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Soil Fertility Breakdown in Soils of Subtropical South Africa Used as Kitchen Garden

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Abstract

Cabbage plants at one plot (L_1) showed chlorosis and necrotic parts on the leaves. At another plot (L_2), the plants grew better and did not reveal any symptoms, but the yield was low as well. Nutrient deficiency was not confirmed by the analysis of plant material. In this study we tried to analyse whether these deficiency symptoms were related to specific soil physical, chemical or biological properties. Samples were taken from an ecological homegarden close to Pietermaritzburg, subtropical South Africa. Soil samples were taken at three depths (0–10, 10–20, 20–30 cm) from two plots that are close together.The two gardens did not differ significantly in particle size distribution at any depth. The mean contents of sand, silt and clay were 13, 42 and 45 %. The bulk density was significantly larger at site L_1 at an average of 1.25 g cm^{-3} in comparison to 1.04 g cm^{-3} at site L_2. Also, the soil pH was significantly increased at site L_1 with an average of 5.6 in comparison to 4.0 at site L_2. Soil organic C, microbial biomass C, ergosterol, and basal respiration all declined markedly with depth. The basal respiration rates were similar at both sites on a depth-specific level, contrasting the contents of soil organic C, microbial biomass C and ergosterol, which were significantly elevated at site L_2. If the concentrations were converted to the total amounts stored per hectare at 0 to 30 cm depth, soil organic C was only 10 % (18.9 versus 17.2 t) larger at site L_2, but microbial biomass C was 110 % (1680 versus 790 kg) and ergosterol even 220 % (5.1 versus 1.6 kg). The ergosterol-to-microbial biomass C was nearly doubled in the new garden soil at 0–10 cm depth in combination with maximum microbial biomass C content. The microbial biomass C-to-soil organic C ratio ranged from 0.25 to 1.10 %, declined markedly with depth and was almost doubled at site L_2. The metabolic quotient qCO_2 revealed strong depth-specific variations of between 18 to 38 mg CO_2-C d^{-1} g^{-1} microbial biomass C at site L_1 on a two to three times larger level than at site L_2.

Keywords: Basal respiration, biomass N, ergosterol, microbial biomass C

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