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## **Carbon Distribution in Different Soil Fractions Affected by Cover Crops and Soybean Rotations under No-Tillage System in Tropical Areas**

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### **1. Introduction**

Carbon (C) is the main component of soil organic matter (SOM), responsible for changes in physical, chemical, and biological properties. As a whole, SOM determines fertility level or the soil's ability to provide necessary conditions for proper growth of crops. In tropical and subtropical soils highly weathered, organic matter is very important in providing nutrients to crops, the stability of the structure, infiltration and water retention, aeration, thus, a key component of its productive capacity [9].

In some situations no-tillage (NT) can lead to surface compaction [8] through of the years, which results in increased density and reduced total soil porosity, and lower relationship between macro and micropores. The C storage in soil organic matter (SOM) is an important strategy to mitigate carbon dioxide emission to atmosphere. The preferential C storage in the labile SOM fraction is an environmental benefit, which is expected to occur only under continuous NT and crop residues addition [2].

The objective of this study was to evaluate the effect of the cover crops in the distribution of organic matter inside different soil fractions, with different chemical stability, in areas under cover crops-soybean rotation in two localizations of São Paulo State under NT system.

### **2. Materials and Methods**

The experimental sites are located at experimental stations located in Campinas where the geographic coordinates of reference are 22° 53' South Latitude e 47° 04' West Longitude and in Colina 20° 42' South Latitude and 48°32' West Longitude, both in São Paulo State. The first experiment was started in 2005 conducted using a randomized complete blocks design with four replications for each treatment and the Colina site is deployment since 2007. The Treatments were five crop systems under no-till, with soybean cropping in summer and the following crops in during autumn/winter/spring season: T1: a gramínea without side dressed nitrogen (N) applied; T2: a gramínea with side dressed 30 kg ha<sup>-1</sup> of N; T3: a gramínea with

side dressed 60 kg ha<sup>-1</sup> of N; T4: a leguminous; T5: fallow (with spontaneous vegetation/weeds). Campinas site is a clayey soil (60%), with the same treatments, deployment at Colina site, however with different amount of clay (25%).

Overview of Activities: Soil samplings were in October and December respectively to Campinas (SP) and Colina SP, both localized in São Paulo State. The composite samples were collected of the surface layer stratified depths 0-0.025, 0.025-0.05, 0.05-0.10 and 0.10-0.20 m, six subsamples to form a composite sample. This technique of mini-trench allowed the stratification well depths sampled. After collecting the samples are air dried and sieved through sieve of 2 mm mesh to obtain the fraction of dried soil air (TFSA). The method used for organic matter fractionation was the physical fractionation of organic matter by particle size [4]. The humification index used was HFil, calculated with organic matter spectrum and carbon normalized in each soil sample [6].

The study variables consisted of analysis of variance of data and application of the Student t test to observe the difference in all treatments with each other, both 5% probability [5].

### 3. Results and Discussion

It is generally accepted that physical protection of SOM within aggregates is an important factor controlling dynamics and decomposition of organic C in cultivated and no-till soils, and the disruption of aggregates is one of the mechanisms proposed for lower SOC in tilled than in no-till systems [7]. The results of this work, when we observe the organic matter fractionation corroborated those obtained by Bayer et al., (2004), working with different crop rotations, where there was greater lability with the addition of waste. However when we look at the organic matter mineral-associated (Figure 1) for the soil conditions of Campinas behavior was different from the study by the author since the age of six tillage did not affect this fraction in agreement with the results of Hill, even with lower clay content. The results of this author showed that a fraction displays the same levels of functionality different according to soil characteristics. For this paper this major division has been carried out fractionation determines biggest difference in the fraction 20-53, demonstrating that the fallow is significantly less when compared to grass at all doses and legume winter. In Campinas, the HFIL index in the outermost layer, which of 0-2.5 cm (Table 1) showed that significantly all treatments were higher than the fallow, which shows the importance of using cover crops and maintain covered soil. In the rehabilitation of these areas, they need to be adopted management systems that focus on a higher amount of carbon to the soil in order to increase the bioavailability of organic matter, soil quality and mitigating CO<sub>2</sub> emissions [1].



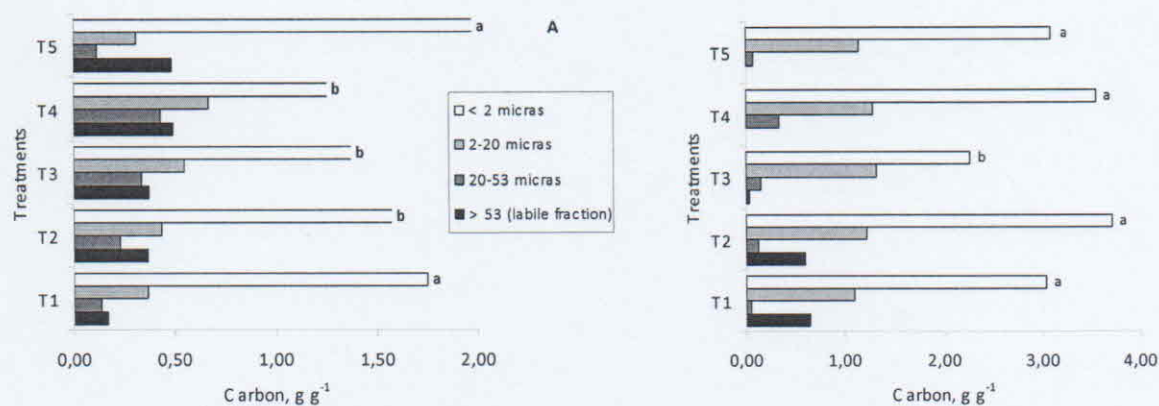


Figure 1: Carbon distribution in different soil fractions in 0-2.5 cm for five crop rotation treatments (T1: a graminea without side dressed nitrogen (N) applied; T2: a graminea with side dressed 30 kg ha<sup>-1</sup> of N; T3: a graminea with side dressed 60 kg ha<sup>-1</sup> of N; T4: a legume; T5: fallow (with spontaneous vegetation/weeds); at experimental sites in Campinas (A) and Colina (B)

Table 1: Results for humification (Hfil) in four layers in a Clayey Oxisol<sup>2</sup> at Campinas and a Silt Loam Oxisol<sup>3</sup> at Colina, SP, Brazil

HFil <sup>1</sup>	<sup>2</sup> T1	T2	T3	T4	T5	<sup>3</sup> T1	T2	T3	T4	T5
0-2.5	2042Ab	1980Ab	2023Ab	2010Ac	1768Bb	1447Bc	1558Bc	1625Bc	1500Ab	1400Bb
2.5-5.0	5536Aa	5538Aa	5534Aa	5471Ab	5670Aa	3680Ab	3724Ab	3700Ab	3500Ab	3700Ab
5.0-10.0	5800Aa	5334Ba	5833Aa	5680Ab	5898Aa	3050Bb	3052Bb	3052Bb	3605Ab	3100Bb
10.020.0	6101Aa	5550Ba	5900Aa	6277Aa	6063Aa	4600Aa	4650Aa	4703Aa	4500Aa	4700a
CV (%) <sup>4</sup>			14					16		

<sup>1</sup>HFil: Humification Index of the SOM. <sup>2</sup>Treatments in the Campinas site. <sup>3</sup> Treatments in Colina site. <sup>4</sup>Coefficient of Variation. Same lowercase in columns (depth) do not differ statically ( $p < 5\%$ ), same letters lines do not differ statistically ( $p < 5\%$ )

The C stock in the mineral-associated SOM fraction was not affected by soil management systems, which can be related with the short term with no-till and or the highly stable soil microaggregates in this clayey Oxisol. The preferential C storage in the labile SOM fraction is an environmental benefit, which is expected to occur only under continuous no-tillage and crop residues addition [2].

#### 4. Conclusions

The humification in Campinas (SP) was higher than Colina (SP); however labile fraction at both sites showed a different behavior, being dependent on both soil type and time of deployment of the no-till. In Colina the HFil index showed and confirmed the improvement of lability in soil surface.

In the physical fractionation was evident that the cover crops provided greater lability in the depth of 0-2.5 cm, in particular T4 (leguminous in winter) while the fallow at both sites showed a higher amount of carbon associated with minerals. The larger amount of the labile fraction was found in Colina soil, thus the mineralogy of this soil.

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