Modification and validation of maize simulation model (MSM) at different applied water and nitrogen levels under furrow irrigation


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The model MSM (Maize Simulation Model) was modified and validated, using data on furrow irrigation in Fars province in Iran during 2003 and 2004. The planted cultivar was SC704 (single cross) a late maturity hybrid. Three nitrogen levels (300, 150, and 0 kg N ha\(^{-1}\) as urea) and four irrigation treatments (applied water at 1.2, 1.0, 0.8, and 0.6 ratios of potential maize water requirements as I₄, I₃, I₂, and I₁ treatments, respectively) were considered. The potential water requirements were estimated based on the differences between soil field capacity and measured soil water contents at root depth in the I₃ treatments before irrigation. The MSM model was modified based on field data in 2003 as: (i) Modification of root N uptake based on soil water pressure head and van Genuchten soil parameters for soil moisture retention curve \(a\), and (ii) modification of grain yield prediction based on seasonal plant stover nitrogen uptake and grain N content. Model subroutines, i.e. leaf area index, dry matter production, prediction of soil water contents at different depths and at different days after planting did not require any modifications. Comparisons between measured data and predicted values by the modified model indicated favorable validation.

Keywords: MSM; nitrogen fertilization; irrigation; simulation model; maize

Introduction

Maize is mostly grown under irrigation in I.R. of Iran. Its grain yield is highly sensitive to water constraint. In most regions of Iran there were water shortages for maize irrigation and many authors noted the effects of applied irrigation water and N fertilizer on grain yield (Sepaskhah et al. 1993; Zand-Parsa and Sepaskhah 2001). The response of maize grain yield to the application of N fertilizer has long been recognized. Furthermore, contamination of groundwater by NO₃-N has promoted researcher to consider methods to improve N management. The effects of both N fertilizer and irrigation water on maize growth and grain yield were investigated by different authors (Pang and Letey 1998; Pandey et al. 2000a, 2000b; Zand-Parsa and Sepaskhah 2001; Shaffer et al. 2004; Zand-Parsa et al. 2006).

Applied water and fertilizer are considered as part of crop management. Crop simulation models are mathematical representations of plant growth processes as

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