EFFECT OF SOIL ORGANIC MATTER ON NUTRIENT AVAILABILITY UNDER DIFFERENT LAND USE PATTERNS WITH SPECIAL EMPHASIS ON THE ROLE OF CARBOHYDRATES

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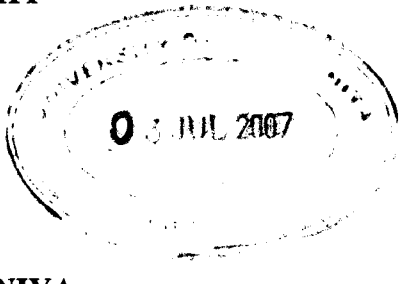

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ABSTRACT

EFFECT OF SOIL ORGANIC MATTER ON NUTRIENT AVAILABILITY UNDER DIFFERENT LAND USE PATTERNS WITH SPECIAL EMPHASIS ON THE ROLE OF CARBOHYDRATES

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Extensive areas of native vegetation in Sri Lanka have been replaced by agriculture over the last 100 years. Although soil fertility may decline under cultivation, the intensive management of the land could improve soil fertility leading to large increases in productivity. An understanding of the factors influencing soil degradation in relation to different forms of vegetation cover will help the adoption of sustainable practices. Studying the variations of different soil organic matter (SOM) pools is one method of detecting these changes.

This study evaluated the influence of land-use change from natural vegetation to cultivated lands on the change in SOM composition with special emphasis on soil carbohydrates. The effects of different SOM fractions on the nutrient availabilities in these land use patterns were also studied.

Litter in the form of free soil litter (FSL) outside aggregates or clay bound organic matter (CBO) behaved differently in the retention and hence availability of limiting nutrients in different land use patterns studied. In the forests with high FSL contents, the nutrient availability was limited possibly by the microbial and chemical immobilization in the litter fraction. However, a major fraction of soil litter in the cultivated lands could be transferred to a clay bound state forming CBO, preventing further immobilization of nutrients microbially or chemically.

The agricultural management not only influenced the amount of SOM but also changed its chemical composition in these tropical soils. Increased SOM turnover in cultivated lands is generally important to increased and sustained agricultural production. Hence, it is important to develop appropriate agronomic practices to overcome the current depletion of SOM and to ensure sustained agricultural production.

Differences in carbohydrate concentrations were detected between two adjacent land types, forests and the cultivated lands mainly due to differences in litter inputs as well as soil management practices especially soil disturbances. In the forests, there was a higher contribution of microbially derived sugars to the nutrient availability. In contrast, in the cultivated land the nutrient availability was determined by plant derived sugars. Heavy land management including the application of agrochemicals may have reduced the carbohydrate concentration in tea and potato soils by lowering the litter inputs and microbial activities.

This study confirmed that the effect of the SOM on the availability of nutrients is through the effects of soil carbohydrates. Also the complex biological, chemical and physical processes involved in the SOM turnover can partly be deduced from the changes of soil carbohydrates. The soil carbohydrates and their relationships with soil nutrients could provide vital information on the availability of limiting nutrients under different land uses in tropical conditions.

The study demonstrated that the use of fine fraction in soil analysis allowed to emerge the relationships existing between the SOM including carbohydrates, and soil nutrients. This lead to disclose the relationships existing among soil characteristics even under heterogeneous land-use patterns, which are otherwise masked by the variability introduced by coarse fractions and debris in the soils.

Another important outcome of the present study is that the disclosure of combustion temperature of FSL. Modified weight loss on ignition (LOI) method used in this experiment can be used as a quick and simple technique for the determination of FSL compared to the time consuming density fractionation methods. The composition of the complex structure of CBO was also determined by using activation energies of oxidation of the other SOM fractions at different temperatures in a multiple regression model and predicted that CBO is composed of a mixture of FSL and the fulvic fraction (FF).

An understanding of the changes of SOM pools including the soil carbohydrate pool is necessary in assessing the impact of organic matter build up and nutrient availability in improving sustainable land management in tropical ecosystems. Such information will be valuable in the proper management of land resources in Sri Lanka.