Changes of autotoxic potential and microbial community structure in rhizosphere soil of continuously planted tea plant (Camellia sinensis L.)

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Abstract

The effect of tea soils with 4-, 14-, 28-, and 32-planted years on the physiological indices and the quality indices of replanted tea leaves was examined. It was found that activities of superoxide dismutase, peroxidase, catalase decreased significantly with increase planted years, while the malondialdehyde levels increased significantly with increase of soil planted years. The levels of polyphenols, caffeine, and free amino acid in tea leaves were significant lower when the tea seedlings cultured in 14-, 28-, and 32-year soils than that in 0- and 4-year soils. In laboratory bioassay, the aqueous soil extracts inhibited lettuce (*Lactuca sativa* L.) growth significantly with increase planted years. The contents of three phenolic acids (protocatechuic acid, *p*-hydroxybenzoic acid, and cinnamic acid) showed significant higher in 14-, 28-, and 32-year soils than that in 0- and 4-year soils. By Biolog EcoPlate method, the carbon source utilization by soil microbe to fatty acid, carboxyl derivatives, and phenolic acids were significantly higher in tested soils, compared to the control. Principal component analysis (PCA) showed the 18 out of 31 carbon sources were significantly correlated with the PC1, PC2, and PC4. The 11 components were positively correlated including 3 of carbohydrates, 3 of carboxyl derivatives, 2 of amino acids, 2 of amides, and 1 of fatty acid, and 7 components were negatively correlated including 6 of carbohydrates and 1 of amino acid. Microbes utilizing carboxyl derivatives were significantly and positively correlated with the inhibitory rates of soil aqueous extracts on lettuce growth. These results indicate that the accumulation of acidic compounds and deficiency of some carbohydrate carbon sources were the main characteristic in the long planted soils. Microbial community led acidic compounds accumulation in tea soils might be a cause of soil toxicity in the long planted tea plantations.

Keywords: Wuyi rock tea, rhizosphere soil, continuously planted soils, soil toxicity, microbial community

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