Case study 24. Earthworms enhance plant tolerance to nematode infection through non-trophic effects of ecosystem engineering

Below-ground interactions are complex and so far the mechanisms involved are not well known. Studies on the importance of non-trophic relationships, both above and below ground, are not abundant. As a result, generalizations on the effect of predicted climate change on plant-mediated interactions between earthworms and above-ground multitrophic groups are not possible. Climate change is expected to affect plant production and the incidence of soil pests.

Plant-parasitic nematodes are serious pests that cause crop production losses with high economic damage. Earthworms and vermicompost have been shown to reduce the harmful impact of nematode infestation in banana plantations.

The nematode Heterodera sacchari Luc and Merny (Heteroderidae) forms external cysts on rice roots leading to serious damage in upland rice fields in Africa. The effect of an earthworm (Millsonia anomala Omodeo; Megascolecidae) on the physiology of nematode-infested plants was demonstrated through selected stress responsive genes coding for lipoxygenase, phospholipase D and cysteine protease. The ability of plants to respond through physiological mechanisms was enhanced by earthworm presence. Decrease in rice growth due to H. sacchari was suppressed in the presence of earthworms. Root biomass was not affected by nematodes when earthworms were present and the expression of stress-responsive genes in the leaves was modulated by below-ground activities.
The mechanisms are not known but need to be discovered as climate change may induce important changes in plant production and the incidence of pests in soil.

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References:

Blouin, M., Zuily-Fodil, Y., Pham-Thi, A.T., Laffray, D., Reversat, G., Pando, A., Tondoh, J. and Lavelle, P. (2005) Belowground organism activities affect plant aboveground phenotype, inducing plant tolerance to parasites. *Ecology Letters* 8, 202–208.

Brown, G.G., Pashanasi, B., Villenave, C., Patron, J.C., Senapati, B.K., Giri, S., Barois, I., Lavelle, P., Blanchart, E., Blakemore, R.J., Spatin, A.V. and Boyer, J. (1999). Effects of earthworms on plant production in the tropics. In: Lavelle, P., Brussaard, L. and Hendrix, P. (eds) *The Management of Earthworms in Tropical Agroecosystems*. CAB International, Wallingford, UK, pp. 87–148.