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[C2.2-2] Soil Organic Carbon: Dynamics, Stabilization, and Environmental Implications

Physical Fractions of Soil Organic Matter as Affected by Cover Crops and No-Till System

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The soil organic matter (SOM) can be greatly increased by growing cover crops under a no-till system (NTS). The magnitude of SOM increase after using a NTS is dependent on soil type, species and biomass input of cover crops, and regional climate. Short-term changes in total SOM due to the soil management practices are often small and difficult to assess. Some physical fractions of SOM are more sensitive to soil management and can be good indicators of soil management changes over the short time period. This is because physical fractions of SOM are more responsive compared to the chemical structure and function of SOM. Therefore, physical fractions (free light fraction, intra-aggregate light fraction and heavy fraction) of soil organic matter (SOM) are good indicators of soil quality for sustainable land use. The objective of this study was to evaluate the effect of cover crops on total organic carbon (TOC) and physical fractions of soil organic matter in soil under a no-tillage system (NTS) and a conventional tillage system (CTS, one plowing and two disking).

A field experiment was conducted in Santo Antonio de Goias, GO, Brazil (16° 27' S , 49º 17' We, and 823 m elevation). The regional climate is tropical savanna, classified as Aw by the Koppen classification system. There are two seasons: the dry season from May to September and the rainy season from October to April. Annual mean rainfall and temperature are 1,500 mm and 22.7°C, respectively. A NTS had been used at the experimental site for six years (2001 - 2007). Crop rotations were corn (Zea mays) for2001, 2003 and 2005 and soybean (Glycine max) for2002, 2004 and 2006 during the rainy season, and the site was fallow during the dry season. Soil at the site is classified as a kaolinitic, thermic Typic Haplorthox. The study was conducted over a three-year period (2007-2009). Crop rotations included a cover crop-rice-cover crop-rice rotation. Cover crops and upland rice were planted in November 2007 andNovember 2008, respectively and planted again in March 29 and November 2009, respectively. The cover crops used for this experiment were 1) fallow (spontaneous vegetation, predominantly Bidens pilosa, Commelina benghalensis, Conyza bonariensis and Cenchrus echinatus), 2) Panicum maximum Jacq., 3) Brachiaria ruziziensis R. Germ. And C.M. Evrard, 4) Brachiaria brizantha (Hochst. Ex A. Rich.) Stapf. - cultivar Marandu, 5) millet, Pennisetum glaucum (L.) R. Br. - cultivar BN-2. Two additional control treatments were included as 6) fallow plus CTS (CTS, one plowing and two disking), and 7) ? Brachiaria brizantha plus CTS. The experimental design was a randomized block design with seven treatments and three replications. The size of each plot was 6 x 10 m with 1 m buffer between plots. Soil samples were collected from depths of 0-0.05, 0.05-0.10 and 0.10-0.20 m after rice harvesting in April 2010. The samples were air-dried, and sieved to pass a 2 mm screen. The

SOM was physically fractionated in free light fraction (FLF), intra-aggregates light fraction (IALF) and heavy fraction (HF). The levels of C in whole soil were also evaluated, as well as C in the light fractions (FLF + IALF) and in the HF.
Results indicated that concentrations of C in the FLF and IALF in surface soils (0-0.05 m) were much higher (10.8 and 1.95 g kg-1, respectively) than in the 0.05-0.1 m soil depth (7.68 and 1.54 g kg-1, respectively) and in the 0.1-0.2 m soil depth (4.98 and 1.24 g kg-1, respectively). The NTS resulted in higher levels of FLF (12.2 g kg-1) and IALF (2.19 g kg-1) than with CTS (1.37-7.30 g kg-1). Millet had the highest C (19.5 g kg-1) and N (1.1 g kg-1) concentrations in soil. There was an accumulation of TOC and total N in the surface soil with cover crops, and concentrations of TOC were higher in the HF (79.0%) than in the light fractions (21.0%). Although SOM changed little during the two years of this experiment, the various C fractions were significantly affected by the tillage treatments. We conclude that SOM physical fractionation allowed seeing significant differences caused by the soil management in the organic matter dynamics in a short period of time.

Keywords：*Brachiaria brizantha, Brachiaria ruziziensis, Panicum maximum, Millet, Soil management.*