International Journal of Plant Production 8 (1), January 2014
ISSN: 1735-6814 (Print), 1735-8043 (Online)
www.ijpp.info

GUASNR

Maize response to water, salinity and nitrogen levels: physiological growth parameters and gas exchange

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Received 16 May 2013; Accepted after revision 18 October 2013; Published online 25 November 2013

Abstract

A split-split-plot design with three replications in two years of 2009 and 2010 was conducted to investigate the effect of different levels of irrigation water (main plot), salinity of irrigation water (sub-plot) and nitrogen fertilizer rate (sub-sub-plot) on maize growth rate and gas exchange. Irrigation treatments were I_1 (1.0 crop evapotranspiration (ET_c)+0.25ET_c as leaching), I_2 (0.75I_1) and I_3 (0.5I_1) applied at 7-day intervals. The salinity treatments of irrigation were 0.6 (fresh water), 2.0 and 4.0 dS m^{-1}. There were also three nitrogen (N) treatments including 0, 150 and 300 kg N ha^{-1}. Results showed that vegetative growth stage of maize in salinity stress lasted 5% more than that in water stress. The most sensitive trait under water, salinity and nitrogen stress was grain yield (GY). The optimum treatment for maize production is full fresh water application by 150 kg N ha^{-1}. Results also showed that crop growth rate (CGR) was statistically higher in I_1 and I_2 as 58 and 34% relative to I_3 treatment, respectively. Furthermore, CGR was statistically lower in S_2 and S_3 as 10 and 18% relative to S_1, respectively. Besides, N application significantly increased CGR by an average of 15% as compared with no N rate. The net assimilation rate (NAR) reached its maximum value in I_2, S_2 and N_2 relative to other treatments indicating that NAR did not necessarily occurred at maximum LAI conditions. In general, maize had statistically greater NAR in pollination and filling stages relative to other growth stages. Results of gas exchange for maize as a sensitive crop to water deficit, showed that photosynthesis rate (A_n) and stomatal conductance (g_s) were statistically decreased in water deficit by an average of 30 and 43% as compared to full irrigation treatment, respectively. However, reduction in A_n and g_s in salinity conditions was the same as 13% compared to no salinity treatment. Transpiration rate (T) was statistically lower under water and salinity stress by an average of 75 and 26% as compared to no water and salinity stress, respectively. The ratio of A_n/g_s in I_2 and I_3 was