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Repression of fungal plant pathogens and fungal-related contaminants: Selected ecosystem services by soil fauna communities in agroecosystems

Friederike Meyer-Wolfarth, Stefan Schrader, Elisabeth Oldenburg, Joachim Brunotte, and Joachim Weinert

In agroecosystems soil-borne fungal plant diseases are major yield-limiting factors which are difficult to control. Fungal plant pathogens, like Fusarium species, survive as a saprophyte in infected tissue like crop residues and endanger the health of the following crop by increasing the infection risk for specific plant diseases. In infected plant organs, these pathogens are able to produce mycotoxins. Mycotoxins like deoxynivalenol (DON) persist during storage, are heat resistant and of major concern for human and animal health after consumption of contaminated food and feed, respectively.
Among fungivorous soil organisms, there are representatives of the soil fauna which are obviously antagonistic to a Fusarium infection and the contamination with mycotoxins. Specific members of the soil macro-, meso-, and microfauna provide a wide range of ecosystem services including the stimulation of decomposition processes which may result in the regulation of plant pathogens and the degradation of environmental contaminants. Investigations under laboratory conditions and in field were conducted to assess the functional linkage between soil faunal communities and plant pathogenic fungi (Fusarium culmorum). The aim was to examine if Fusarium biomass and the content of its mycotoxin DON decrease substantially in the presence of soil fauna (earthworms: Lumbricus terrestris, collembolans: Folsomia candida and nematodes: Aphelenchoides saprophilus) in a commercial cropping system managed with conservation tillage located in Northern Germany.
The results of our investigations pointed out that the degradation performance of the introduced soil fauna must be considered as an important contribution to the biodegradation of fungal plant diseases and fungal-related contaminants. Different size classes within functional groups and the traits of keystone species appear to be significant for soil function and the provision of ecosystem services as in particular L. terrestris revealed to be the driver of the degradation process. Thus, earthworms contribute to a sustainable control of fungal pathogens like Fusarium and its mycotoxins in wheat straw by reducing the risk of plant diseases and environmental pollution as ecosystem services.
Further studies are planned within the EU-project SoilMan under the BiodivERsA network. In context of the suppression of fungal plant pathogens and the detoxification of their mycotoxins by soil organisms in agroecosystems it is hypothesised that (1) processes related to services or disservices are induced and directed by abundance and activity of functional groups of soil biota; (2) dynamics and interaction in the soil biota community control ecosystem function and services.