ABSTRACT

Crop simulation models serve as effective instruments for evaluating the management conditions of irrigation systems. This study aims to simulate maize production to identify optimal irrigation water management strategies under deficit irrigation and moisture conservation practices, utilizing the AquaCrop model. We conducted this research at Woleh irrigation schemes during the 2023/2024 irrigation season in the Wag-himra zone of northern Ethiopia. To check how well the model worked, we used statistical tests such as prediction error (PE), root mean square error (RMSE), index of agreement (D), goodness-of-fit (R^2), and the Nash–Sutcliffe coefficient of efficiency (NCE). The model effectively simulated canopy cover, aboveground biomass, and yield across all treatments, evidenced by the high R^2 (0.99) and NSE (0.99) values. Furrow-irrigated raised bed planting (FRBP) at 100% and 75% ETc with mulch exhibited the lowest predicted errors and deviations in yield and water productivity. The model effectively predicted maize yield and biomass under full irrigation in FRBP at 75% ETc with mulch. The AquaCrop model serves as a dependable measure of maize crop development and outcomes across different irrigation conditions and mulch types, potentially enhancing sustainable maize productivity in water-stressed areas.

Keywords:

AquaCrop; **calibration**; **validation**; **mulch**; **pearlmillet**; **sustainablecrop productivity**; **sustainable water use**