Impacts of Agricultural Use on Organic Matter of Histosols in the Cerrado in the north of Minas Gerais State, Brazil

B.G. Cunha¹, A. Pedrotti², C.E.G.R. Schaefer³

Despite restrictions imposed by environmental legislation, there is a recurring use of Histosols in Veredas in the Cerrado region, by the farmers in northern Minas Gerais State in southeast Brazil. This hydrophilic environment has low regenerative capacity and is sensitive to human disturbance, and is of great ecological and socio-economic importance (Cunha, 2009).

This study analyzed the impacts of agricultural land use by farmers of the rural settlement of San Francisco, Buritizeiro, Minas Gerais, on the organic matter of Histosols. As methodology, we observed the forms of land use and management of these soils through dialogues with farmers, before selecting three representative points for the classification of soils, according to the Soil Taxonomy (USDA, 1999) and the collection of samples at 0-20 cm and 20-40 cm depths. We determined the density of organic matter - DMO (Lynn et al., 1974), organic matter – OM, and the total carbon - C_T (Embrapa, 2006), microbial biomass carbon content - C_BMS (Islam and Weil, 1998; Tedesco et al., 1995), and carbon - C_org fractions of soil organic matter (Swift, 1996; Yeomans and Bremner, 1988).

Table 1: Characterization of organic matter of Histosols at three locations in the Cerrado, Brazil.

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>DMO (Mgm⁻³)</th>
<th>FAF* (dagkg⁻¹)</th>
<th>FAH (HUM)</th>
<th>FAH/FAF</th>
<th>EA/HUM</th>
<th>OM (dagkg⁻¹)</th>
<th>∑C_org (µg)</th>
<th>C_T (µg)</th>
<th>C_BMS (µg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>0.20</td>
<td>0.72</td>
<td>4.74</td>
<td>3.98</td>
<td>6.58</td>
<td>1.37</td>
<td>25.43</td>
<td>9.44</td>
<td>15.48</td>
</tr>
<tr>
<td>20-40</td>
<td>0.15</td>
<td>0.26</td>
<td>3.20</td>
<td>2.06</td>
<td>12.31</td>
<td>1.68</td>
<td>19.21</td>
<td>5.52</td>
<td>11.43</td>
</tr>
<tr>
<td>0-20</td>
<td>0.13</td>
<td>1.57</td>
<td>5.37</td>
<td>2.96</td>
<td>4.53</td>
<td>2.62</td>
<td>23.37</td>
<td>9.90</td>
<td>13.91</td>
</tr>
<tr>
<td>20-40</td>
<td>0.13</td>
<td>0.96</td>
<td>5.96</td>
<td>4.45</td>
<td>6.21</td>
<td>1.56</td>
<td>26.77</td>
<td>11.37</td>
<td>15.93</td>
</tr>
<tr>
<td>0-20</td>
<td>0.14</td>
<td>1.70</td>
<td>6.00</td>
<td>6.54</td>
<td>3.53</td>
<td>1.18</td>
<td>31.99</td>
<td>14.24</td>
<td>19.04</td>
</tr>
<tr>
<td>20-40</td>
<td>0.12</td>
<td>1.07</td>
<td>5.32</td>
<td>6.05</td>
<td>4.97</td>
<td>1.06</td>
<td>31.71</td>
<td>12.44</td>
<td>18.88</td>
</tr>
</tbody>
</table>

Notes: FAF = Fluvic acid fraction; FAH = Humic acid fraction; HUM = Humin fraction; EA = Alkaline extract (FAF + FAH).

In the areas studied, there was no use of fire or mechanization, only the construction of small drains, to control the water table height. The agricultural use was more than 10 years old, with subsistence farming (grains, vegetables and tubers) and chip feed (pasture and sugarcane). We observed biological activity (ants, termites and earthworms) in the P.5 and P.16 profiles. The organic matter density (DMO) was determined by calculation [DMO = Ds - (Ds / MM)], with its values ranging from 0.12 to 0.20 Mg m⁻³, and an average value of 0.15 Mg m⁻³. Based on these results, we inferred that all profiles were under anthropogenic use, because DMO was greater than 0.07 Mgm⁻³ (Lynn et al., 1974) and also profile P.5 had more use since DMO increases under agricultural cultivation and drainage of Histosols (Ebeling et al., 2013).

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Total carbon content $C_T$ ranged from 11.43 to 19.04 dag kg$^{-1}$, with a mean value of 15.72 dag kg$^{-1}$, and was greatest in the sapric profile (P.17). Among the fractions of organic matter, fluvic acid (FAF) was the lowest (1.05 dag kg$^{-1}$), but was higher than in the 0-20 cm layer of all profiles, Humin fraction (HUM) was less than the humic acid fraction (FAH) in hemic profiles, while in sapric profiles, the values of FAH and HUM were similar throughout the layers.

As for $\Sigma C_{org}$, which is the sum of all fractions of organic matter (Fluvic acid, humic acid, and humin) in Haplic profiles, the FAH contributed the largest percentage of $\Sigma C_{org}$ in all layers. In all profiles, the FAF was the fraction with the lowest contribution. EA/HUM ratio ranged from 1.06 to 2.62, inferring that there was an initial process of destabilization of carbon, but the HUM still predominated over the other fractions. FAH/FAF ratio increased with depth down the profiles, varying from 3.53 to 12.31 dag kg$^{-1}$. The carbon content of the microbial biomass, $C_{BMS}$, in the surface layer (0-20 cm) in all profiles was less than the $C_{BMS}$ of the subsurface layer (20-40 cm), inferring that there was a negative impact of human activities, especially in the P.16 profile.

Finally, through analytical study of organic matter, we determined that agricultural activity has interfered with the quality of soil organic matter at the sampled locations, and though not preventing the use and management of the soils, it needs periodic monitoring.

References