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Interaction between soil micro- and mesofauna regarding mycotoxin degradation in wheat straw as a function of soil texture

Wolfarth, Friederike[1]; Schrader, Stefan[1]; Oldenburg, Elisabeth[2]; Weigel, Hans-Joachim[1]
[1]vTI, GERMANY; [2]JKI, GERMANY

Introduction

Besides well-known positive aspects of conservation tillage combined with mulching, a drawback may be the survival of phytopathogenic fungi like Fusarium species on plant residues. This may endanger the health of the following crop by increasing the infection risk for specific plant diseases like Fusarium head blight. In infected plant organs, these pathogens are able to produce mycotoxins like deoxynivalenol (DON). Against this background, a microcosm-study was conducted under laboratory conditions to assess the interaction between soil fauna (nematodes and collembolans) and DON. Our hypotheses were: (1) nematodes and collembolans reduce the DON content in infected wheat straw; (2) the species interaction of Aphelenchoides saprophilus and Folsomia candida enhances the degradation of DON concentration in wheat straw; (3) the degradation efficiency of nematodes and collembolans is affected by soil texture.

Materials and methods

Microcosms (n=5 for all treatments) were filled with soil of different texture (sandy loam, silt loam, clay loam) and finely chopped wheat straw (*Fusarium*-infected vs. non-infected). The microcosms were inoculated with *Aphelenchoides saprophilus* (Nematoda) and *Folsomia candida* (Collembola) in different combinations (single and mixed species, non-faunal control). After 2 and 4 weeks of incubation at 17°C in darkness, the individual densities in all soil faunal treatments were counted and the DON concentrations were quantified by using a competitive ELISA.

Results

After 2 and 4 weeks of incubation, the individual densities in all soil faunal treatments increased with highest individual numbers in the non-infected treatments in case of collembolans and in the infected treatments in case of nematodes. DON concentrations in remaining infected straw were reduced significantly compared to the initial concentration in all treatments after 4 weeks. According to RM ANOVA, the effect of the introduced soil fauna in degrading DON was significant. The highest reduction was found in mixed species treatments, whereas the lowest reduction of DON was measured in non-faunal control treatments (Tab. 1).

In sandy and silt loam soil, the DON degradation was significantly higher compared with clay loam in all faunal and non-faunal treatments. After 4 weeks still positive DON concentrations were determined in the soil of the infected treatments. The lowest DON concentrations were determined in sandy and silt loam of the mixed species treatments.

Conclusions

Collembolans and nematodes significantly contribute to mycotoxin degradation in wheat straw, especially in sandy and silty soils. We conclude that particularly interacting collembolans and nematodes play an important role in mycotoxin degradation as an ecosystem service. Accordingly, fungal feeding soil micro- and mesofauna might be able to promote compensating for the enhanced risk of fungal crop diseases and mycotoxin contamination of food and feed deriving from

Tab. 1 Relative DON degradation in *Fusarium*-infected wheat straw in presence of nematodes, collembolans, interaction of both groups and in a control regarding different soil texture after 4 weeks incubation.

	Nematodes	Collembolans	Interaction	Non-faunal control
Sandy loam	90%	67%	92%	83%
Silt loam	79%	88%	95%	65%
Clay loam	6%	34%	39%	20%

conservation tillage practices. In any case, soil texture matters in the provision of these ecosystem services by collembolans and nematodes. The given soil texture provided an environment, which significantly influenced the degradation of the mycotoxin in infected wheat straw. Especially in case of tight crop rotations, where the time slot between harvest of the previous and sowing of the following crop is short, interacting soil fauna and, in addition, soil microorganisms might enhance and accelerate the degradation of soil-borne phytopathogenic fungi and their mycotoxins as ecosystem services for crop protection.

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