ARE OTHER CROPS BETTER THAN CORN UNDER LIMITED IRRIGATION?

Alan Schlegel, Agronomist
Loyd Stone, Soil Physicist
Troy Dumler, Extension Economist
Kansas State University
SWREC-Tribune, KS
Voice: 620-376-4761 Fax: 620-376-2278
Email:schlegel@ksu.edu

ABSTRACT

Research was initiated under sprinkler irrigation to compare limited irrigation of corn with three other summer crops (grain sorghum, soybean, and sunflower) grown under no-till practices. Corn responded the most to increased irrigation. Because of changes in growing conditions, the crop that is most profitable changes from year-to-year. Growing different crops when irrigation is limited can reduce risk and increase profitability. Averaged across the past 8 years, corn has been the most profitable crop at higher irrigation amounts, while at the lowest irrigation level, profitability was similar for all crops.

INTRODUCTION

Most groundwater pumped from the High Plains (Ogallala) Aquifer in western Kansas is used for irrigation, with corn being the predominant crop. Groundwater withdrawal from the aquifer has reduced saturated thickness and well capacities. While corn responds well to irrigation, it also requires substantial amounts of water to maximize production. Therefore, there is increased interest in reducing the amount of irrigation, and increased questions on whether crops other than corn would make more profitable use of limited amounts of irrigation.

MATERIALS AND METHODS

A study was initiated under sprinkler irrigation at the Tribune Unit, Southwest Research-Extension Center near Tribune in the spring of 2001. The objectives were to determine the impact of limited irrigation on grain yield, water use, and profitability of several summer row crops. Irrigation amounts were 5, 10, and 15 inches annually. Irrigations were scheduled to supply water at the most critical stress periods for the specific crops and limited to 1.5 inches/week. All water levels were present each year and replicated four times. The irrigation amounts for a particular plot remain constant throughout the study regardless of crop. The

crops evaluated were corn, grain sorghum, soybean, and sunflower (a total of 12 treatments). The crop rotation was corn-sunflower-grain sorghum-soybean (alternating grass and broadleaf crops). All crops were grown no-till while other cultural practices (hybrid selection, fertility practices, weed control, etc.) were selected to optimize production. Seeding rate (seeds/acre) was 30,000 for corn, 80,000 for grain sorghum, 150,000 for soybean, and 23,500 for sunflower. Soil water was measured at planting, during the growing season, and at harvest in one-ft increments to a depth of 8 ft by neutron attenuation. The center four rows of each plot were machine harvested after physiological maturity with yields adjusted to 15.5% moisture for corn, 10% moisture for sunflower, and 12.5% moisture for grain sorghum and soybean. An economic analysis determined economic returns to land, management, and irrigation equipment for all crops and irrigation amounts. Custom rates were used to determine machinery operation costs. The costs of inputs (seed, fertilizer, herbicide, etc.) were based on individual year costs for the area and grain prices were harvest prices for the area. No government program payments or crop insurance costs or proceeds were included in the analyses.

RESULTS

Summer precipitation was near normal when averaged across the 8-yr period (Fig. 1). However, there were considerable differences among years. June precipitation ranged from about 1 inch to more than 5 inches. Similar variation was observed in the other months.

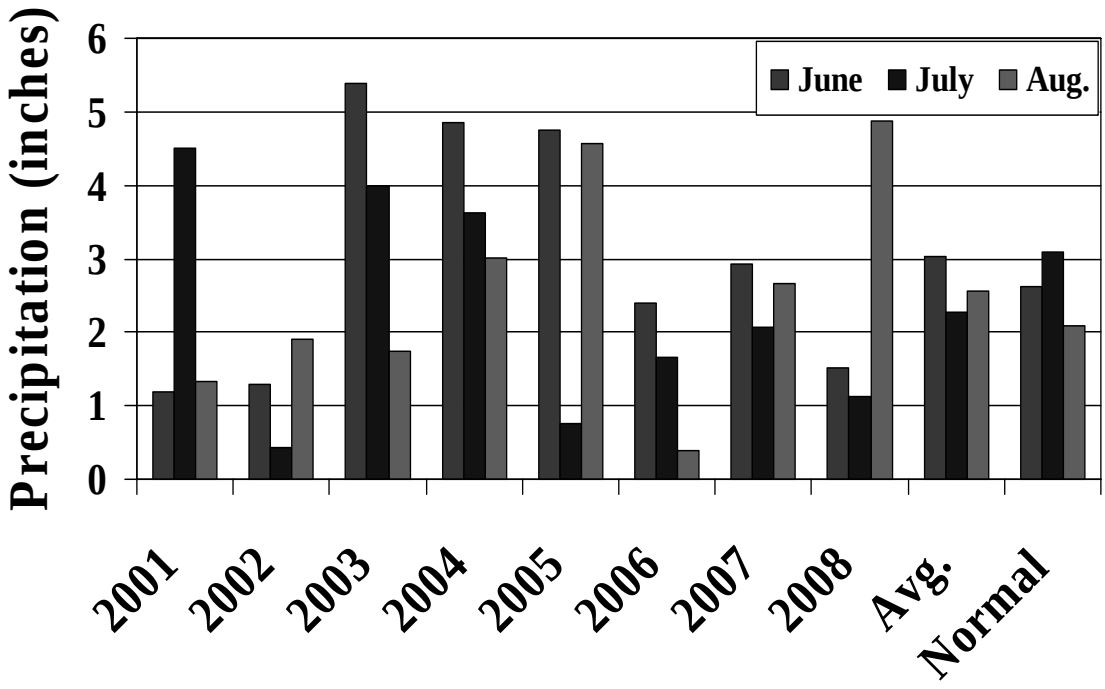

Figure 1. Summer precipitation at SWREC-Tribune Irrigation Field, 2001-2008.

Available soil water in the profile (8 ft) at planting was affected more by irrigation amount rather than crop (Fig. 2). With 5-in of irrigation, profile available water ranged from 6.5 to 8 inches. While with greater irrigation amounts profile available water was 10 to 11 inches regardless of crop.

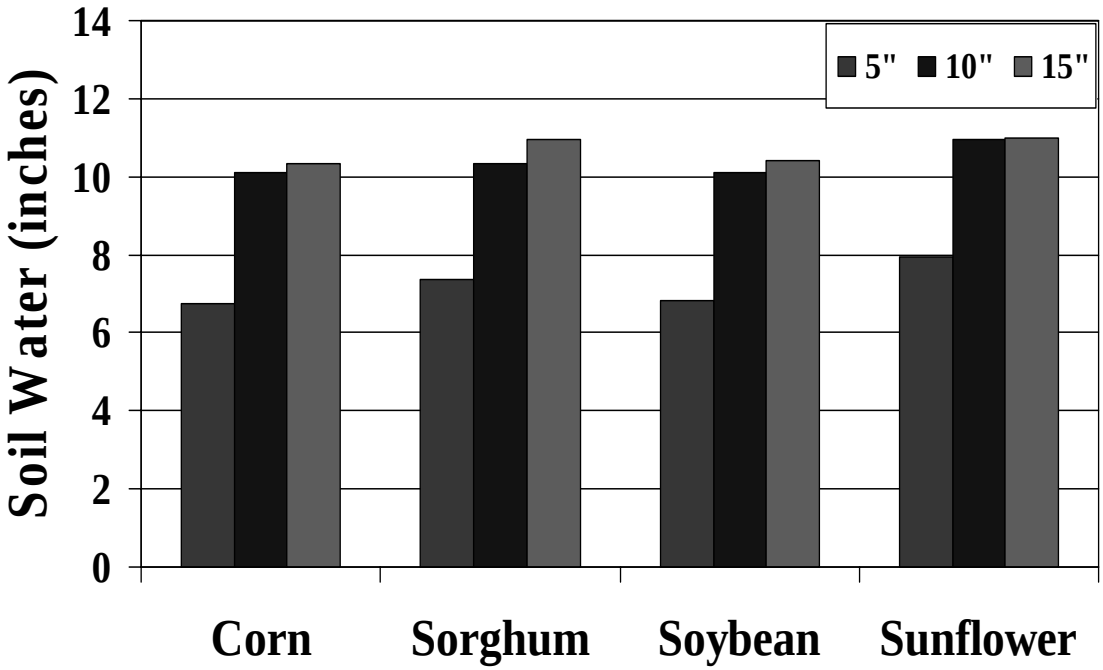

Figure 2. Available soil water at planting for four summer crops under varying irrigation levels. SWREC-Tribune, 2001-2008.

Profile available soil water at harvest was about 4 inches for all crops receiving 5 inches of irrigation (Fig. 3). With 10 inches or more of irrigation, profile available soil water at harvest was 8 to 10 inches for all crops.

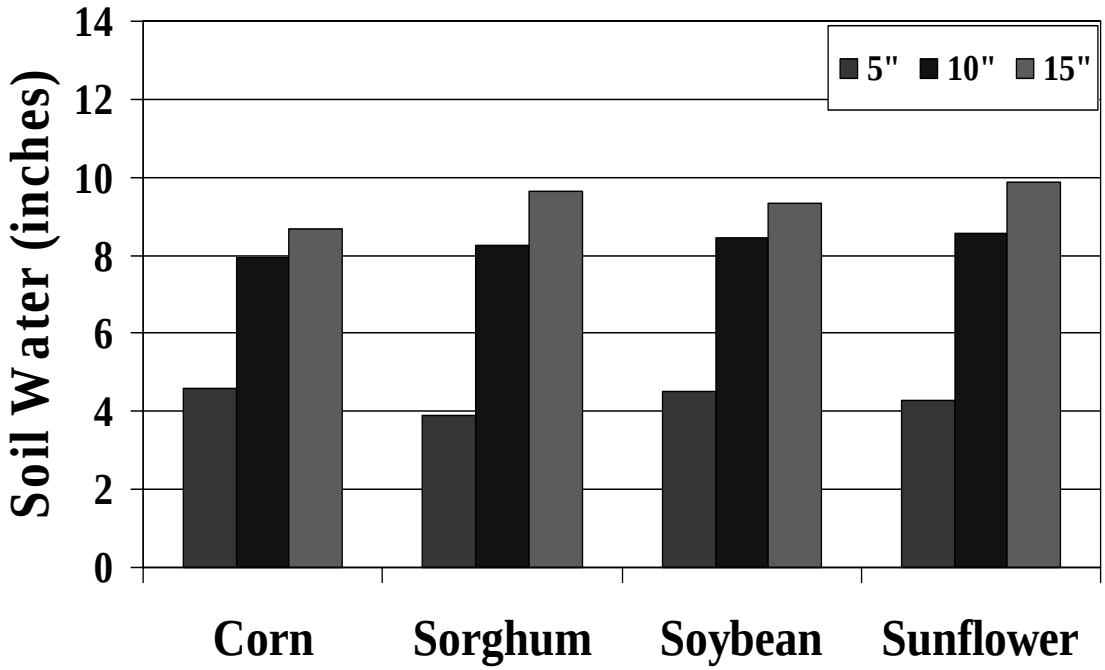

Figure 3. Available soil water at harvest for four summer crops under varying irrigation levels. SWREC-Tribune, 2001-2008.

Crop water use was more affected by irrigation amount rather than crop (Fig. 4). At higher irrigation levels, crop water use tended to be slightly greater with corn and least with sunflower.

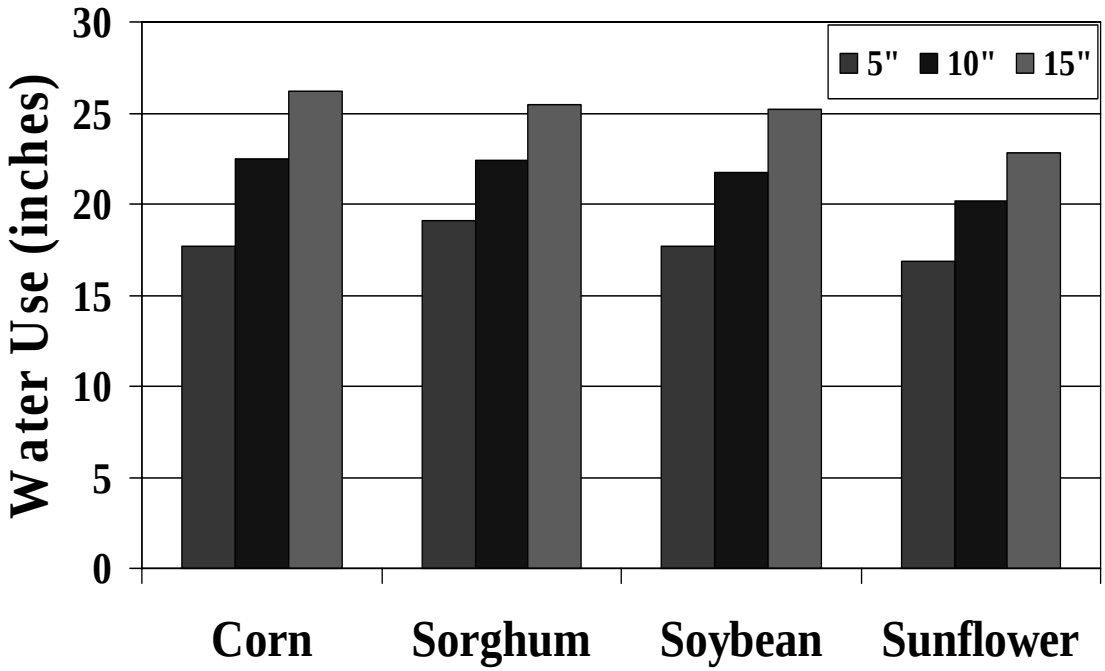

Figure 4. Crop water use for four summer crops under varying irrigation levels. SWREC-Tribune, 2001-2008.

Water use efficiency (WUE) was greater with feed grains than oilseed crops (Fig. 5). For feed grains, corn made more efficient use of water than did grain sorghum. Corn was also the only crop that had higher WUE with 10 inches of irrigation than with 5 inches of irrigation. For all other crops, WUE was similar for all irrigation amounts.

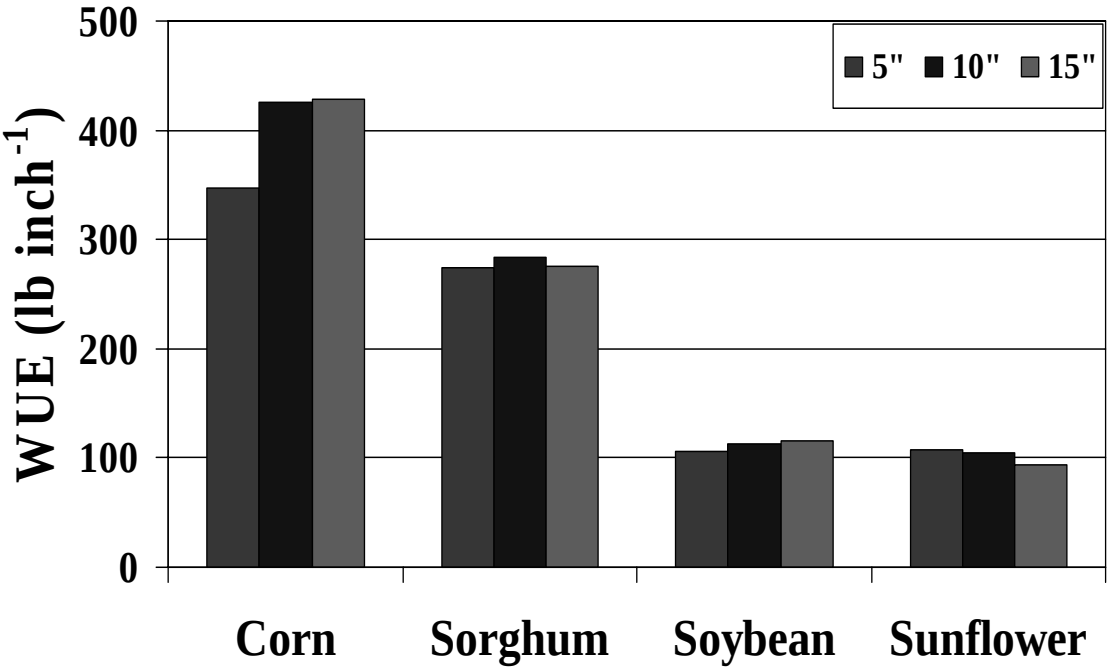

Figure 5. Water use efficiency for four summer crops under varying irrigation levels. SWREC-Tribune, 2001-2008.

Average grain yields (2001-2008) of all crops responded positively to increased irrigation (Table 1). When irrigation was increased from 5 inches to 10 inches, yield increases were 52% for corn, 18% for sorghum, 35% for soybean, and 16% for sunflower. When irrigation amounts were increased past 10 inches, yield increases were 17% for corn, 11% for sorghum, 12% for soybean and only 4% for sunflower. Corn yields increased 78% when irrigation was increased from 5 inches up to 15 inches while grain sorghum increased 31%, soybean by 52%, and sunflower by 20%.

Table 1. Average grain yield (2001-2008) of four crops as affected by irrigation amount, SWREC-Tribune, KS.

Irrigation amount	Corn	Grain sorghum	Soybean	Sunflower
acre-inch	- - - - - - - - - -bu/acre - - - - - - - - -			lb/acre
5	113	94	31	1800
10	172	111	42	2080
15	201	123	47	2160

An economic analysis (based on October grain prices each year and input costs from each year) found that at the lowest irrigation level, average net returns (2001-2008) were similar for all crops (Fig. 6). At the higher irrigation levels, corn was the more profitable crop. Corn was the only crop where profitability increased appreciably with more than 10 inches of irrigation.

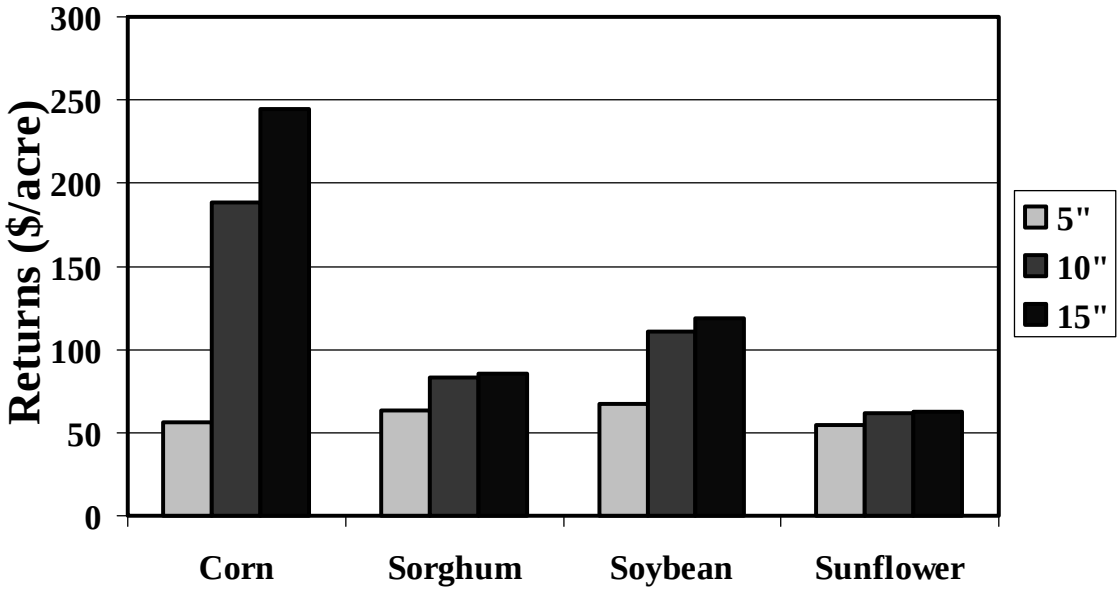

Figure 6. Average (2001-2008) net returns to land, management, and irrigation equipment, SWREC-Tribune, KS.

CONCLUSIONS

With very limited amounts of irrigation, there are several crops (grain sorghum, soybean, and sunflower) that can be grown that are as profitable as corn. These crops may also provide additional benefits in breaking pest cycles (weed, insect,

and disease) that can arise with production of continuous corn. However, when irrigation amounts of 10 inches or more annually are available, corn is the most profitable crop.

Acknowledgement: Project supported in part by Kansas Corn, Grain Sorghum, and Soybean Commissions, Groundwater Management District #1, and the Ogallala Aquifer Program.