

Impact of Nitrogen Fertilization on Soil Respiration and Net Ecosystem Production in Maize

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Abstract : Agriculture in the semi-arid is often challenged by overuse of N, inadequate soil water, and heavy carbon emissions thereby threatening sustainability. Field experiments were conducted to investigate the effect of nitrogen fertilization levels (0-N₀, 100-N₁₀₀, 200-N₂₀₀, and 300 kg ha⁻¹-N₃₀₀) on soil water dynamics, soil respiration (Rs), net ecosystem production (NEP), and biomass yield. Zero nitrogen soils decreased Rs by 23% and 16% compared to N₃₀₀ and N₂₀₀ soils, respectively. However, biomass yield was greatest under N₃₀₀ compared with N₀, which therefore translated into increased net primary production (NPP) by 89% and NEP by 101% compared to N₀. To a lesser extent, N₂₀₀ increased net primary production by 69% and net ecosystem production by 79% compared to N₀. Grain yields were greatest under N₃₀₀ compared with N₁₀₀ and N₀, which therefore translated into increased carbon emission efficiency (CEE) by 53%, 39% and 3% under N₃₀₀ compared to N₀, N₁₀₀, and N₂₀₀ treatments respectively. Under the conditions of this study, crop yield and CEE may be optimized at nitrogen application rates in the range of 200-300 kg ha⁻¹. Based on these results, there appears potential for 200 kg N ha⁻¹ to be used to improve yield and increase CEE in the context of the rainfall-limiting environment.

Keywords : carbon emission, carbon emission efficiency, C sequestration, N rates, semi-arid

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