Root System Response of Three Agricultural Crops to Microplastic Type and Concentrations

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Root System Response of Three Agricultural Crops to Varying Microplastic Types and Concentrations

Problem Statement

Microplastics are introduced to agricultural fields through several pathways including the addition of biosolids as a source of nutrients. Crops grown in soils with biosolids alter their rooting strategy to uptake these additional nutrients which can alter a number of important traits related to nutrient uptake at the root-system and root segment level. This can be seen in changes in root length density. Other affects in plant root growth and rhizosphere interactions are not yet known, giving rise to concerns that there are unknown risks to a common practice in agriculture.

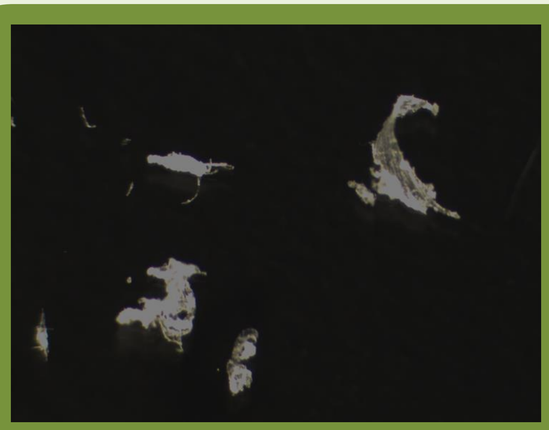

Figure 1: Microplastic Mimics 500um-90um

Materials

Microplastic mimics were constructed from sheet polyethylene and bead polypropylene by manual grinding and subsequent size fractionation using 2mm - 5mm, 500um-2mm, 90-500um, and 20-90um metal sieves. The percentage of each size fraction was based on the average of biosolids derived from four waste water treatment plants in Ontario, Canada. Microplastics and Burford Loam soil collected from a soybean farm in Essex County were homogenized and packed into custom rhizoboxes (18x2x48”). Biosolids were applied to the top 10cm of soil. Seeds were buried at a depth of 1cm and a nutrient solution based approximately equal to the nutrient content of the biosolids was added. To minimize microplastic movement due to watering, rhizobox irrigators (Rhizosphere Research Products) were used to supply water at rates based on climate normals. Plants were watered weekly and soil moisture levels monitored by embedded soil moisture probes (HOBOnet Soil Moisture 10HS Sensor). Rhizobox imaging was performed weekly with an Epson 12000XL scanner mounted on a custom vertical stage.

Methods

Soil samples were collected prior to plant growth and at the end of plant growth from the bulk and rhizosphere soil. Four samples of rhizosphere soil were collected from each rhizobox. Microplastics will be separated from soil using density separation with Sodium Iodine and subsequent digestion to remove surface contaminants. Microplastics filtered onto a glass filter paper will be analysed by Ramen spectroscopy using a Horiba lab Ram Solei equipped with 532, 638, 785nm lasers as well as Particle Finder, Q-Scan and Smart Sampling software. The Raman analysis provides data on individual microplastics such as their geometry, surface roughness, etc., in conjunction with Open Specy to identify plastic type.

Figure 2: Rhizobox 31 images. Left) Week 4. Right) Week 8.

Results

Root response analysis was conducted through visual inspections of growth patterns. Microplastics analysis through sample filtration, digestion and floatation has not been completed. This will then be followed by analysing samples using a Ramen spectroscope. Samples grown with biosolids will have their plastic analysed for composition and weathering for further comparison to the lab-created mimics.

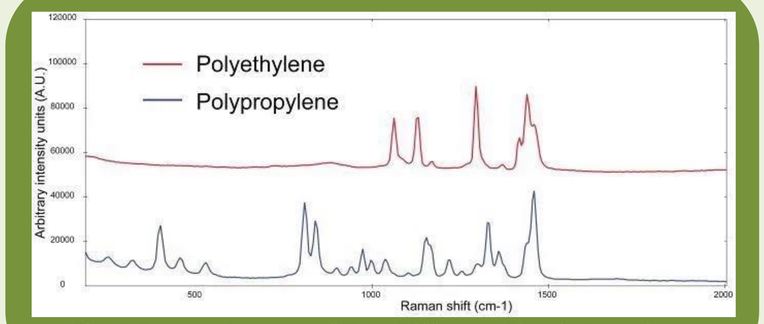

Fig. 3 Raman Spectra of Two Different Plastic Samples

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