COTTON YIELD AND WATER USE REPONSE TO VARIABLE IRRIGATION RATE AND TIMING

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Abstract

Irrigated agriculture in the Arizona low desert faces multiple threats, including drought in the Colorado River basin, depletion of reservoirs supplying water to irrigation districts, competition from growing municipal and industrial sectors, and climate uncertainty. Improving irrigation water use efficiency is imperative for sustaining agricultural production in the region. The objective of the study was to measure responses of cotton yield, water use efficiency, and fiber quality to variable irrigation rates and timings for the 2016, 2017, and 2018 cotton growing seasons at Maricopa, Arizona. Four irrigation rates were used, including 60%, 80%, 100%, and 120% of recommended amounts from a scheduling tool. The four rates were administered differentially during two time periods: 1) squaring to peak bloom and 2) peak bloom to 90% open boll. The experimental design incorporated 16 irrigation treatments in a randomized block design with four replications, and irrigation was applied via an overhead lateral-move sprinkler system with commercial site-specific irrigation equipment. Linear mixed models could estimate cotton fiber yield, seasonal evapotranspiration, fiber micronaire, and fiber strength with root mean squared errors of cross validation (RMSECV) of 11.9%, 1.8%, 6.4%, and 3.6%, respectively. Variation in irrigation water use efficiency and several fiber quality metrics could be explained by water applied in the second irrigation period but not in the first, suggesting more opportunity in the early season for improving water use efficiency without sacrificing yield or fiber quality. Irrigation rates in the first period could be reduced up to 70 mm (6% of total water applied to the 100%-100% treatment) without sacrificing yield. During the second irrigation period, full irrigation was required to prevent yield losses and maintain high fiber quality. This study provides valuable guidance on opportunities for using sprinkler irrigation to improve water use efficiency while maintaining acceptable cotton yield and fiber quality in the Arizona low desert. Further effort is needed to clarify requirements for pre-plant irrigation, incorporate plant feedback data into in-season irrigation scheduling algorithms, and identify metrics to guide irrigation termination decisions.