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Plastic mulch debris in agriculture: accumulation and interactions with pesticides and soil microbiota

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Plastic mulch is widely used in agriculture to decrease the water evaporation, increase the soil temperature, or prevent weeds. Most plastic mulches are made of highly resistant Low Density Polyethylene (LDPE). The incomplete removal of polyethylene mulch after usage causes plastic pollution. Pro-oxidant Additive Containing (PAC) and "biodegradable" (Bio) plastics were developed to avoid the need of plastic removal while preventing the plastic debris accumulation. In conventional agriculture, the use of pesticides releases substances which can be sorbed to soil particles and plastic debris. Pesticides and their residues may affect the soil microbial community. Some microbial groups are capable of using applied pesticide as a source of energy and nutrients to multiply, whereas the pesticide may be toxic to other organisms. Little is known about the long term effects of plastic debris accumulations in relation with pesticides residues. We studied 36 parcels in commercial farms, either organic or conventional, where plastic mulch has been used for 5 to 20 years in Cartagena's country side (SE Spain). We compared the macro and micro plastic debris contents, pesticides residue levels, soil physiochemical properties in the soil surface among all parcels. Eighteen insecticides, 17 fungicides, and 6 herbicides were analysed with LC-MS/MS and GC-MS/MS systems. The ribosomal 16S and ITS DNA variable regions were sequenced to study shifts in bacterial and fungal communities, respectively. We found accumulation of plastic debris in all soil samples, plastic contents being higher in soils from organic farms. The average plastic concentration in both managements was 0.20±0.26 g/kg of plastic debris. Soils under conventional management contained on average more than 6 different pesticide residues and an overall pesticides concentration of 0.20±0.18 mg/kg. The interactions between plastic debris concentration and pesticide concentration will be presented, together with the interaction of plastic and pesticides in soil with changes in soil microbial communities, identifying the most sensitive groups which can act as bioindicators for plastic and pesticide pollution in soil.