INTRODUCTION

Cotton is a relatively new crop to producers of Southwest Kansas. Irrigation practices designed to maximize corn yields have evolved with a long history of corn production. Typically, good conditions after emergence lead to the formation of an adequate number of squares to obtain maximum yield potentials for the available thermal units. However, as the season progresses and corn water demands increase, producers have been reluctant to divert irrigation water to cotton, typically resulting in the abortion of squares, and thus yield potential. This study was designed to evaluate crop response to applied irrigation, and the partitioning and timing of water in corn-cotton systems under simulated irrigation capacity constraints.

MATERIALS AND METHODS

The study was conducted from 2011 to 2015 on a producer field near Moscow in Stevens County, Kansas. The soil was mapped as a Zella loam with 0 to 1 percent slopes. This is a well drained soil formed from silty and clayey loess and is capable of holding 2 inches of plant available water per foot of depth.

An advisory committee of producers and crop consultants assisted in developing the irrigation strategies. Three irrigation capacities were simulated for full season irrigation of corn and cotton: 1.9, 2.7, and 3.8 gpm ac⁻¹. Additional paired treatments constrained the use of water to either the corn or cotton during any given time period. This was to simulate fields split in half, or multiple irrigation systems sharing a common water supply. Two capacities, 3 and 4.5 gpm ac⁻¹, were simulated to provide full season irrigation of the crop except for targeted applications to cotton at match-head square (MHS), bloom, or both. All irrigation applications were targeted to a depth of 1 inch. Pre-season irrigation applications were made as needed to mimic producer actions with a general target of 50-60% ASW in the profile at planting. All treatments (including the dryland cotton treatment) received a minimum of 1 inch after planting to ensure uniform germination and emergence.

The study was conducted using spring strip-tillage in the context of a corn-cotton rotation. Treatments were arranged in a split-plot design with four replications. Rotation phase (corn or cotton) was the whole-plot treatment with irrigation strategy assigned to the split-plots. Plots measured 10 by 40 ft. Irrigation was applied using pressure compensated drip tape placed on the soil surface approximately 4-6 inches to the side of the planted row. The drip tape was designed with an emitter flow rate of 1.32 gallons hr⁻¹ and an emitter spacing of 7.6 inches. This configuration simulates the area-weighted mean application rate under a standard 132 ac center-pivot nozzleled at 500 GPM.

Corn (Pioneer 35F40, 2011-2012; Pioneer P1151AMX, 2013-2015) and Cotton (NexGen NG1551RF, 2011-2014; NG1572, 2015) were typically seeded the third or fourth week of May at average rates of 29,500 and 64,000 seeds ac⁻¹ respectively. Fertilizer was applied during the spring strip-till operation to ensure non-limiting levels for crop growth and yield formation. The center two rows were machine harvested for grain and lint yield. Corn yield components were calculated and cotton fiber quality was analyzed with HVI.

RESULTS AND DISCUSSION

A wide range of climatic conditions were experienced during the course of the study. In-season precipitation (Figure 1) set record lows during the 2011 and 2012 seasons, and was well above average in 2015. Cumulative heat units were above normal in all years of the study (Figure 2), playing an important role in maximizing cotton yield potential and maintaining fiber quality in a traditionally thermally limited environment. The duration of the irrigation season, and thus applied irrigation amounts, remained fairly consistent throughout the study duration (Table 1).

The dry conditions greatly affected corn grain yields, with several of the treatments failing to produce grain in 2012 (Table 2). In general, corn grain yields increased with increasing irrigation level. Of the paired treatments, corn irrigated at 3 gpm ac⁻¹ produced the lowest grain yields regardless if 1 or 2 inches was removed for cotton irrigation. Corn irrigated at 4.5 gpm ac⁻¹ performed similarly and generally produced the highest yields in the study, regardless if 1 or 2 inches of irrigation was removed for targeted application to the cotton.