Earthworm activities induce better resistance to plant-parasitic nematodes in banana

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Earthworm activities induces better resistance to plant-parasitic nematodes in banana plants

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Key words: Pontoscolex corethrurus, soil engineers, soil biophysical and chemical properties

Abstract

In tropical agro-ecosystems, nematodes *Radopholus similis*, *Pratylenchus spp.* and *Helicotylenchus spp.* are considered as the worst constraints to banana (*Musa acuminata* group Cavendish) production. These pests attack primary and lateral roots, causing necrosis, affecting plant nutrition and reducing the root anchorage, shortening plantations' lifespan and reducing yields. Since the use of chemical nematicides has been regimented, new ecological alternatives have been prospected. Among them, the use of earthworms as control agents of nematodes patogenicity was tested. Lafont et al. (2007) shown that the pathogenicity of nematode *Radopholus similis* was significantly reduced in the presence of earthworm *Pontoscolex corethrurus.* While a positive effect on the growth of banana was found, the processes involved were not clearly identified.

The objective of this work is to understand how earthworm *Pontoscolex corethrurus* activity affects the pathogenicity of the main parasitic nematodes of banana.

Indirect effects of earthworm activity via physical, chemical and biological modifications of the soil biotic and abiotic components are hypothesized as the main factor contributing to the decrease of nematodes pathogenicity by reducing root necrosis and increasing nutrient availability. This hypothesis was tested in controlled conditions in a greenhouse of the INRA research station in Guadeloupe (FWI). Four treatments : N-E- (absence of fauna); N-E+ (P. corethrurus alone); N+E- (phytoparasitic nematodes alone); N+E+ (earthworms plus nematodes) were setted-up and replicated five times. Each replication was composed by a banana plant cultivated in a pot containing 20 kg of soil. 337 days after the experiment set-up, shoot and root weight, shoot chemical contents, root necrosis extent and the populations of nematodes were determined. Soil samples were analysed for determination of total C and N and for nutrient contents (P2O5, NO3- and NH4+). Shrinkage curves of centimetric aggregates and casts were also calculated.

Results showed that: i) root necrosis induced by nematodes was significantly reduced (50%) in the presence of the earthworm *P. corethrurus*, whereas the population of nematodes did not decrease ii) the burrowing activity destroyed most of the initial structural pores (3-300µm) and increased the volume of finest structural pores diameter class (0.3-3µm). Earthworm aggregates could then shelter high microbial activity in the increased 0.3-3 µm pore class and probably became unfavourable to nematodes activity due to the decrease of larger pores of 3-300µm in diameter. This observation was corroborated by a greater phosphorus availability in earthworm casts, and a better plant phosphorus nutrition in the presence of earthworms that induced a better growth of banana plants.

These results confirm the indirect and positive effects enhanced by earthworm activity and mainly the availibilty of phosphorus via soil porosity transfer. The reduction of nematodes pathogenicity without a significant reduction of nematodes abundance, however, could not be clearly explained. Blouin et al. (2005) attested of similar effects in a rice experiment and hypothesized a systemic action of earthworm on plant growth driven by a modification of the expression of genes that code for tissue reparation. Complex interactions occurring in the soil biota-soil-plant continuum still remain a great challenge in the field of ecological engineering dedicated to the improvement agro-ecosystems performances.

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In the book of abstracts:

Ecological engineering: from concepts to applications international congress, EECA (2-4 December 2009, Cité internationale universitaire de Paris, France);
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