Soil Biological Properties in Conventional and Organic Orchards

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Abstract

The aim of the study was to compare the effects of five years of conventional and organic fruit production systems on several major soil biological and mineral properties. The experiment was conducted in Gembloux, Belgium, on two adjacent experimental orchards, both planted in 2002, on a flat site with a common cultivation history. The first orchard was managed following organic guidelines and the second one was under conventional management, during five growing seasons. The orchards had different agricultural inputs (fertilizers, pesticides) and weed control systems. Soil management practices in the organic orchard included additions of composted cattle manure and organic fertilizers and the use of mechanical tillage for weed control involving the "Swiss-Sandwich-System." Conventional soil management practices included additions of synthetic fertilizers and the use of herbicides for weed control. Both orchards received different kinds of fungicides. In year 2 (2003) of the study, the soil methane oxidation process as an important soil ecological process was measured in order to compare the orchards' soil biological activities. In year 5 (2006), the overall soil microbial activity was assessed by measuring, during five short-term campaigns from May to October, the basal respiration (BAS), the substrate induced respiration (SIR), and the in situ soil CO_2 efflux (CDE). Closed-dynamic-chamber systems were used to analyze the soil CO_2 efflux in situ in the orchards. The spatial variability of the soil efflux was measured during each short-term campaign on 60 points. Earthworm abundance as useful bio-indicators of agro-ecosystem sustainability was assessed together with chemical soil parameters. No significant difference in the methane oxidation rate was observed between the two orchard management systems in year 2. In year 5, however, important differences were detected for the microbial activity indicators in orchards subjected to different agricultural practices. The BAS, SIR, and CDE values were significantly higher in the organic than in the conventional orchard on most sampling dates. Total earthworm abundance was severely reduced by conventional practices. Soil mineral analysis and soil pH values did not show important differences between the two orchard management systems.

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