

Comparing yield, nutritional quality, water and nitrogen use efficiencies of deficit drip and flood irrigated sorghum (*Sorghum bicolor*) and corn (*Zea mays*) subjected to different nitrogen rates

Brar R K.^{1,2*}, Frnzyan T.², Reyes-Solorio L.^{1,2}, Cassel S. F.^{1,2*}, Jacobson T², Muraka C.^{1,2}, Steinhauer K.^{1,2}, Robles, J², Venegas A.^{1,2}, Goorahoo D.^{1,2}, Mele A.^{1,2}, Garcia A.^{1,2}

¹ Department of Plant Science, California State University, Fresno, ²Center for Irrigation Technology, California State University, Fresno

*E-mail: brarramandeep@mail.fresnostate.edu; fcasselss@csufresno.edu

Abstract

Drought conditions have mandated that California growers use low quality groundwater resources for irrigation of forage crops. In the current study we compare the Nitrogen and Water Uses Efficiencies (NUE and WUE) of sorghum and corn grown under various irrigation regimes and N fertilization rates. Data from the 2019 growing season showed that N treatments affected corn yield but no N response was observed in the sorghum which showed a 30% increase in NUE compared to corn. The deficit irrigated (70% ET) treatments had significantly higher WUE compared to the fully irrigated treatments (100% ET) for both corn and sorghum.

Keywords: Sorghum, Corn, Nitrogen Use Efficiency (NUE), Water Use Efficiency (WUE).

1. Introduction and Objective

Historic droughts have forced California growers to rely on low quality ground water resources for irrigation. The sole reliance on well waters is not allowable; there is need to evaluate alternative efficient cropping systems. Corn (*Zea mays*) has been primarily used forage crop in dairy industry. However, studies have found that sorghum (*Sorghum bicolor*) and corn is more reliable option than corn due to its high tolerance to drought and salinity. Recent studies have evaluated sorghum's response to different irrigation rates based on cultivar (Hutmacher, 2016). To date, no research has been carried out on evaluating corn and sorghum with effects of irrigation and nitrogen (N).

The objective of our study was to evaluate the Nitrogen and Water Uses Efficiencies (NUE and WUE) of sorghum and corn grown under various irrigation regimes (drip, deficit drip and flood) and N fertilization rates.

2. Experimental Approach

The experimental design was a split-split plot with two crops (sorghum, corn) as a main factor and four replications of fertilizer N rate as the sub-treatment (0, 86.04, 168.13 and 252.19 kg N ha⁻¹) and irrigation as the sub-sub treatment (100%, 70% ET surface-drip, and 100% ET flood). Irrigation was scheduled using ET_o values obtained from a proximate CIMIS station (#80 Fresno State) and crop coefficients computed based on published FAO-56 values (Allen et al., 1998).

3. Results

Preliminary results from the 2019 growing season showed that crop and N treatments did have an effect on yield, and NUE. The sorghum had significantly higher yields than corn for all treatments at P = 0.05. Furthermore, the deficit irrigated (70% ET) treatments had significantly higher WUE compared to the fully irrigated treatments (100% ET) for both corn and sorghum. The sorghum crop had approximately an average of 30% increase in NUE compared to corn. The N treatments had

a significant effect on the corn yields at $P = 0.057$; however, no significant difference was observed for sorghum.

	CORN		SORGHUM	
Treatment	Yield	NUE	Yield	NUE
	(tons/ha)	(tons/ha/kg N)	(tons/ha)	(tons/ha/kg N)
86.04 kg/ha	45.22	0.526	61.28	0.712
168.13kg/ha	40.86	0.243	63.74	0.379
252.19 kg/ha	33.95	0.135	57.61	0.228

Fig.1-Table comparing the nitrogen use efficiencies of sorghum and corn subjected to different nitrogen rates.

4. Conclusion

These first-year results suggest that sorghum could outperform corn in terms of yield and efficiency. Crop nutritional analysis is currently being analysed to determine the effect, if any, of nitrogen and irrigation treatment on corn and sorghum quality. The experiment will be repeated next year to validate these findings.

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