

Plastic mulch in agriculture

Low density polyethylene (LDPE) and pesticides contamination effects on soil microbiota



Nicolas Beriot, Raul Zornoza, Paul Zomer, Onurcan Ozbolat, Eva Lloret, Isabel Miralles, Raúl Ortega, Esperanza Huerta Lwanga, Violette Geissen

Introduction, the use of plastic mulch in Murcia Region

Study case: Murcia country side in south-east Spain

- Semi-arid climate
- Intensive vegetable agriculture : the "garden of Europe"
- Long history of plastic mulch application (>20 years)



LDPE mulch after harvest of Kohlrabi in the Murcia region. The sides of the mulch are buried into the soil making complete removal impossible and leading to plastic debris accumulation over time.

Materials & methods

Agricultural Management:

- Organic and conventional
- Intensive (several crops/ year)
- Irrigated vegetables
- Use of LDPE mulch from 1 to 4 times/ 2 years

Set-up:

- 6 farms
- 3 parcels per farm,
- 3 samples per parcel,
- 2 depths per sample, 0-10cm and 10-30cm.

→108 samples



Materials & methods

Measurements:

- Soil physicochemical parameters
- Light density plastic content
- 37 pesticides content with LC-MS
- 16S and ITS rRNA sequencing



Optical identification of micro-plastics



LC-MS/MS for pesticides analysis in the QuEChERS method



Ion Torrent System for sequencing



Macro-plastics: 2mm to 8 cm

Micro-plastics don't contribute a lot to the total area of plastic debris

Pesticides residues are present in all conventional samples





No correlation between Pesticides and Plastic residues in soil

The samples cover a diversity of Pesticides residues and Plastic debris content in soil

54 top soils samples, 0-10cm



Some species are more abundant in soil with higher plastic area



Number of plastic debris and Relative abundance of Gemm-5

Relative abundance of Gemm-5 in conventional farm decrease with increasing number of microplastics particles in soil

Gemm-5, only Class correlated to number of plastic debris



Opportunity to study Gemm-5 species as a bioindicator?



PLOS ONE

RESEARCH ARTICLE

Changes in the Bacterial Community Structure of Remediated Anthracene-Contaminated Soils

Laura Delgado-Balbuena, Juan M. Bello-López, Yendi E. Navarro-Noya, Analine Rodríguez-Valentín, Marco L. Luna-Guido, Luc Dendooven*

Anthracene

Laboratory of Soil Ecology, ABACUS, Cinvestav, Mexico City, D.F., Mexico

Relative abundance of Gemm-5 in the soil is reduced after application of a surfactant for remediation of a soil contaminated with Anthracene



Effect of the pesticides residues in soil on species relative abundance

Some species are more abundant in soil with more pesticides residues

Either positive correlation or no correlations with the total content of pesticides



Fungal diversity decrease with increasing Boscalid content in soil

Boscalid : broad range fungicide, affect the all fungi community



Some Fungi abundance is positively correlated with Boscalid content



Fungal diversity decrease with increasing Boscalid content in soil

Some bacteria are more abundant when Fungicides residues are present



Management

Conventional Organic

3 broad spectrum fungicides

14

In general, some bacteria are more abundant when pesticides residues are present



Conclusion

Soil contamination

Plastic contamination of 0.2 g/kg soil in both managements.

Pesticide contamination of **0.2 mg/kg** soil in conventional top soil with most samples having a **mixture of 6 to 10 pesticides**.

Soil microbiome

- Gemm-5 was the only Class negatively correlated to number of plastic debris
 - The **plastic area** is the parameter to study increase of relative abundance
 - Pesticides have few correlations with decrease of abundance and many correlation with increase of abundance : Opportunistic species ?

Thank you for you attention!



Supplementary figures

Pesticides residues in soil, present in all conventional samples





























Insecticide : inactive calcium channels in muscles



