Modelling Alfalfa Yield Response to Limited Water

Isaya Kisekka, University of California - Davis, CA USA

Isaya Kisekka is an associate professor of Hydrology and Agricultural Water Management in the Department of Land, Air, and Water Resources and the Department of Biological and Agricultural Engineering at the University of California Davis. He also serves as the Director for the UC Davis Agricultural Water Center of Excellence, where he leads efforts on sustaining groundwater use and irrigated agriculture in the Southwestern United States. The overall goal of his research is to enhance sustainable water management in agroecosystems. His research focuses on quantifying the influence of irrigation on crop production, water balance, water quality, and climate change adaptation. He seeks to develop precision irrigation technologies (e.g., novel soil and plant water status sensing technologies) and water management strategies (e.g., modeling and optimization). His research is conducted at a range of scales from the groundwater basin, to farm, to the field to smaller scales (e.g., greenhouse and soil columns). His research involves both experimental studies, and modeling. Examples of his current research projects include developing precision irrigation management for nut trees and vegetable crops, groundwater demand management, groundwater allocation monitoring using remote sensing, vadose monitoring and modeling of nitrate leaching to groundwater, developing novel soil nitrate sensors, using Volatile Organic Compounds (VOCs) to monitor salinity stress, and recycled water reuse in agriculture impacts on soil hydrology.

He received a BSc. Agricultural Engineering from Makerere University in Uganda, and Master and PhD in Agricultural and Biological Engineering (specializing in Hydrologic Sciences) from the University of Florida. Prior to joining UC Davis, he served as an Assistant Professor of Irrigation Engineering/Water Management at Kansas State University where he worked on irrigation and groundwater sustainability issues in the Ogallala Aquifer region of Western Kansas.

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Alfalfa is one of the main forages utilized in dairy rations around the globe including the United States. Alfalfa production is threatened by constrained water supplies and climate change e.g., multiyear droughts. However, due to its deep-rooted characteristics, it can sustain long periods of drought. In this paper, we applied the online crop modeling tool called the Food, Agriculture, and Resource Management system (FARMs) to simulate alfalfa response to full and deficit irrigation regimes. FARMs simplifies crop modeling by automating the creation of input weather, climate, and soil data and adding geospatial capabilities. The online interface makes it convenient to select a field, create management practices and run crop models without requiring deep knowledge of software and database management. A fall dormancy 7 (FD 7) alfalfa variety was used in this study. Full irrigation (100% ET-Full) was applied following the crop evapotranspiration (ET_c) for the entire season while deficit irrigation (60% ET-Cutoff) was fully irrigated until mid-summer and no water was applied after mid-July. Irrigation was applied using a linear move sprinkler irrigation system. The FARMs web app performed well with an R^2 of 0.87 and an RMSE of 782.6 kg ha^{-1} for the alfalfa forage yield. The web app was able to simulate the crop water stress late in the season which corresponds well with the observed soil water content. Under changing climate and associated droughts, decision support tools like the FARMs web app may enable California growers to make optimum decisions for producing alfalfa with limited water supplies.