2020

Irrigated Corn Farm Management Competition Report

Jason Warren, Sumit Sharma, and Brian Arnall
Department of Plant and Soil Sciences.

Introduction

The Testing Ag Performance Solutions (TAPS) program hosts farm management competitions that promotes profitability and efficiency through peer-to-peer interaction. The program hosted 13 competitors in the Irrigated Corn competition at the Oklahoma State University's McCaull Research and Demonstration Farm near Eva, OK. The competitors were assigned "farms" numbered 1-14 with the 14th farm being one managed by the Oklahoma State extension team. Each farm was replicated in three plots imposed with our variable rate irrigation system. The project also included check treatments that received no water and/or no nitrogen which allowed for the calculation of efficiency indexes. The TAPS competition allows growers to compete against each other as well as against University extension specialists within the same field for most profitable, and highest efficiency for water and nitrogen (N) fertilizer.

Approach

The contestants were responsible for six management decisions including; irrigation scheduling, nitrogen fertilizer amounts and application (via pre-plant, and fertigation), hybrid selection, seeding rate, and marketing choices of their grain yields. Each team's decisions were implemented in a single field on three randomized plots within a split plot trial design. Eight rows of each plot was planted to the participants selected hybrid and population; and the other eight rows were planted at a seeding rate of 30,000 seeds/acre for P1366. This standard hybrid and population was selected based on Pioneer seed representative's recommendation. The staff of Oklahoma Panhandle Research Extension Center managed all farm plots. The yields and costs from each farm were amplified to represent 3,000 harvested acres. This amplification provided the opportunity to market an amount of grain that was more representative of a modern-sized farm. Each team had access to a number of new and emerging technologies provided by industry partners, such as sensors, models, and imagery, to aid their decision-making process in real-time.

2020 Results

The 2020 growing season was another challenging year for irrigated crop production in the Oklahoma Panhandle with dry and warm weather in the early season, with high winds. The McCaull R&D station did receive approximately 6 inches of rainfall in July and August that many areas in the panhandle did not receive, therefore the total rainfall for the season was 9.6 inches. Although the 2020 growing season started dry the research station experienced near average rainfall for the area. Figure 1 shows the average long-term temperature and rainfall at the Goodwell OK mesonet and the temperature and rainfall at EVA, OK mesonet in 2020.

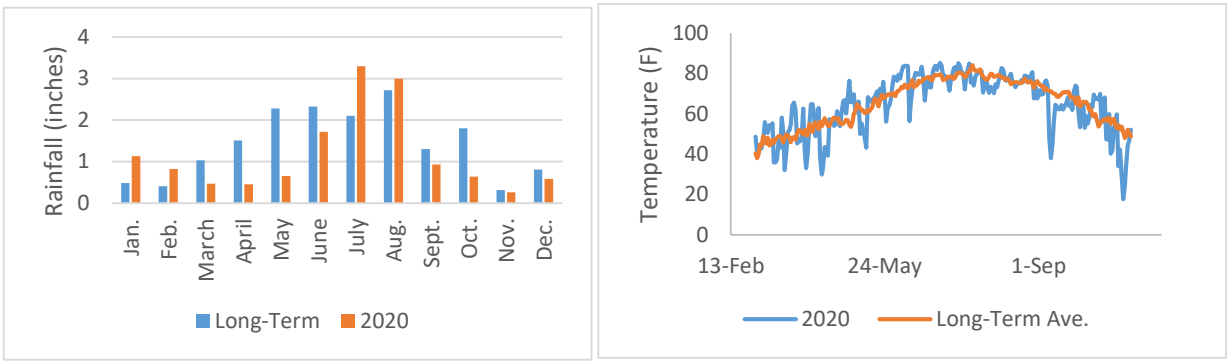

Figure 1: The average long-term temperature and rainfall at goodwell, OK mesonet and the temperature and rainfall at the Eva, OK mesonet in 2020.

The limited rainfall in March April and May made pre-plant irrigation a necessity to increase soil profile moisture to levels needed to successfully strip till and establish the corn crop. This pre irrigation accounts for 3.6 inches for each participant (Figure 2). In May after planting the amount of water that participant applied ranged from 1.5 to 3.8. In June, July, and August the ranges in irrigation applied was 4.8 to 7.5, 6.5 to 9.6, and 3.4 to 6.3 inches, respectively. Farm 10 applied the least irrigation during each month of production except for August. In contrast, Farm 6 applied the most water in every month except August when they applied only 0.3 inches less that the maximum allowed. The irrigation season was ended after the irrigation event applied on August 26-31. During this period 2 inches of rain were received and the pivot was stopped to prevent excess irrigation of other studies on the pivot. On September 2 attempts were made to restart the pivot but because it was stopped in a low area of the field where ruts were very deep, the drying mud in the wheel tracts prevented us from moving the pivot again until after harvest.

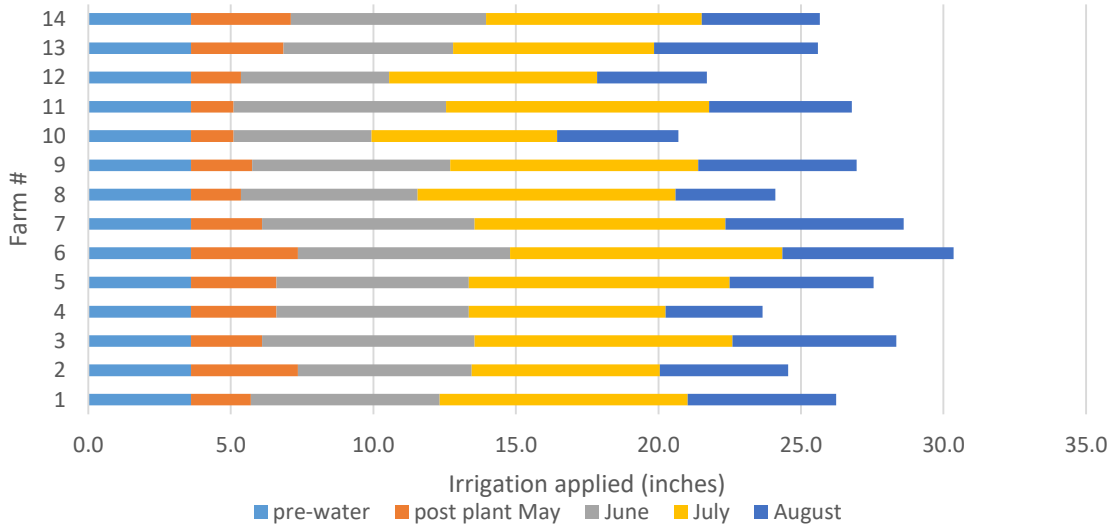

Figure 2: Irrigation Water applied for each corn farm during the irrigation season, which started with pre water on April 26 and ended on August 31. OSU Extension managed farm 14. The total length of bar represents total irrigation applied.

Figure 3 shows the amount of nitrogen applied pre-plant and during four fertigation events. The total applied ranged from as little as 170 lbs applied on farm 14 which was managed by our precision nutrient management extension specialist at OSU, Brian Arnall to as much as 420 lbs on farm 9 which took the maximum application during each event. The treatment structure also included a non-fertilized Check that received no nitrogen other than that applied with 100 lbs of MESZ (12_{N}-40_{P2O5}-0_{K2O}-10_{S}-1_{Zn}). It should be noted that this 0 N rate produced 224 bu/acre. Therefore, this field was considered to be marginally responsive to N fertilizer in 2020. This is likely due to exceptional rooting depth of the crop which provided for utilization of subsoil residual.

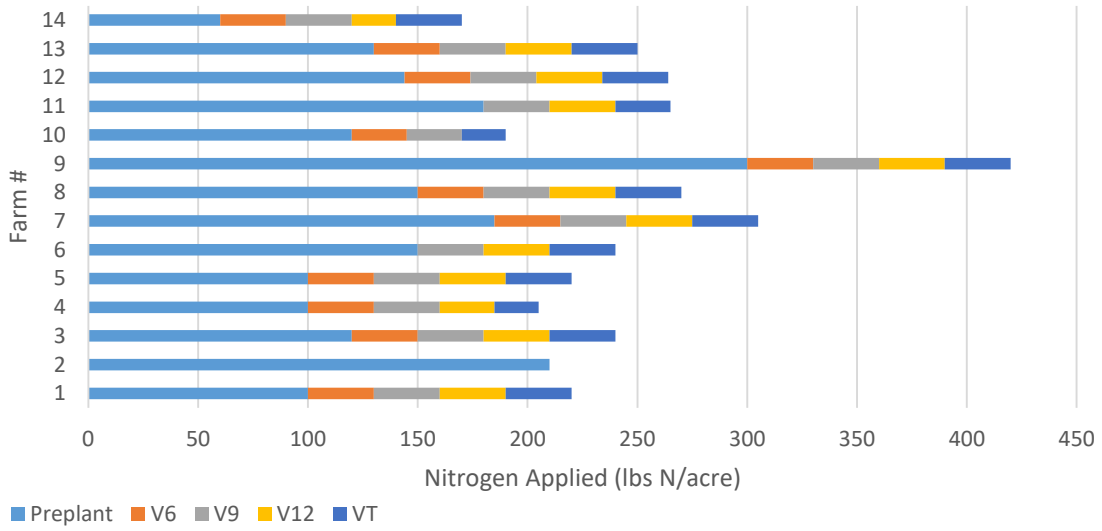

Figure 3: Nitrogen amount and method for each corn farm at Eva, OK. OSU Extension managed farm 14. The total length of bar represents total N applied.

Figure 4 shows grain yield for the participant selected hybrid and the standard hybrid on each farm. The 1366 out yielded other hybrids on most farms except for Farm 2. Participant hybrid yields ranged from 126 bu/acre on Farm 10 to 238 bu/acre on Farm 11, which selected 1366 as their hybrid. The standard hybrid yielded 184 to 254 bu/acre. This shows that in 2020 the standard hybrid performed well across a wide range of management strategies.

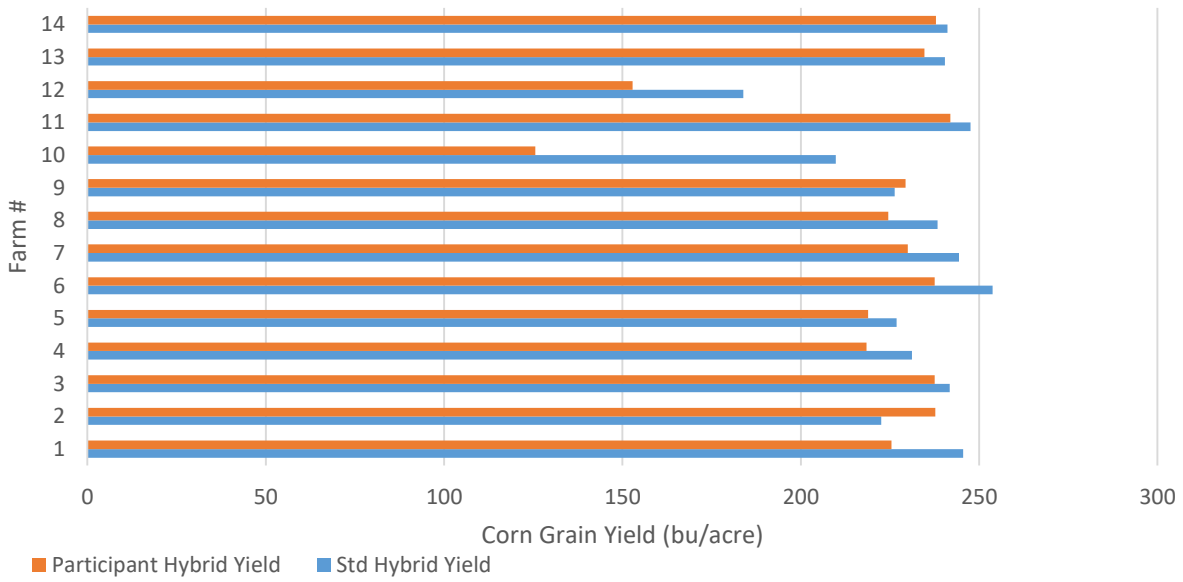

Figure 4: Grain Yield for the participant hybrid and the standard hybrid produced on each farm at Eva, OK. OSU Extension managed farm 14.

Table 1: Participant selected hybrid and Seeding rate and the standard hybrid and Seeding rate.

Farm #	hybrid	Seeding rate
1	DK63-99	32000
2	P1359	30000
3	DK70-27	32000
4	DK63-21	32531
5	DK70-27	31000
6	DK70-27	34000
7	LG5643 VT2	25000
8	CHANNEL 209-15	32000
9	P1828Q	30000
10	F2F1C-128	30000
11	P1366AM	30000
12	FONT10D308	30000
13	P1828Q	26000
14	1366AM	30000
Standard	1366AM	30000

Figure 5 shows the net return to land and management for each farm given the yield and the sale prices achieved by each participant's hybrid and marketing selections. The figure also shows the net return to land and management for each farm given the yield of the standard hybrid and the cash price of corn on Dec. 15 at Elkhart Kansas ($4.65/bushel). The standard price and hybrid produced

similar net returns for farms 1, 6, 11, 14 with the maximum return achieved by Farm 6 which generated a yield that was 12 bu per acre greater than any other farm. However, using the participant's hybrid and marketing strategies this farm ranked 9th in net returns. Farm 6 applied nearly the maximum amount of water available under the circumstances provided by the contest. Therefore, this represents a substantial loss of potential revenue for the 2020 crop year as well as opportunity costs for future production with the water saved by taking a more conservative approach. In contrast, farm 13 which generated the most net revenue using the participant's hybrid and marketing strategy achieved this with a moderate irrigation rate, saving 4.8 inches of irrigation for future production.

Figure 6 illustrates the impact of diminishing returns per inch of water very clearly. This presentation shows that there was some variability due to input costs, yield and marketing above 24 inches of irrigation for both the participant and standard hybrid and marketing scenarios but that the gains in profitability from irrigating beyond this level were negligible.

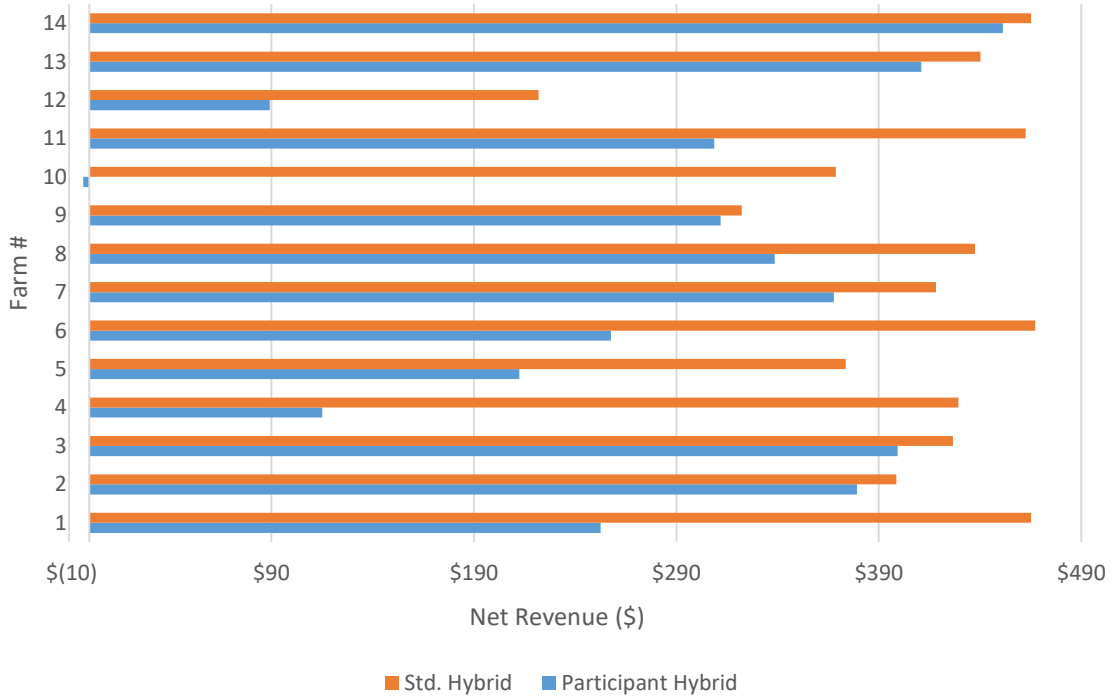

Figure 5: Net return to land and labor for each farm based on the participant's hybrid yield and grain marketing, and the standard hybrid yield and grain price on Dec. 15. OSU Extension managed farm 14.

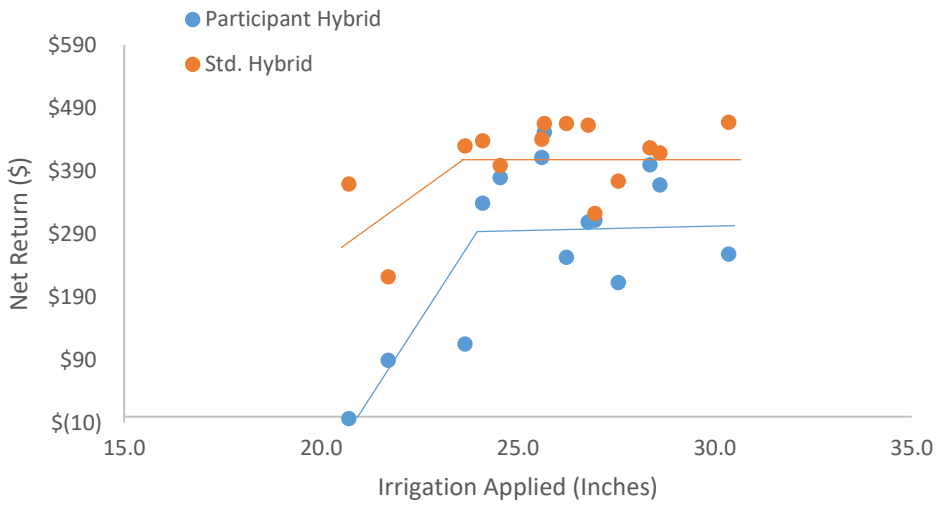

Figure 6: Net return to land and labor as a function of irrigation applied to each farm based on the participant's hybrid yield and grain marketing, and the standard hybrid yield and grain price on Dec. 15. OSU Extension managed farm 14.

Figure 7 shows the Water-Nitrogen efficiency intensity index calculated as:

$$\text{OSU WNIPI} = \frac{((Y_{Farm} - Y_{Control})/Y_{Control})}{((ET_{Control} + I_{Farm})/ET_{Control}) \times ((Y_{0N} + Y_{Farm})/Y_{0N})}$$

Where Y_{farm} is the yield for the farm $Y_{control}$ is the yield of the treatment that received no irrigation, $ET_{Control}$ is the mesonet estimated ET, I_{farm} is the irrigation applied to the farm, Y_{0N} is the yield of the treatment that received adequate irrigation and zero nitrogen. This efficiency index is modified from the index used in the University of Nebraska Lincoln (UNL) irrigated corn TAPS program. he UNL equation uses the above ground biomass N instead of the grain yield as used in our equation.

Farm 2 shows the highest efficiency index when the participant hybrid is used for the analysis. This farm applied irrigation at 24.6 inches which was very close to the optimum irrigation and applied a moderate N rate of 210 lbs/acre while producing the highest yield among the participant hybrids. The hybrid 1359 was well suited for the production environment provided by Farm 2. In fact, it was the only participant hybrid that outperformed the 1366.

It is noteworthy that the extension team farm 14 generated the highest efficiency score due to the N rate of 170 lbs N/acre. Other noteworthy efficiency scores were generated by the farms 1, 4 and 10 using the standard hybrid. Farm 1 rank 3rd in efficiency because they generated an excellent yield of 246 bu with 26.2 inches of irrigation and 220 lbs N/acre. Farm 4 rank second with a yield of 231 bu/acre produced with only 23.7 inches of irrigation and 205 lbs N/acre. Farm 10 produced 210 bu/acre with 20.7 inches and 190 lbs N/acre to rank 4th in the efficiency index using the standard hybrid. Farms 1 and 4 also ranked in the top 4 when we use the yield from the participant hybrid,

demonstrating that these hybrids did very well under the conditions provided. In contrast the participant hybrid for farm 10 only generated 126 bu/acre which moved its efficiency score to the lowest score of any farm.

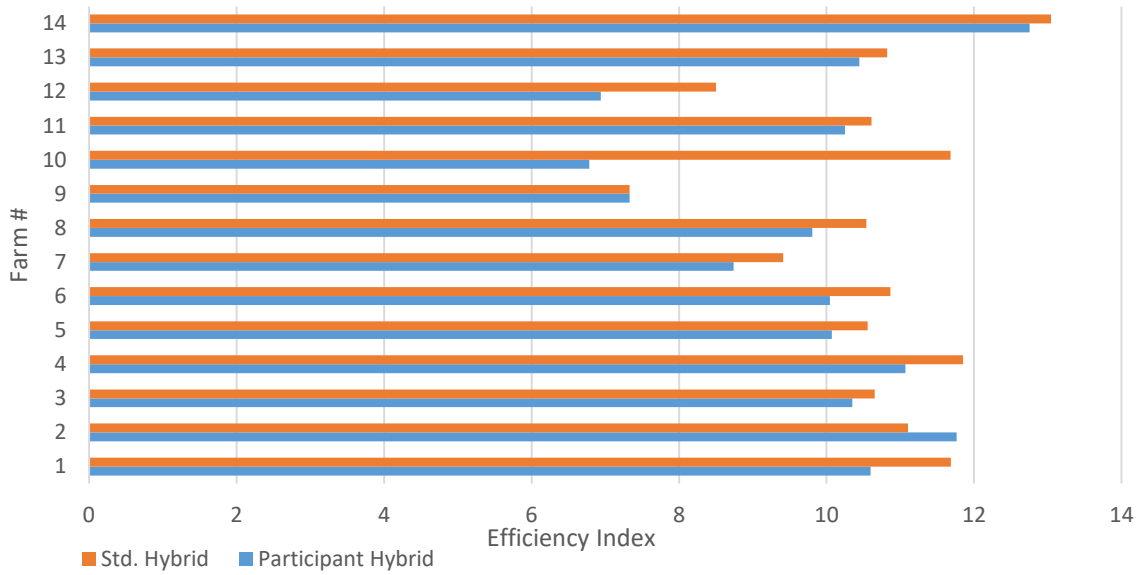

Figure 7 shows the efficiency score as calculated with an adjusted UNL efficiency equation for the standard and participant hybrids. OSU Extension managed farm 14.

Competition Results and Winners:

This year the most profitable farm based on participant hybrid and marketing decision was farm 13. This farm was managed by Jarod McDaniel of Hooker, Oklahoma. His success was achieved by applying 25.6 inches of irrigation, 250 lbs N/acre, and growing 235 bu/acre of P1828Q planted at 26,000 seeds per acre. His success in being the most profitable was primarily driven by marketing because he sold all of his corn on the last marketing day of the season on December 15 for $4.65/bu.

The most efficient farm based on participant hybid decisions was farm 2. This farm was managed by Darren Buck of Elkhart, KS. Darren produced 238 bu/acre with P1359 planted at 30,000 seeds per acre. His crop received 24.6 inches of irrigation and 210 lbs N/acre.

Congratulations to these two participants and many thanks the following participants who made this 2020 corn TAPS project a very successful project.

Matt Steinert Covington, OK; Pat Long, Optima, OK; Brent Rendall, Miami, OK; Jason Becker, Turpin, OK; Brett Reiss, Kismet, KS; Roric Paulman, North Platte, NE; Russell Issacs, Turpin, OK; Wes Woolmen, Boise City, OK, Fred Fischer, Optima, OK; Clinton Oyler, Turpin, OK; and Harrison Krey, Rolla, KS