Recovery of soil macrofauna diversity through organic fertility patches: consequences for soil erosion in the uplands of northern Vietnam

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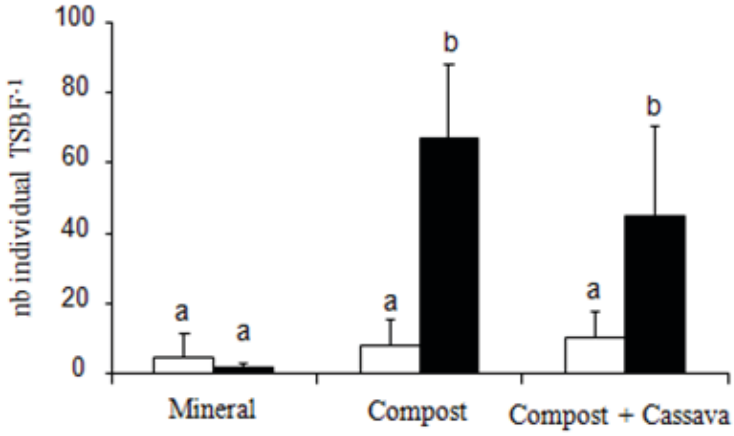
The loss of soil biodiversity is a serious threat to sustainable agricultural land use. A practice known as zai technology is used in the West African Sahel to manage and rehabilitate degraded soils in dryland ecosystems. The practice consists of incorporating organic matter into pits, which increases activity by macrofauna and improves soil fertility (Roose & Barthès 2001). The aim of this study was to test zai technology in soil degraded by water erosion in northern Vietnam for the recovery of the diversity and activity of soil macrofauna (invertebrates 2–20 mm) and of underlying ecosystem services.

Field experiments were carried out in an experimental catchment (46 ha) of the MSEC (Management of Soil Erosion Consortium, IRD) project. Maize was grown in 4 fields, each of which received the same amounts of fertilisers. Each field was divided into 3 equal-sized plots separated by at least 2 m from each other. Patches of fertility were created every 1 m between the rows of maize. Three treatments were tested: 20 Mg ha^{-1} of dry compost applied in patches ~10 cm in diameter and 10–20 cm deep; compost plus 3 kg of dried cassava stems on top of the soil; and mineral fertiliser (N as 1.65 g CH_4N_2O, 0.38 g P_2O_5 and 1.47 g K_2O) in equivalent patches. To investigate water runoff and soil erosion, we built three 1-m^2 microplots in each field (1 per treatment), in which surface runoff and detached sediments were collected after each rainfall event in a collector at the base of the microplot.

The soil macrofauna were able to locate and proliferate in the organic patches (Fig. 1). In particular, earthworms, termites, millipedes and ants proliferated, all of which are described as soil engineers in relation to soil organic matter and soil properties (Lavelle et al. 1997; Jouquet et al. 2006). A local decrease in soil density was evident. However, maize growth and yield did not correlate with this local improvement in soil quality, probably because the maize did not have access to the nutrients in the patch. In addition, these patches did not have a positive effect on water infiltration and soil erosion. In other words, although it is clear that conservation agriculture practices favour the proliferation of soil biota, whether this proliferation can then play a significant role in the recovery of soil fertility on sloping lands remains to be seen.

Figure 1. Soil macrofauna abundance (number of individuals per sample) outside (white) and inside (black) the patches of fertility.



TSBF = Tropical Soil Biology and Fertility Institute (sampling method). Histograms with the same letters are not significantly different at P = 0.05 (n = 4).

Keywords

Heterogeneity, organic matter, soil biodiversity, maize, zai technology

References

Jouquet P, Dauber J, Lagerlof J, Lavelle P, Lepage M. 2006. Soil invertebrates as ecosystem engineers: intended and accidental effects on soil and feedback loops. Applied Soil Ecology 32(2): 153–164.

Lavelle P, Bignell D, Lepage M. 1997. Soil function in a changing world: the role of invertebrate ecosystem engineers. European Journal of Soil Biology 33(4): 159–193.

Roose E, Barthès B. 2001. Organic matter management for soil conservation and productivity restoration in Africa: a contribution from Francophone research. Nutrient Cycling in Agroecosystems 61: 159–170.

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