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The effect of cultivation practices on soil - atmosphere carbon cycle under arid climate conditions

Dbvid Lifschitz (1), Mbrcelo Sternberg (2), Dbvid Bonfil (3), Eybl Ben-Dor (4), bnd Gil Eshel (5)

(1) Porter School of Environmentbl Studies, Tel-Aviv University, Tel-Aviv, Isrbel (dbvids_bbr@hotmbil.com), (2) Depbrtment of Plbnt Sciences, Tel-Aviv University, Tel-Aviv, Isrbel, (3) Gilbt Resebrch Center, Agriculturbl Resebrch Orgbnizbtion, Gilbt, Isrbel, (4) Geogrbphy bnd the Environment Depbrtment, Tel-Aviv University, Tel-Aviv, Isrbel, (5) The Soil Erosion Resebrch Stbtion, Isrbel

The soil – atmosphere carbon cycle was studied under arid climate conditions, in relation to crop management. Management included different tillage (Conventional vs. No Tillage, CT vs. NT respectively) and fertilization (nitrogen and phosphorus application vs. unfertilized) practices, in a continuous (winter) wheat field, for two growing seasons (2007-08 and 2008-09).

The NT practice was characterized by higher CO_2 effluxes than the CT during the growing season. In turn, the CT practice had higher pCO_2 throughout the soil profile to a depth of 2m. This could be explained partially by a physical crust formation due to raindrop impact, emerging on the bare soil, mostly in the CT practice. The crust serves as a barrier for gas exchange (soil aeration) and in addition, also reduces rainfall infiltration, and all together harms the growing potential (the NT practice yielded higher plant biomass). Fertilization application had no apparent effect on the CO_2 effluxes or the pCO_2, but had a significant effect on the yield of the plant biomass.

The NT practice had also higher amounts of soil organic Carbon, (SOC) mainly in the surface layer, and soil inorganic Carbon (SIC) to a depth of 2m. This is attributed to straw mulch application for the former and better gas and water conductivity (that initiates carbonate dissolution – precipitation cycles) for the latter, which is a much more dominant factor in arid area soils. The stable carbon isotope analysis ($\delta^{13}C$) values for the total Carbon (TC), SOC and SIC results show that the NT practice generates higher amounts of pedogenic carbonates also, and in general is clearly superior over CT in almost every aspect in the soil – atmosphere C cycle.