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Effects of Deficit irrigation on Sugar Beet Production in the Northwest U.S.

Increased water demands and drought have resulted in a need to determine the impact of tillage and deficit water management practices in irrigated sugarbeet production. Two studies were conducted to assess these factors at the USDA-Agricultural Research Service, Northwest Irrigation and Soils Research Laboratory in Kimberly, ID on a Portneuf silt loam soil. Study 1 was conducted in 2012, 2013, and 2015. Treatments consisted of two tillage treatments (strip tillage [ST] and conventional tillage [CT]) and four water input treatments (approximately 100%, 75%, 50% and 25% of model estimated crop ET [ET_d]). Estimated recoverable sucrose (ERS) yield, root yield, and sucrose and brei nitrate concentrations were statistically the same for ST and CT across all water input levels. However, there was a significant tillage by water interaction for root yield in 2012. The significant interaction was a result of ST at the W3 (\approx 57% ET_d) water input level having a higher root yield (72 Mg ha⁻¹) compared to the CT treatment (63 Mg ha⁻¹). Water input had significant effects on ERS and root yields. In general, as water input increased, yields increased. Estimated recoverable sucrose and root yields in 2012, 2013, and 2015 were maximized at the ET_d rates of 75%, 97% and 58%, respectively. Data from this study supports the use of ST in sugarbeet production. This support is based on equal yield potential as compared to CT, tillage cost savings compared to CT, and agronomic and environmental benefits associated with increased soil surface residue. Study 2 was conducted in 2011, 2012, and 2016. The treatments consisted of end of season cumulative estimated crop evapotranspiration (ET_c) rates combined with irrigation application timing. Treatments were: (1) 100% even - 100% ET_c evenly throughout the growing season; (2) 60% even - 60% ET_c evenly throughout the growing season; (3) 60% early - 100% ET_c from emergence to end of June, 55% ET_c from end of June to harvest; (4) 60% late - rain-fed from emergence to end of July, 100% ET_c from end of July to harvest; (5) 35% even - 35% ET_c evenly throughout the growing season; (6) 35% early - 100% ET_c from emergence to end of June, 25% ET_c end of June to harvest; and (7) 35% Late - rain-fed from emergence to mid August, 100% ET_c from mid August to harvest, and (8) rain-fed - no post emergence irrigation. All ET_c percentages were based on crop needs without water stress. Results showed that under deficit irrigation, higher yields were obtained when water was applied evenly throughout the season (even treatments) or 100% of ET_c was applied early with deficit irrigation later in the season (early treatments). Sugarbeet with severe water stress early in the season (rain-fed) followed by 100% ET_c later (late treatments) had lower yield.