Carbon dioxide emissions under different soil tillage systems in the cultivation of mechanically harvested sugarcane

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Carbon dioxide (CO_2) is the most important anthropogenic greenhouse gas (GHG). Its annual emissions increased by about 80% between 1970 and 2004. Tillage and other methods of soil preparation may influence CO_2 emissions because they accelerate the mineralization of organic carbon in the soil. This study aimed to quantify the CO_2 emissions under conventional tillage (CT), minimum tillage (MT) and reduced tillage (RT) during the renovation of sugarcane fields. The experiment was performed on an Oxisol in the sugarcane-planting area in the southeastern region of Brazil, where harvesting is performed without prior burning sugarcane leaves. An undisturbed or no-till (NT) plot was left as a control treatment. The results indicated a significant interaction ($p < 0.001$) between the tillage method and the time after tillage. Significant increases in CO_2 emissions were also observed on the days of rainy events in the area. By quantifying the emissions accumulated over 44 days after soil preparation, we observed that emissions were highest in the CT system, reaching 350.09 g m^{-2} of CO_2 (954.79 kg ha^{-1} of C-CO_2). The impact of the RT and MT systems was lower, resulting in accumulated emissions of 51.7 and 5.5 g m^{-2} over the same period. Mechanized sugarcane harvest results in an annual increase of 1.2 Mg ha^{-1} in the soil C stocks in the 0-20-cm layer. Thus, over a period of only 44 days, the use of conventional tillage would result in a loss equivalent to 80% of the C that could potentially be lost (removed) from this soil layer during one year of mechanized harvest. Soil preparation during the renewal of the sugar plantation using RT methods would result in the loss of 12% of the C accumulated over one year. For MT techniques, the corresponding value would be approximately 2%.

Keywords: Carbon dioxide, Emission after tillage, soil carbon, greenhouse gas