EGU2020-6545
https://doi.org/10.5194/egusphere-egu2020-6545
EGU General Assembly 2020

Soil fauna regulates the ecosystem service/disservice balance in mulched soils

Christine van Capelle[1], Friederike Meyer-Wolfarth[2], Torsten Meiners[3], Mignon Sandor[4], and Stefan Schrader[1]

[1]Johann Heinrich von Thünen Institute, Institute of Biodiversity, Braunschweig, Germany (christine.vancapelle@thuenen.de)
[2]Julius Kühn-Institute, Institute for Plant Protection in Field Crops and Grassland, Braunschweig, Germany (friederike.meyer-wolfarth@julius-kuehn.de)
[3]Julius Kühn-Institute, Institute for Ecological Chemistry, Plant Analysis and Stored Product Protection, Berlin, Germany (torsten.meiners@julius-kuehn.de)
[4]University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Agriculture, Cluj-Napoca, Romania (sandor.mignon@usamvcluj.ro)

A sustainable agricultural management can contribute to promoting soil biodiversity performance, thereby preserving soil functions and ensuring the provision of soil biota-induced ecosystem services. In order to make the best possible use of these services for the benefit of agricultural production, a better understanding of interlinkages between management measures, ecosystem service/disservice balance and soil self-regulation potential is essential. In this context, it is well known that the reduction of soil tillage intensity combined with mulching techniques, on the one hand, promote the survival, development and spread of plant pathogenic mycotoxin-producing soil-borne fungi, but, on the other hand, enhance the diversity of antagonistic mycotoxin-degrading fungivorous soil animals. However, up to now it is still unclear, which ecosystem service/disservice balance results from both pathways and which self-regulation mechanisms are involved.

To analyse and assess the bioregulation potential of fungivorous soil faunal key species (earthworms: Lumbricus terrestris, collembolans: Proisotoma minuta, enchytraeids: Enchytraeus crypticus and E. christenseni) on economically relevant plant pathogenic species of the fungal genus Fusarium (F. graminearum, F. culmorum, F. verticillioides) and its mycotoxins (deoxynivalenol (DON), zearalenon (ZEN), 3-acetyl-deoxynivalenol (3AcDON) and fumonisin B1 (FB1)) in maize residues, field and laboratory experiments were performed as part of the EU BiodivERsA project SoilMan. Based on these studies the following hypotheses were tested: (1) soil faunal key organisms supress Fusarium species and reduce their mycotoxins in maize residues, (2) the bioregulation potential depends on substrate size and soil texture (3) interactions between fungivorous key species affect their bioregulation potential, (4) leaching of mycotoxins represents a potential risk for arable soils.

The results reflect that soil faunal key species regulate amounts of F. graminearum and F. culmorum in maize residues depending on substrate size and soil texture, but did not affect amounts of F. verticillioides. Fungivorous soil animals significantly accelerate degradation rates of Fusarium mycotoxins by up to 300%, depending on soil faunal species, respective mycotoxin and soil texture. In particular, primary decomposers within the earthworm community (L. terrestris) are pivotal for the bioregulation of Fusarium species and their mycotoxins in the mulch layer. The bioregulation potential of the mesofauna (collembolans and enchytraeids) strongly depends on soil faunal interactions. The findings further indicate that the mycotoxins DON and ZEN leach from infected maize residues.

The present studies contribute to improve understanding of the complex interrelations between arable management and ecosystem service/disservice balance in agroecosystems.