2011 Pioneer Optimum® AQUAmax™ First Generation Drought Tolerant Corn Trial Progress Report

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Introduction

2011 was the first year of commercially available drought tolerant corn research at the Texas AgriLife Research Station in Etter, TX, located approximately 10 miles north of Dumas, TX. The objective of this trial was to determine if Pioneer's Aquamax hybrids produced significantly more grain under drought stressed conditions than check hybrids, and to examine how this technology performed in the High Plains of Texas.

Materials and Methods

The trial consisted of one commercial check hybrid and three Aquamax hybrids (Table 1). These hybrids were planted at three seeding rates under 4 irrigation levels with 4 replications. Entries were planted under a center pivot irrigation system on 30-inch raised beds. Treatments were blocked across the length of the pivot by replication, in case of an equipment breakdown. Irrigation scheduling was determined by a water loss equation developed by Thomas Marek, Texas AgriLife Research Irrigation Engineer, which accounts for evapotranspiration (ET or water use), and calculates the amount of plant available water in the profile. Irrigation rates were set at 100% 75% 50% and 40% ET. Because of limited space, the 40% ET rate had only one check hybrid and one Aquamax hybrid. Total irrigation amounts can be found below in Table 2. All plots were irrigated when soil water in the 100% ET treatment dropped to 50% plant available water. Irrigation amounts were varied across ET levels by using different output nozzles in different spans of the pivot. On the first two irrigation applications, all ET levels were watered at 100% irrigation to assure adequate germination and emergence. In addition,

Table 1. Hybrids and Maturity

Hybrid	Relative Maturity
Check – P33D49	115
P1151HR	111
P1324HR	113
P1498HR	114

Table 2. Irrigation Levels

ET Level	Inches of Irrigation
100%	29.7
75%	23.0
50%	16.3
40%	14.1

AquaSpy sensors were installed in the 100% and 75% ET levels to monitor relative soil water throughout the season. Climate data is illustrated in Figure 1. An unprecedented drought in the High Plains of Texas provided little effective rainfall to the crop. Only three rainfall events of over 0.5 inch were observed from planting until harvest. In addition, temperatures were also above normal much of

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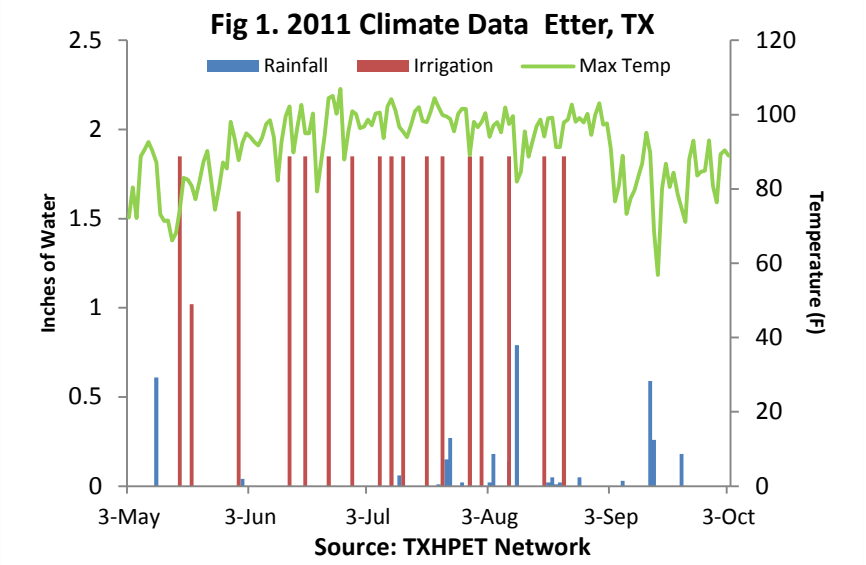
the growing season with 30 days of over 100°F. A total of 1.86" was applied at each irrigation to the 100% ET span. This allowed for 0.93" to still be applied to the 50% ET to allow for better water infiltration and to minimize evaporative losses while keeping runoff at the 100% ET to a minimum.

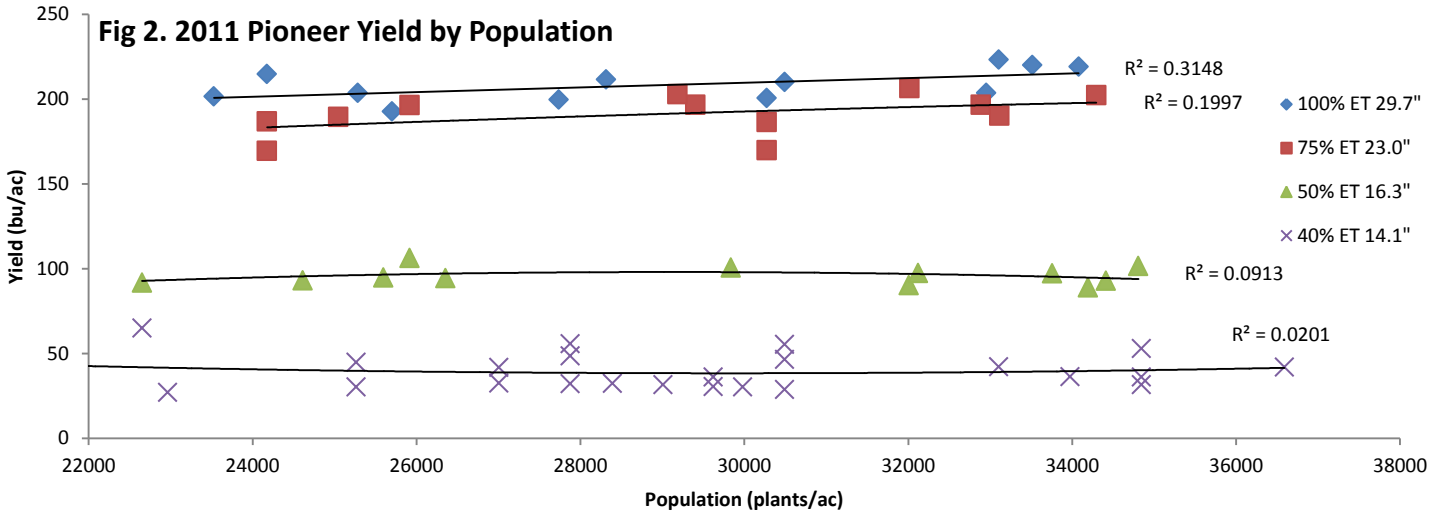


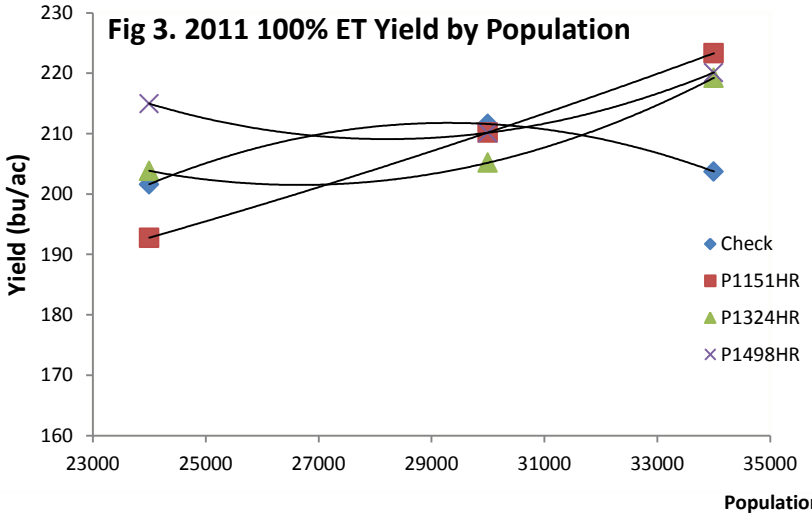
Other cultural practices and study information are listed below:

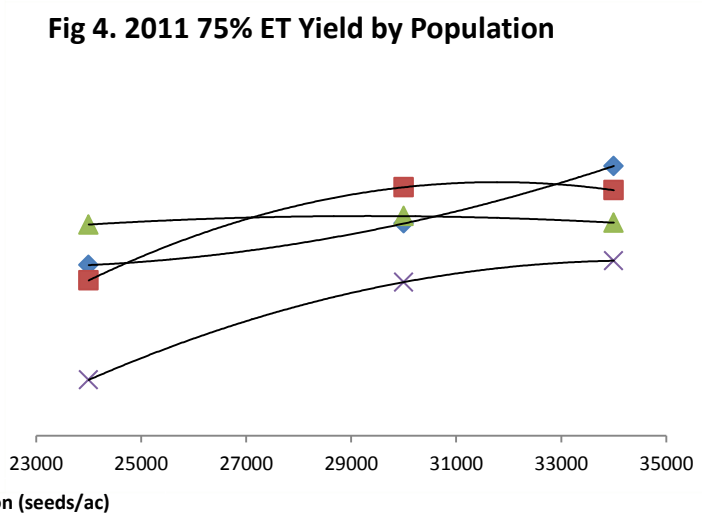
Trial Location:	Etter, TX approximately 10 miles north of Dumas, TX
Previous Crop:	Wheat
Soil Type:	Sherm Clay Loam, pH = 7.5
Plot Size:	Four, 30 inch bedded rows by 35 foot long
Replications:	4
Study Design:	Randomized complete block
Planting Date:	May 3, 2011
Planting Rate:	24,000 30,000 34,000 sd/ac
Seed Method:	John Deere Max-Emerge planter with Almaco seed cones
Fertilizer:	Applied 300 lb/acre N and 100 lb/acre P_2O_5 preplant based on soil test results
Herbicide:	Bicep Lite immediately after planting. Status for bindweed control One aerial application of Oberon and Onager for spider mite control
Irrigation:	Center Pivot Irrigation. Amounts listed in Table 1

Results and Discussion

No lodging or disease was observed in the trial. Yield by population data can be seen in Fig 2. In general, a positive correlation was observed between population and yield at the 100% and 75% ET levels. Surprisingly, not much difference in yield between 100% and 75% ET is evident. Perhaps populations were not pushed high enough in the 100% ET level to show an overall difference. At the low ET levels no response to increasing plant population was observed when averaged across hybrids however, a water x population x hybrid interaction was significant (Table 3). When the response of individual hybrids to seeding rate and irrigation level is examined, many differences can be observed. At the 100% ET level, every Aquamax hybrid responded to increasing populations with P1151HR showing a nearly linear response to population increases (Fig 3). Undoubtedly, this hybrid has a population plateau, but it is probably higher than 34,000 seeds/ac under 100% ET. The check hybrid appeared to obtain maximum yield at 30,000 seeds/ac.





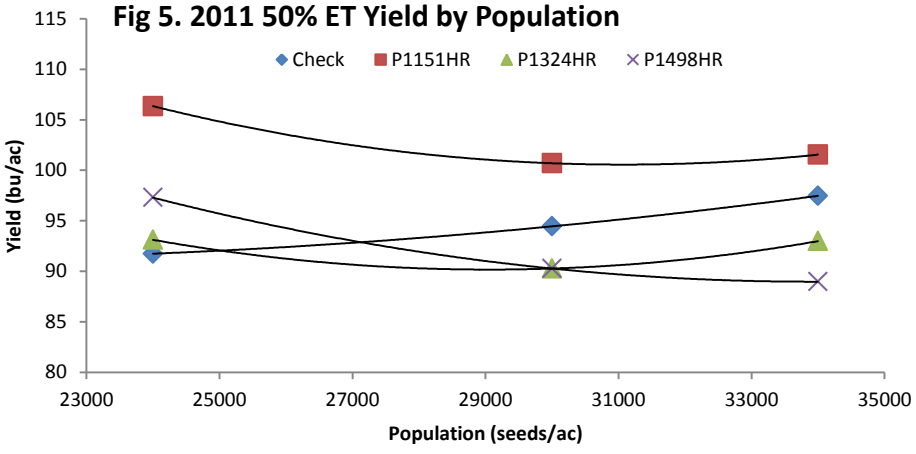


Population (seeds/ac)

At the 75% ET level, the P1324HR hybrid yield response to population was flat, yielding approximately 197 bu/ac at all seeding rates (Fig 4). However, the other three hybrids had significantly lower yields at the 24,000 seed/ac compared to 30,000 and 34,000 seed/ac. P1151HR hybrid plateaued at 32,000 seed/ac with a yield of 203 bu/ac. P1498HR's yield is substantially lower at 75% when compared to the 100% ET (Fig 3 and 4). This might be caused by ear tip dieback at pollination (Pic 1). Therefore, more ears were needed (higher population)

Table 3. Factorial AOV

	Grain Yield (bu/ac)		ET (in)	WUE (bu/ac/in)
	Prob(F)	LSD	Prob(F)	Prob(F)
Replication	0.3267	NS	0.0001	0.0002
Water Level	0.0001	4.23	0.0001	0.0001
Population	0.0003	4.23	0.0808	0.0099
Water x Pop	0.0281	7.32	0.5329	0.0861
Hybrid	0.0122	4.88	0.5433	0.1007
Water x Hybrid	0.0114	8.47	0.1808	0.1288
Pop x Hybrid	0.025	8.45	0.92	0.3492
Water x Pop x Hybird	0.0054	14.65	0.8984	0.3334



to reach its maximum yield at 75% ET.

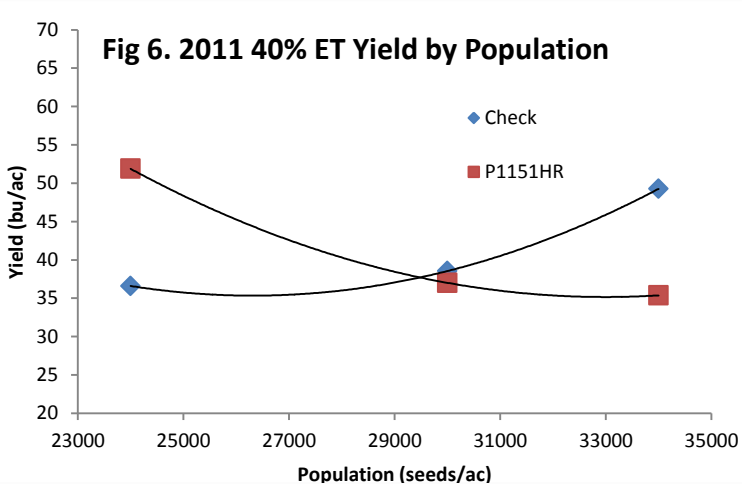
P1151HR significantly out yielded all hybrids in the 50% and 40% ET levels at the lowest population (24,000 seeds/ac) (Fig 5 and 6). This hybrid's general yield trend is down with an increasing population, although this is not significant. The hybrid appears to be very versatile, yielding well at low and high irrigation levels. It is interesting to note that the check hybrid increased in yield with increasing seeding rate in contrast to the Aquamax hybrids.

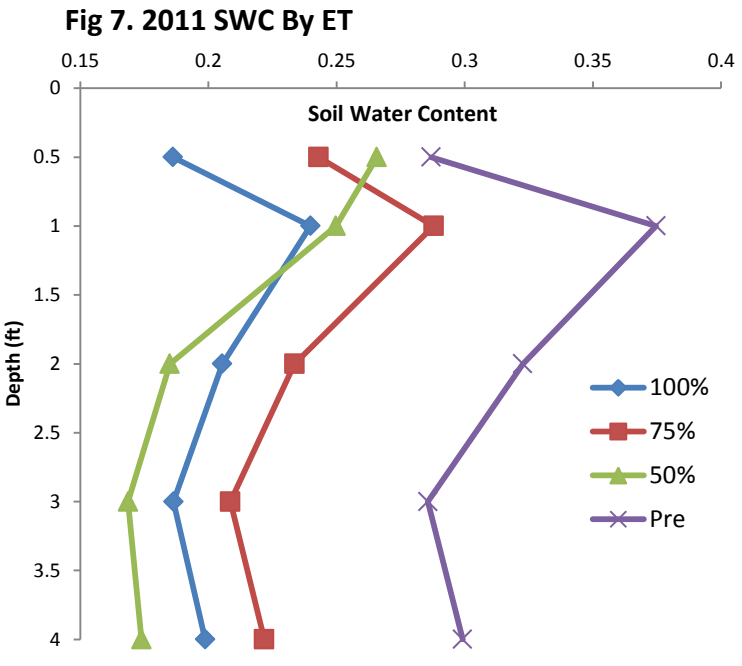
Soil samples were collected at the beginning and end of the season for water content. Post-harvest volumetric water samples can be seen in Fig. 7 averaged across ET levels. 100% and 75% ET have the same relative amount of water at depth in the profile. 100% ET plots used slightly more water possibly because the plants were larger in the 100% ET level and required more water late in the season. The 50% ET level extracted almost all the plant available water below 2 feet in the profile.

Hybrid and population differences in yield relating to total water used (ET) are shown in Table 4. No soil samples were taken at the 40% irrigation level, therefore no water use efficiency (WUE) data is reported. The 75% ET level was the most efficient across all hybrids. P1151HR showed the highest WUE across all irrigation levels when compared to other hybrids.

Yields and WUE from all treatments are reported in Table 4. Other comparisons

Pic 1. P1498HR at 30,000 sd/ac. 75% ET left and 100% ET right. Illustrating tip dieback.





not discussed here can be made by using information from Tables 3 and 4.

Conclusions*

- Aquamax P1151 was the highest yielding hybrid at the 40% and 50% ET irrigation levels and yielded as well as the check hybrid when irrigated at 75% and 100% ET.
- Seeding rates in this study may not have been high enough at the 100% ET level to maximize the yields of the Aquamax hybrids.
- At the 50% ET level, the Aquamax hybrids yields were highest at 24,000 seed/ac with yields trending down as seeding rate increased. This is in contrast to the check hybrid whose yield trended upward as seeding rate increased. These trends were also evident at the 40% ET level.
- ***All conclusions made from this study should keep in mind that in 2011 the Texas High Plains experienced the highest temperatures and the most severe drought on record. Clearly these conditions impacted the results of this study. This trial will be repeated in 2012, hopefully under more normal climatic conditions.**

Table 4. 2011 Pioneer Aquamax Drought Tolerant Corn Trial

Irrigation		Yield				Evapotranspiration (in)				Water use efficiency (bu/ac/in)			
(% ET)	Hybrid	24,000	30,000	34,000	Mean	24,000	30,000	34,000	Mean	24,000	30,000	34,000	Mean
100	Check	201.6	211.6	203.7	**205.6**	32.9	32.2	31.3	**32.1**	6.13	6.57	6.51	**6.4**
75	Check	189.5	196.7	206.7	**197.6**	24.4	24.3	24.8	**24.5**	7.77	8.09	8.35	**8.1**
50	Check	91.7	94.4	97.5	**94.6**	19.5	20.0	19.8	**19.8**	4.72	4.73	4.91	**4.8**
100	P1151HR	192.8	210.2	223.3	**208.8**	31.4	31.4	31.2	**31.3**	6.14	6.69	7.16	**6.7**
75	P1151HR	186.9	203.0	202.5	**197.5**	23.0	24.1	24.0	**23.7**	8.12	8.44	8.42	**8.3**
50	P1151HR	106.3	100.7	101.5	**102.8**	19.6	20.2	19.8	**19.9**	5.43	4.98	5.13	**5.2**
100	P1324HR	203.8	199.8	219.2	**207.6**	31.6	31.8	31.0	**31.5**	6.45	6.28	7.07	**6.6**
75	P1324HR	196.5	196.9	196.8	**196.7**	23.7	23.9	24.4	**24.0**	8.29	8.24	8.07	**8.2**
50	P1324HR	93.1	90.3	93.0	**92.1**	19.5	19.6	20.2	**19.8**	4.77	4.60	4.60	**4.7**
100	P1498HR	215.0	200.7	220.1	**211.9**	32.1	31.8	31.0	**31.6**	6.69	6.31	7.11	**6.7**
75	P1498HR	169.6	186.3	190.3	**182.1**	24.2	24.2	24.1	**24.1**	7.01	7.71	7.89	**7.5**
50	P1498HR	97.3	90.3	88.9	**92.2**	19.3	19.7	19.6	**19.5**	5.05	4.58	4.53	**4.7**