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Comparing Carbon Dioxide and Water Vapor Fluxes from Tilled and Non-tilled Maize Canopy Fields

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ABSTRACT

Agricultural activities account for approximately 25% of worldwide greenhouse gas emissions. Farm management practices, such as tillage and no-tillage, may contribute more to this percentage than others. The two most abundant greenhouse gases responsible for climate change are CO_2 and H_2O, therefore it is important to determine whether tillage or no-tillage emits less of these gases. Fluxes of CO_2 and H_2O from two maize canopy fields, one with tillage and one with no-tillage, were measured in Indiana during the 2016 growing season. This study utilized the eddy covariance method, which represents flux as a covariance between vertical velocity and gas concentration. Measurements of canopy height and leaf area index (LAI) from both fields were collected since these parameters influence photosynthesis, respiration, and evapotranspiration rates and show differences in the growth of maize. Results showed that the tilled field had a 14% higher maximum CO_2 uptake and a 4% higher maximum H_2O flux to the atmosphere when LAI was 32% larger than the non-tilled field. Previous studies suggest these fluxes should be higher for the tilled field than what was measured. Drought conditions caused the maize to be water stressed, which restricted H_2O loss and caused less CO_2 uptake. These outcomes indicate that while maize canopies with tillage may typically have a higher CO_2 uptake and higher H_2O emissions than with no-tillage, this effect tends to disappear when maize is under water stress.

KEYWORDS

Greenhouse gases, eddy covariance, leaf area index (LAI), tillage, maize stress