- Toxicity of real-world doses (most studies have very high doses)
- Overall need for more ecotoxicity studies (species and food chain transport)

Information in this presentation is based on a large # of peer-reviewed papers

- Our review & research findings are preliminary at this stage
- We hope to have a review paper ready to share by early 2022
- Full results from our study of depackaged food waste in Spring 2022
- In the meantime, please feel free to reach out to us for papers on any topics included in this presentation

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