ABSTRACT

The impact of agricultural land use management practices on the soil organic matter status and carbon dioxide dynamics in some Trinidadian soils

The major climatic problem "global warming" is directly related to agricultural activities since CO_2 (carbon dioxide), a greenhouse gas can be produced via microbial respiration of soil organic matter (SOM). Different land use practices may enhance the production of CO_2 and at the same time, lead to a decline in soil organic matter content, which is vital for good soil fertility. For this research, a preliminary soil survey was first conducted to investigate the effects of land use managements systems on the soil chemical and physical properties and soil profile CO_2. A soil probe was used to sample the soil atmosphere and samples were analyzed for CO_2 using gas chromatography. Results from this preliminary soil survey suggest that land use changes have contributed to a decline in the soil's fertility and an increase in CO_2 concentrations within the soil profile. Bejucal clay displayed the highest (44%) reduction in SOM in the high input agriculture (HIA) compared the natural area (NA). The total soil pore space and aggregate stability was highest in the NA while the bulk density was the lowest. For most soils, the CO_2 concentration was highest under the HIA system and lowest under the NA and the overall concentration increased down the soil profile. Results from greenhouse experiments 1 and 2 were able to show the short-term effects that tillage, soil moisture, soil type, fertilizer and manure applications had on the SOM and CO_2 emissions. Carbon dioxide emissions were measured by incubating soil samples in chambers for 24 hours and later

withdrawing air samples to be analyzed using a gas chromatograph. Except for fertilizer, all factors significantly ($p<0.05$) affected the CO_2 emissions. The tilled soil produced the highest CO_2 emissions (0.94 -18.8 mg CO_2 m^{-2} hr^{-1}) while the natural soil produced the lowest (1.04-12.7 mg CO_2 m^{-2} hr^{-1}) because of higher aeration, thus more microbial activity in the former. Carbon dioxide evolution at field capacity (FC) was 18.9 - 42.0% higher than that at half-field capacity (half-FC) because a higher quantity of moisture was available for microbial production at FC. River Estate soil displayed the highest CO_2 emissions (1.24 -22.6 mg CO_2 m^{-2} hr^{-2}) while Piarco displayed the lowest (0.72 - 13.2 mg CO_2 m^{-2} hr^{-2}) since River Estate had a more porous soil structure compared to Piarco. The addition of manure resulted in an 18-22 % increase in CO_2 evolution over the period of the experiment due to greater amounts of organic carbon available for microbial growth. Available N and P generally increased during the experiment while available K remained fairly stable. These findings should be considered when designing a sustainable soil management system.

Keywords: Carbon dioxide, greenhouse gas, microbial respiration, soil organic matter and land use.