

Optimization of Fertilizer Consumption and Improvement of Water and Nitrogen Use Efficiency in Sugarcane Furrow Irrigation (Case Study in Dehkhoda Agro-Industry)

ABSTRACT

The aim of this study was to investigate the effects of split application and different rates of urea fertilizer on yield and some quantitative and qualitative attributes of furrow-irrigated sugarcane in 25 hectares of a new plant farm belonging to the Dehkhoda Sugarcane Agro-Industry Company. A split plots experiment was conducted as a randomized complete blocks design with three replications. The main factor was split application of fertilizer at three levels: two, three and four splits. Sub-main factor was different amounts of fertilizer used (i.e. 350, 280 and 210 kg urea corresponding to 100%, 80% and 60% fertilizer requirements, respectively). The results of this study showed that two splits treatment with 60% fertilizer level was the best treatment in terms of all quantitative and qualitative attributes and two splits treatment was the best treatment in terms of water use efficiency of sugarcane and white sugar and fertilizer use efficiency, which are 7.474 and 0.710 kg/m³ and 437.7 kg/kg urea, respectively. The coefficients of Kostiakov infiltration equation were derived through the volumetric balance model. Abbasi et al. E statistical index was greater than 0.990 for all fertigation treatments, indicating good performance of the model in predicting the advance and recession times. Comparison of the means for advance and recession times using T-test showed that T- statistic was less than 2.447 (i.e. critical T) for all treatments, indicating good performance of the model. In this study, the HYDRUS-1D model was used to simulate the moisture and nitrate transport in furrow irrigation of sugarcane. The results indicated that R² for simulated moisture content and nitrate concentration in four splits and 60% fertilizer requirement treatment (i.e. calibrated treatment) were 62.7 and 91.2 percent, respectively. Moreover, the amounts of RMSE, ME and SSQ were 0.338, 0.291 and 3.08 $\frac{cm^3}{cm^3}$, respectively. Soil moisture content amounts in the surface layer varied from 21 to 45 and 21 to 42 percent, for calibration and validation treatments, respectively while the changes in the deep layer moisture content were 33 to 38 percent, similarly for both treatments. In the study, AquaCrop model was used to simulate the performance, water use efficiency and soil moisture in the sugarcane field. The root mean square error (RMSE) and model efficiency coefficient (E) corresponding to the estimated yield and water use efficiency were 0.545 ton/ha and 0.99997, and 0.017 kg/m³ and 0.99862, respectively. It shows the good performance of the model. The model was able to simulate soil moisture values with acceptable accuracy. In the scenarios defined by the model AquaCrop, decreased by 10% to 40% of irrigation water intake caused a significant decrease in the yield of sugarcane was so reducing the amount of irrigation water in different treatments, reduced from 1% to 4% of the yield out.

Keywords: Fertigation, nitrogen, model. Abbasi et al., HYDRUS-1D model, AquaCrop model.



University of Zabol
Faculty of Water and Soil
Department of Water Engineering

Thesis Title:

**Optimization of Fertilizer Consumption and
Improvement of Water and Nitrogen Efficiency in
Sugarcane Furrow Irrigation (Case Study in
Dehkhoda Agro-Industry)**

Supervisors:

Dr. M. Delbari
Dr. F. Abbasi

Advisors:

Dr. P. Afrasiab
Dr. F. karandish

By:

Nader salamati

June 2015