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Microplastics in agroecosystem – effects of plastic mulch film residues on soil-plant system

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In the last decades, the use of plastic mulch film in (semi-) arid agricultural regions has strongly increased. Plastic residues from mulching remain and accumulate in soil that can lead to serious environment problems. Biodegradable plastic mulch films were produced as environmentally friendly alternative for solving plastic pollution in agricultural land. However, the effects of polyethylene and biodegradable mulch film residues on soil-plant system are largely unknown.

In this PhD project, we performed a series of experiments to assess the effects of low density polyethylene (LDPE) and biodegradable plastic (Bio, made of polyethylene terephthalate, polybutylene terephthalate, pullulan) with macro- (5 mm², Ma) and micro- (50 µm-1 mm, Mi) sizes on wheat growth, rhizosphere microbiome, soil physicochemical and hydrological properties and soil suppressiveness. The results showed that plastic residues presented negative effects on both above- and below-ground parts for both vegetative and reproductive development of wheat. We also identified significant effects of Bio and LDPE plastic residues on the rhizosphere bacterial communities and on the blend of volatiles emitted in the rhizosphere. Tested with a gradient in concentration of plastic residues (0, 0.5%, 1% and 2% w/w), soil physicochemical and hydrological properties nonmonotonically responded to residual amount of plastic debris in the soil. Lastly, although we did not observe effects of plastic residues on disease infection in our experiment, we anticipated that soil suppressiveness and other soil functions would be affected with the presence of plastics in soil.

Overall, our study provides evidence for impacts of plastic residues on the soil-plant system, suggesting urgent need for more research examining their environmental impacts on agroecosystems.