EVALUATION OF IRRIGATION WATER ALLOCATIONS UNDER DEFICIT IRRIGATION

David D. Tarkalson * and Bradley A. King
Northwest Soils and Irrigation Research Laboratory, USDA,
Agricultural Research Service, 3793 N. 3600 E., Twin Falls, ID 83301

Increased water demands and drought have resulted in a need to determine deficit water management practices in sugar beet production. This study was conducted in 2011 and 2012 at the USDA-ARS Northwest Irrigation and Soils Research Laboratory in Kimberly, ID. The climate at Kimberly is arid, with average annual precipitation and reference evapotranspiration of approximately 237 and 1443 mm, respectively. On average, about 36% of the annual precipitation occurs during the growing season, which extends from late April to mid October (Bureau of Reclamation AgriMet System, 2012). The soil at the experimental site is a Portneuf silt loam (coarse-silty mixed mesic Durixerollic Calciorthid). The experiment was conducted using a randomized complete block design with eight irrigation strategy treatments which were a combination of irrigation amount and irrigation timing, each replicated four times. Each experimental plot was 2.24 m wide × 12.19 m long, which accommodated four rows of sugarbeet. Irrigation treatments consist of end of season estimated cumulative ET water application rates of 100% (100% evenly throughout the growing season, **100% even**), 60% (60% evenly throughout the growing season; **60% even**), 60% (100% from emergence to end of June, 55% end of June to harvest; **60% early**), 60% (rain-fed from emergence to end of July, 100% end of July to harvest; **60% late**), 35% (35% evenly throughout the growing season; **35% even**), 35% (100% from emergence to end of June, 25% end of June to harvest; **35% early**), and 35% (rain-fed from emergence to mid August, 100% mid August to harvest; **35% late**) and rain-fed (no irrigation, 8% ET; **rain-fed**). Irrigation amounts were based on applying irrigation to supplement precipitation to match 100% crop ET, based on the 1982 Kimberly-Penman Reference Evapotranspiration Model (Wright, 1982) using data from an Agrimet weather station (U.S. Bureau of Reclamation, Boise, ID). Sugarbeet cultivar Betaseed 27RR10 was planted on May 2 in 2011 and 2012, respectively. The seeds for both years were treated with the insecticide Pancho Beta (60 g a.i. clothianidin and 8 g a.i. beta-cyfluthrin) per 100,000 seeds, and the fungicides Allegiance and Thiram. The crop was planted at 0.56 m row spacing at a seeding spacing of 76.2 mm. After planting, approximately 50 mm of water was uniformly applied to all plots using sprinklers to ensure even plant emergence. Following emergence, entire study area was thinned using hoes to reach plant populations of approximately 88,070 plants ha^{-1}. To meet treatment ET requirements, irrigation water was applied two times a week during the early and late periods of the growing season and three times a week during the middle of the growing season. Experimental plots were irrigated using a drip irrigation system that was installed immediately after sugarbeet emergence. The drip laterals were spaced every 0.56 m (every crop row in the plot) and were laid on the ground surface approximately 10 cm from the sugarbeet rows. Drip laterals were T-Tape (T-Systems) U.S. Model 508-06-670 with 8 mil thinwall dripperlines with emitters spaced every 15 cm and an inside diameter of 1.6 cm. The nominal flow of each emitter was 0.75 L h^{-1} at a nominal pressure of 55 kPa. Prior to entering the drip irrigation system, irrigation water was filtered using a FILTOMAT M100-750 hydraulic turbine self-cleaning filter (Amiad Filtration Systems). Irrigation water was supplied through a manifold instrumented with flowmeters, manual valves, and 70 kPa pressure

regulators installed in the supply line to each plot. Irrigation depths and timing to each plot were controlled manually. On October 14, 2011 and October 3, 2012, roots in the center two rows of each plot were counted and harvested. Total root yield was determined from each plot using a load cell-scale mounted on the plot harvester. From each plot, two-8 root samples were collected and sent to the Amalgamated Sugar Co. Tare lab for analysis of percent sugar and impurities. Analysis of variance and separation of means by the least significant difference method was conducted using Statistix 8 (Analytical Software, 2003). Significance was determined at the 0.05 probability level. Results show that when deficit water inputs are applied, it is better to apply the water evenly throughout the season (even treatments) or supply 100% of ETc early then deficit irrigate later in the season (early treatments). Sugar beet with severe water stress early in the season (rain-fed) followed by 100% ETc later (late treatments) did not result in recovered yield potential.

References

Wright, J.L. 1982. New evapotranspiration crop coefficients. Journal of Irrigation and Drainage Division, Proceedings of the ASCE 108:57-74.