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- N_0 , 100- N_{100} , 200- N_{200} , and 300 kg ha⁻¹- N_{300}) 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 N_{300} and N_{200} soils, respectively. However, biomass yield was greatest under N_{300} compared with N_0 , which therefore translated into increased net primary production (NPP) by 89% and NEP by 101% compared to N_0 . To a lesser extent, N_{200} increased net primary production by 69% and net ecosystem production by 79% compared to N_0 . Grain yields were greatest under N_{300} compared to N_0 , which therefore translated into increased carbon emission efficiency (CEE) by 53%, 39% and 3% under N_{300} compared to N_0 , N_{100} , and N_{200} 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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