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# Calibration and Validation of the Aquacrop Model for Simulating Growth and Yield of Rain-Fed Sesame (Sesamum Indicum L.) Under Different Soil Fertility Levels in the Semi-arid Areas of Tigray, Ethiopia

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**Abstract :** Sesame is an important oilseed crop in Ethiopia, which is the second most exported agricultural commodity next to coffee. However, there is poor soil fertility management and a research-led farming system for the crop. The AquaCrop model was applied as a decision-support tool, which performs a semi-quantitative approach to simulate the yield of crops under different soil fertility levels. The objective of this experiment was to calibrate and validate the AquaCrop model for simulating the growth and yield of sesame under different nitrogen fertilizer levels and to test the performance of the model as a decision-support tool for improved sesame cultivation in the study area. The experiment was laid out as a randomized complete block design (RCBD) in a factorial arrangement in the 2016, 2017, and 2018 main cropping seasons. In this experiment, four nitrogen fertilizer rates, 0, 23, 46, and 69 Kg/ha nitrogen, and three improved varieties (Setit-1, Setit-2, and Humera-1). In the meantime, growth, yield, and yield components of sesame were collected from each treatment. Coefficient of determination (R2), Root mean square error (RMSE), Normalized root mean square error (N-RMSE), Model efficiency (E), and Degree of agreement (D) were used to test the performance of the model. The results indicated that the AquaCrop model successfully simulated soil water content with R2 varying from 0.92 to 0.98, RMSE 6.5 to 13.9 mm, E 0.78 to 0.94, and D 0.95 to 0.99, and the corresponding values for AB also varied from 0.92 to 0.98, 0.33 to 0.54 tons/ha, 0.74 to 0.93, and 0.9 to 0.98, respectively. The results on the canopy cover of sesame also showed that the model acceptably simulated canopy cover with R2 varying from 0.95 to 0.99 and a RMSE of 5.3 to 8.6%. The AquaCrop model was appropriately calibrated to simulate soil water content, canopy cover, aboveground biomass, and sesame yield; the results indicated that the model adequately simulated the growth and yield of sesame under the different nitrogen fertilizer levels. The AquaCrop model might be an important tool for improved soil fertility management and yield enhancement strategies of sesame. Hence, the model might be applied as a decision-support tool in soil fertility management in sesame production.

**Keywords :** aquacrop model, normalized water productivity, nitrogen fertilizer, canopy cover, sesame
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