Differences in the Carbon Dioxide Movement in Tillage and No-Tillage Systems during the Transition from Autumn to Winter in Andisol of Japan

HTM Perera[1], J Nishiwaki [2] and DAL Leelamanie[1*]
[1]Department of Soil Science, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka
[2]Department of Soil Science, Collage of Agriculture, University of Ibaraki, Japan

Abstract
Global warming has grown into a serious menace in the context of climate change, especially due to anthropogenic greenhouse gas (GHG) emissions including carbon dioxide (CO_2). Soil or the terrestrial carbon pool is one of the major sources of atmospheric CO_2. Soil respiration and decomposition of organic matter are accountable for the emissions of CO_2 from the soil. Tillage activities have the potential to suppress or enhance CO_2 emissions by altering soil respiration and organic matter decomposition. This short-term experiment was conducted in a Japanese Andisol during the transitional period of autumn to winter and aimed (a) to investigate the difference of CO_2 flux between no-tilled and tilled soils, (b) to evaluate the relationship between CO_2 concentration, surface CO_2 flux, and gas diffusion coefficient in the soil profile. The closed-chamber method, Ozozawa-type diffusion apparatus, and buried gas sampling tube method were used to quantify the soil surface CO_2 flux, gas diffusion coefficient, and soil CO_2 concentration, respectively. The pooled t-test was employed to test the statistical significance (α = 0.05). Tilled soil had large relative diffusion coefficient values (0.61). Diffusivity decreased with the depth in both systems. Significantly higher surface CO_2 fluxes were observed in tilled soil than in no-tilled, in July to September. Similar fluxes were observed in tilled and no-tilled soils in October. Tilled soil showed CO_2 fluxes significantly lower than that of no-tilled soils in November. The magnitudes of surface CO_2 flux and soil CO_2 concentration decreased in both tilled and no-tilled soils during the transitional period. Tilled soil showed higher CO_2 concentrations (1.56 g cm^{-3}) during autumn and low CO_2 concentrations (0.28 g cm^{-3}) at the beginning of winter compared to no-tilled soil. No-tilled soil has relatively higher soil moisture content and higher soil temperatures compared to tilled soil during the transitional period. Enhanced cold-air intrusion into tilled can be considered as the reason for the relatively low temperature in the vadose zone of tilled soil. Higher soil moisture could have led to lower gas diffusivity inside the soil profile. Higher CO_2 concentration in soil profile increased the emissions from the soil surface. Further evaluations will be required on variations and the amplitude of CO_2 emissions from the soil under various soil types and various cropping systems as this research was conducted in bare land.

Keywords*:* Gas diffusion coefficient, No-tillage, Soil CO_2 concentration, Surface CO_2 flux, Tillage
[*]**Corresponding Author:** leelamanieе@yahoo.co.uk