

# **Drought Tolerant Corn Hybrids as a way of Increasing Water Use Efficiency**

PROGRESS REPORT

Project Number: 2011TX390B

Primary Investigator: Jacob Becker

Other Investigators: Brent Bean, Brock Blaser

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### **Abstract**

Texas corn producers are able to obtain corn yields that rival that of any region in the world. Without irrigation from the declining Ogallala aquifer, these yields would not be possible. Over the past 50 years, tremendous advances have been made in improving irrigation efficiency. However, many producers are turning to limited irrigation, because of the dwindling water supply and implemented water pumping restrictions from regional water authorities. Irrigation application, planting population and hybrid selection can all play important roles in determining water use efficiency (WUE). Two separate studies were planted in 2011 at the North Plains Research Field (NPRF) in Etter, TX, comparing the first generation drought tolerant hybrid corn technologies from Pioneer and Syngenta. Irrigation rates were set at 100%, 75%, 50% and 40% of evapotranspiration (ET). A low, medium and high population was selected for each company. The highest water use efficiency (WUE) was observed at 75% ET with 40,000 seeds acre<sup>-1</sup> at 8.64 bushels acre<sup>-1</sup> inch<sup>-1</sup> of total water. Population effects were related to hybrids and irrigation level. In general, the commercially available drought tolerant hybrids showed an increase in yield over the check hybrids at lower water levels. Pollination also improved with a drought tolerant hybrid in the 50% and 40% irrigation levels when compared with a check. 2011 was an exceptional year of drought and heat in the Southern High Plains. This should be taken into consideration when interpreting these results.

### **Problem and Research Objectives**

The Southern High Plains sits at the Southern edge of the largest aquifer system in the world. The Ogallala aquifer is a confined aquifer that can vary in water depth from 0 to 1200 feet. With above ground municipal water supplies falling to all-time lows, cities are looking towards the aquifer to meet their needs. With agriculture pumping approximately 70% of the water out of the aquifer, increased pressure will be continually placed on producers to limit their water use. Water restrictions placed on producers or a dwindling water supply would be detrimental

to a major cropping system in the Southern High Plains. Corn is a major irrigated crop in the Texas Panhandle. With producers' water supply becoming more limiting year after year, WUE must be increased to conserve water in the Ogallala while maintaining a sustainable cropping system that includes corn.

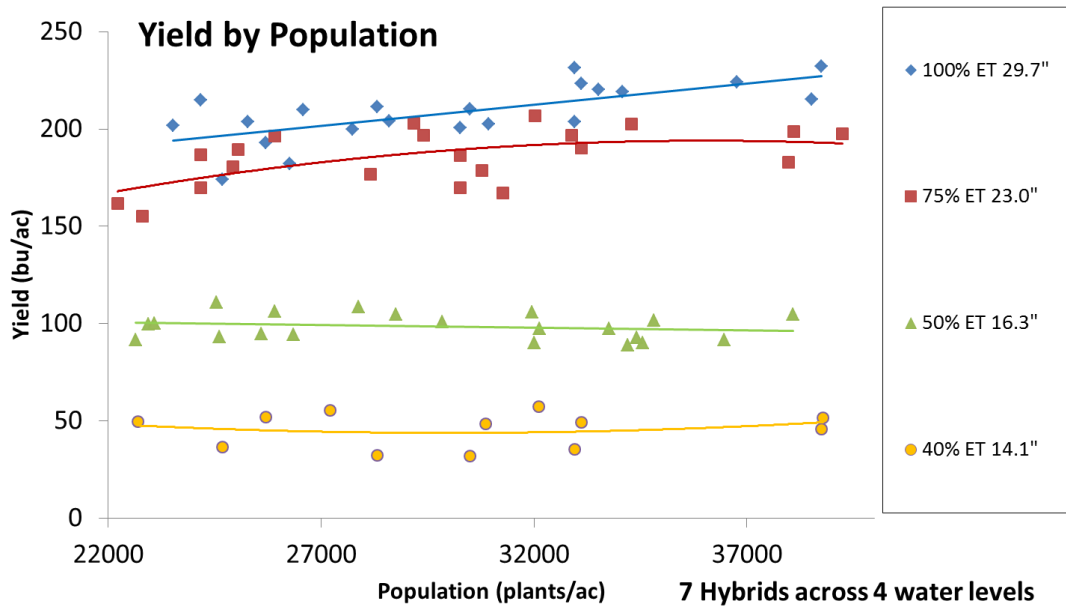
These studies were meant to examine corn hybrids at varying irrigation levels, seeding rates and hybrids to determine the water use efficiency. This data will ultimately be used by producers in the Southern High Plains to make production decisions about full and limited irrigated corn by applying production functions created from this research.

### **Materials/Methodology**

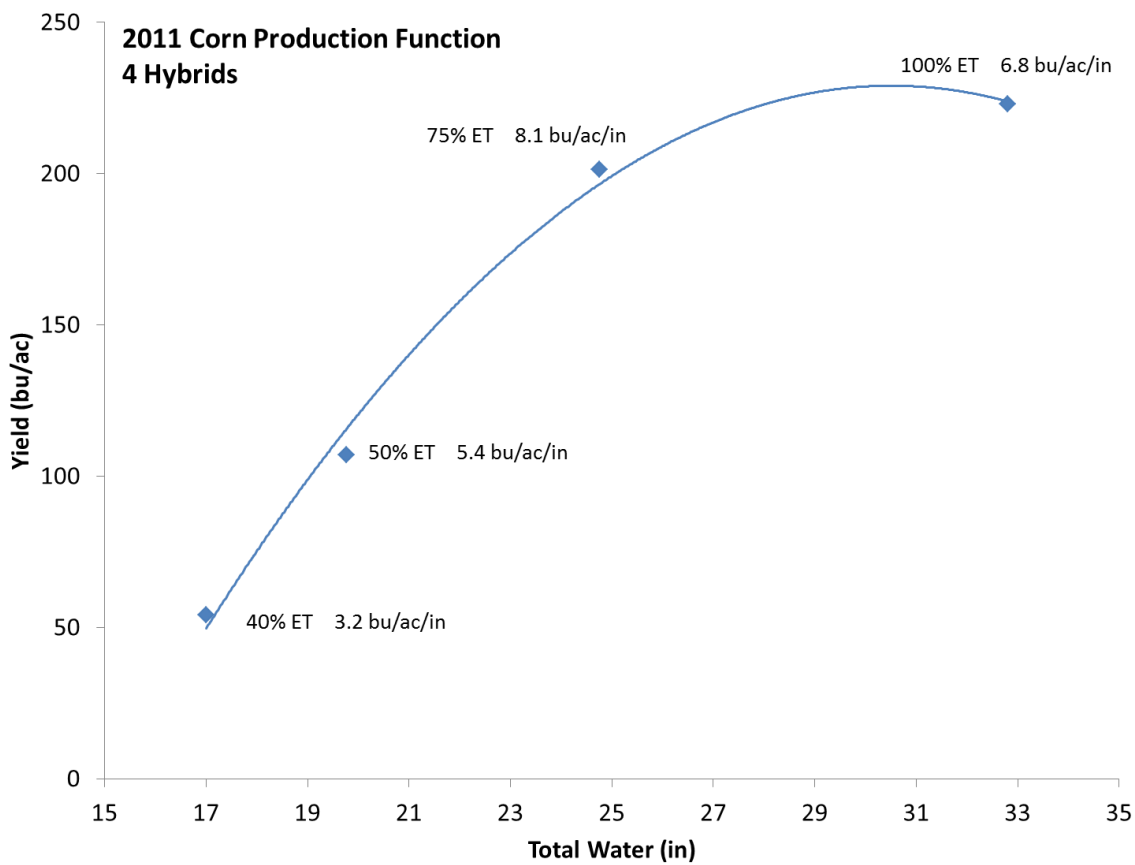
Research was primarily conducted at the North Plains Research Field (NPRF) in Etter, TX (approximately 60 miles north of Amarillo, TX). Four irrigation levels were set at 100%, 75%, 50% and 40% of evapotranspiration (ET). 29.7, 23.0, 16.3 and 14.1 inches of water were applied in the four irrigation levels, respectively. Three seeding rates were planted under each irrigation level (low, medium and high), with four hybrids from each company (Pioneer and Syngenta). Pioneer provided three drought tolerant hybrids and one check hybrid. Syngenta provided one drought tolerant hybrid and three check hybrids. Plots were 10 feet wide and 40 feet long. Four replications of the Pioneer treatments were used and six replications of the Syngenta treatments were planted. Soil moisture was determined from core samples taken prior to planting and post-harvest. Irrigation scheduling was determined by using the Texas High Plains ET Network and plots were irrigated when soil moisture fell below 50% of plant available water (PAW) in the 100% ET irrigation level. Yields and grain moisture were determined by a Massey 8XP small plot combine with Alamco weigh scales. Biomass samples were harvested immediately after harvest, and then dried to determine biomass for harvest index (HI) calculations.

### **Principal Findings**

- Surprisingly, all eight hybrids produced grain at the high population and lowest irrigation level (40% ET)
- Maximum water use efficiency (WUE) was observed at 75% ET with 40,000 seeds acre<sup>-1</sup> at 8.64 bushels acre<sup>-1</sup> inch<sup>-1</sup> of total water. This supports previous research, that 75% ET has the highest WUE.
- Yield by population interactions were very much hybrid dependent. Complex interactions exist between water level, hybrid and yield exist in relation to plant population.



**Figure 1.** Yield by population across both trials



**Figure 2.** 2011 Production function. Notice steep curve at low water levels. Total water includes irrigation, soil water and rainfall.

- Yields were similar at low populations when comparing 100% and 75% ET irrigation levels (Fig. 1). This was caused by ears filling to the tip (maximum yield potential) at each water level.
- The production function is very steep at low water levels. At 40% ET, yields averaged 50 bushels per acre. At 50% ET, yields averaged 100 bushels per acre. There was only two inches difference in irrigation water and 50 bushels per acre difference in yield.
- In general, the drought tolerant hybrids did a better job pollenating and out yielded the check hybrids at lower irrigation levels.

### **Significance**

The results of these studies provide the information necessary for understanding newly released hybrids and their relationship with irrigation water and plant population. Moving forward, limited irrigated corn will become a more normal production practice than fully irrigated corn. Results, such as these, can be used by regional producers and water districts on establishing obtainable yield goals with a set amount of irrigation water to pump. Drought tolerant corn hybrids will, without doubt, play a big role in producers' future production practices. All results from this study should keep in mind that the Texas Panhandle experienced exceptional drought and heat when this study was taking place.