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Soil Macrofauna as Indicator of Soil Quality in Improved (silvo)pastoral Systems in the Tropics

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Abstract

Silvopastoral systems (SPS) are an environmentally and economically beneficial alternative to single grass systems for livestock production. The incorporation of trees, especially legumes, in pastures has been shown to have several positive effects on soil properties and nutrient cycling, while creating a favourable microclimate for the animals and increasing the productivity (i.e. milk and meat). The inclusion of legumes or legume-trees in the pastures systems leads to improved nutrient cycling and increased biological activity creating fertility islands within the SPS. Soil macrofauna has been considered as bioindicator of soil quality because of the direct effect on soil properties and on soil organic matter fragmentation and nutrient dynamics. The present study was performed in an experimental block designed (n=3) (silvo)pastoral trial located at CIAT (Colombia) and aimed to evaluate the effect of the inclusion of the herbaceous legume (*Canavalia brasiliensis*) and both herbaceous and shrub legume (*Leucaena leucocephala*) respect to the *Brachiaria* cv. Cayman monoculture on a set of biological and physical parameters. We measured the abundance and diversity of soil macrofauna, macroaggregate morphology and soil aggregation, as well as their spatial heterogeneity in relation to the trees in the SPS. Soil samples were collected at three different distances from the *Leucaena* double-row as follows: i) between the rows, ii) at 1.5 m and iii) 5.5 m from the trees. Results obtained showed that the inclusion of legumes has a positive effect on soil macrofauna with the highest abundance found at 1.5 m distance from *Leucaena*. On the contrary, reduction of total abundance was found around the trees corresponding to higher soil compaction areas probably due to the animal grazing preference and search for shade. This phenomenon was reflected in higher proportion of physicogenic aggregates and lower amount of large water-stable macroaggregates. In addition to increased productivity of legume-based pastures and the potential to sustain higher densities of animals, our results highlight the importance of an integrated evaluation of spatial heterogeneity within SPS and discuss possible consequences for the management of trade-offs. Multivariate statistics of forthcoming data will reveal possible role of soil macrofauna as a reliable soil quality indicator.

Keywords: Livestock production, silvopastoral systems, soil macrofauna, soil quality indicators