Drip Irrigation Frequency: The Effects and Their Interaction with Nitrogen Fertilization on Maize Growth and Nitrogen Use Efficiency under Arid Conditions

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Abstract

Differences in soil moisture and wetting pattern under different irrigation frequencies mean that vegetative growth and nitrogen use efficiency in maize can differ even when the same total amount of irrigated water is applied under different frequency regimes. The goal of this study was to evaluate the effects of drip irrigation frequency and its interaction with nitrogen fertilization on vegetative growth and nitrogen use efficiency of a maize crop at different growth stages and on grain quality at maturity stage in a sandy soil. The experiment was conducted for 2 years (2005 and 2006) using a randomized complete block split split plot design with four irrigation frequencies (once every 2, 3, 4 and 5 days), two nitrogen levels (190 and 380 kg N ha-1) and two maize hybrids (three-way cross 310 and single cross 10) as the main plot, split plot and split split plot variables, respectively. Irrigation water, totaling 524 mm ha-1, applied for each irrigation frequency was divided into 28, 21, 17 and 14 doses for the F2, F3, F4 and F5 treatments, respectively. Results indicated that vegetative growth, crop growth and nitrogen efficiency parameters at the 10-leaf and tasseling growth stages increased with increasing drip irrigation frequency, whereas grain protein content decreased. Although the values of the vegetative growth and crop growth parameters increased with increasing nitrogen levels, significant decreases in nitrogen efficiency parameters were also observed indicating the need for further optimization with a reduced nitrogen application rate. Significant interaction effects between irrigation frequency and nitrogen levels were detected for all parameters measured. In most cases, the parameters were not significantly different between the two nitrogen levels at an irrigation frequency of once every 5 days, but did differ significantly at irrigation frequencies of once every 2, 3 or 4 days. The relationship between the nitrogen use efficiency parameters and retained available soil water content at the 10-leaf and tasseling growth stages was best represented by a second order polynomial equation with an R2 ranging from 0.73 to 0.98. Based on our findings, an irrigation frequency of once every 2 and 3 days is recommended to enhance growth and nitrogen use efficiency of drip-irrigated maize in sandy soil in Egypt.