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Patterns and Drivers of Soil Carbon Dioxide Emissions from Well-Watered and Drought-Stressed Silage Maize Production

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Abstract

The projected global warming risks due to high emissions of greenhouse gases, mainly from anthropogenic activities, increases the need for an agricultural practice with high carbon sink capacity and water use efficiency without compromising on food security. On one hand, it's well accepted that soil temperature and moisture content directly affect microbial activity, whereas on the other hand, drought stress was recently postulated to increase root exudates, which in turn will accelerate soil organic matter mineralisation. Thus, the objective of this study was to investigate the interplay between soil moisture (well-watered and drought stressed) and maize (*Zea mays* L.) root exudates on soil CO₂ efflux. The experiment consisted of three treatments, which are well-watered, drought stressed maize plus a control (without plants). Soil CO₂ efflux, soil temperature and moisture content were measured weekly during the growing season (April to September) and monthly in the fallow period. Under well-watered conditions, the annual average of CO₂ efflux was 0.12 g CO₂-C m⁻² hr⁻¹, which was 24.5% and 20% significantly higher than under drought stressed and the control, respectively. Moreover, well-watered treatment had significantly greater primed carbon than drought stressed maize. Soil temperature in deeper soil layers (25, 50 and 75 cm) correlated positively with the CO₂ efflux, while soil moisture correlated negatively at the 5 cm and 25 cm. In addition, above and below ground biomass correlated significantly to soil CO₂ efflux. Overall, these results suggested that the root exudates decreased under drought conditions, which decreasing soil respiration. Drought tolerance varieties could be an option to decrease soil respiration and maintain productivity.

Keywords: Carbon sequestration, ecosystem, microbial biomass, soil respiration