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Nutrient Source and Tillage Effects on Maize: II. Yield, Soil Carbon, and Carbon Dioxide Emissions

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Environment

Nutrient Source and Tillage Effects on Maize: I. Micrometeorological Methods for Measuring Carbon Dioxide Emissions

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Core Ideas

- Aerodynamic methods can be used to gap-fill Bowen ratio energy balance micrometeorological measurements.
- Eddy covariance and Bowen ratio energy balance methods agree during turbulent daytime conditions.
- Measuring nighttime net ecosystem exchange is challenging using turbulence-based micrometeorology.

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ABSTRACT

There is a need to understand the potential benefits of using the biotechnology waste by-product from manufacturing as a fertilizer replacement in agriculture, by quantifying the economic value for the farmer and measuring the environmental impact. Measuring CO_2 emissions can be used to assess environmental impact, including three widely used micrometeorological methodologies: (i) the Bowen Ratio Energy Balance (BREB), (ii) aerodynamic flux-gradient theory, and (iii) eddy covariance (EC). As a first step in quantifying benefits of applying biotechnology waste in agriculture, a detailed examination of these three methods was conducted to understand their effectiveness in quantifying CO_2 emissions for this specific circumstance. The study measured micrometeorological properties over a field planted to maize (*Zea mays* L. var. *indentata*), one plot treated with biotechnology waste applied as a nutrient amendment, and one plot treated with a typical farmer fertilizer practice. Carbon dioxide flux measurements took place over 1 yr, using both BREB and EC systems. The aerodynamic method was used to gap-fill BREB system measurements, and those flux estimates were compared with estimates produced separately by the aerodynamic and EC methods. All methods found greater emissions over the biotechnology waste application. The aerodynamic method CO_2 flux estimates were considerably greater than both the EC and a combined BREB-aerodynamic approach. During the day, the EC and BREB methods agree. At night, the aerodynamic approach detects and accounts for buildup of CO_2 at the surface during