A Numerical Model to Predict Crop Yield from Soil Water Deficit

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ABSTRACT
A computer model to estimate the yield of cowpea as well as components of the water balance for the cropped layered soil profile is described. Infiltration and soil water redistribution are governed by numerical solution of the transient, one-dimensional flow of water through a porous medium with a sink term to account for water uptake by plant roots. Yield is related to a multiplicative model of the transpiration deficit of the different growth stages and water extraction is based on the pressure difference between the plant and the soil. In addition to yield, transpiration and evaporation, model output also includes fluxes, pressure head, soil moisture at different depths of the profile, and runoff at the soil surface. The model was validated for a tropical humid region in Ile-Ife, Nigeria under variable irrigation. The mean average error and coefficient of variation between predicted and measured soil water content were 0.003m³/m³ and 0.032, respectively, while those between measured and predicted evapotranspiration were 2.35mm and 0.063. The per cent variation between predicted and measured yield varied from 0.7 to 21.3. The model was considered appropriate for long-term simulation of water balance and irrigation requirement. However further modification may be necessary for better simulation of the evapotranspiration rates.

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