SOIL GREENHOUSE GAS DYNAMICS IN RESPONSE TO DAIRY MANURE COMPOST IN AN ALMOND ORCHARD

A. Coyotl[1], J. Murch[1], SDS Khalsa[1], and W.R. Horwath[1]
[1]University of California, Davis.

ABSTRACT

Application of dairy manure compost in soils under almond production may confer benefits such as increased carbon sequestration, improved crop nutrient use efficiency, and reduction of greenhouse gas emissions. Elucidating the mechanisms of greenhouse gas emissions and mitigation is a primary concern in the management of agricultural soils and it is directly linked to nutrient management. Presently, agricultural soils account for 11.2% of U.S. greenhouse gas emissions. Of particular concern is how agricultural management influences CO_2, CH_4, and especially N_2O emissions. Indeed, there is greater demand for soils to mitigate climate change and increase food production while also reducing negative impacts on the environment. This is especially relevant to management of agricultural soils in intensive Mediterranean climates, such as the growing almond industry in California. Though it is generally understood that N_2O production is largely constrained by microbial activity, the specific drivers of N_2O emissions are also dependent on season, N inputs, soil moisture content, and available carbon sources. Therefore, we ask, to what extent can compost application mitigate N_2O emissions? To investigate the effects of dairy manure compost on greenhouse gas dynamics in almond orchards, we split an orchard into four blocks, each with a control of no compost or fertigation (T1-0N), compost only (T9-0N: 7 tons wet weight per acre), compost with fertigation (T9-+N: 7 tons wet weight per acre and 90 lb N/acre with UAN32), and fertigation only (T1-+N: 90 lb N/acre with UAN32). Four rows for every block were randomly assigned one of the four treatments. Static flux collars were randomly assigned a tree within the treatment row and all collars were installed 140 cm from the target tree (halfway between micro sprinkler and tree). Data was collected in duplicate for each experimental unit. Preliminary analysis of flux dynamics shows that there are compost effects on N_2O flux. A strong decoupling is apparent between T1-+N and the other treatments, including the control. This is most apparent by the third fertigation event, where N_2O flux of T1-+N was three times higher than T9-+N, both of which received the same rates of UAN32 fertilizer. CO_2 flux was variable, but patterns were consistent across treatments. CH_4 flux was consistently negative, indicating methane oxidation and aerated soils. There was an expected delineation in NO_3-N concentrations between fertilized rows and non-fertilized rows. However, an inverse relationship between NO_3^--N and NH_4^+-N emerged by the second fertigation event. This may indicate immobilization processes where trees may compete with microorganisms for inorganic nitrogen, possibly explaining the lower nitrous oxide flux in the compost treatments. There was also an expected increase in DOC concentrations in the compost treatments relative to T1-0N and T1-+N. NH_4^+-N concentrations across treatments eventually stabilized to comparable levels. Initial results indicate that compost application can mitigate net N_2O emissions. Future directions will involve further flux measurements for the next 4 growing seasons and determination of microbial/enzymatic activity response.