TESTING AG PERFORMANCE SOLUTIONS (TAPS) IN NEBRASKA AND OKLAHOMA

Daran Rudnick
Irrigation Management Specialist
University of Nebraska
Voice: 308-696-6709
Email: daran.rudnick@unl.edu

Jason G. Warren
Soil and Water Conservation
Extension Specialist
Oklahoma State University
Voice: 405-744-1721
Email: Jason.warren@okstate.edu

Chuck Burr
Extension Educator
West Central Research and Extension Center
Email: chuck.burr@unl.edu
Phone: (308) 696-6783

Sumit Sharma
Extension Irrigation Specialist
Oklahoma Panhandle Research and Extension Center
Email: sumit.sharma@okstate.edu
Phone: 580-349-5440

Matt Stockton
Associate Prof., Ag. Economic
West Central Research and Extension Center
Email: matt.stockton@unl.edu
Phone: (308) 696-6713

Brian Arnall
Precision Nutrient Management
Extension Specialist
Oklahoma State University
Email: b.arnall@okstate.edu
Phone: 405-744-1722

*Disclaimer: An earlier version of this article has been published in the Proceedings of the Kansas State University Cover your Acres Conference (*https://www.northwest.k-state.edu/events/cover-your-acres/).

INTRODUCTION

The Testing Ag Performance Solutions (TAPS) program hosts farm management competitions that promotes profitability and efficiency through peer-to-peer interaction. The program hosts competitions at the University of Nebraska-Lincoln (UNL) West Central Research, Extension, and Education Center in North Platte, NE, UNL's High Plains Agricultural Laboratory in Sidney, NE, and at the Oklahoma State University McCaull Research and Demonstration Farm near Eva, OK. This innovative and unique program was developed to enhance the engagement of crop producers at a high level around resource use efficiency and profitability by providing a common platform for peer-to-peer learning with participation by scientists and industry personnel. The TAPS competitions allow growers to compete against each other as well as against University extension specialists and educators within the same field for most profitable, highest efficiency for water and nitrogen (N)

fertilizer, and greatest grain yield. The TAPS program concluded its third year in December of 2019 with five competitions, including sprinkler irrigated corn, sprinkler irrigated sorghum, and subsurface drip irrigated corn in North Platte, NE, sprinkler irrigated corn in Eva, OK, and dryland wheat in Sidney, NE. This report will focus on the 2019 sprinkler irrigated corn competitions hosted in Eva, OK, and North Platte, NE. We encourage readers to visit the TAPS website to learn more about the other competitions.

MATERIALS AND METHODS

The contestants were responsible for six types of management decisions, including irrigation scheduling; nitrogen fertilizer amounts and application (via pre-plant, side-dress and fertigation); corn hybrid selection; seeding rate; crop insurance selection; and marketing choices of their grain yields. Each team's decisions were implemented in a single field on three randomized plots. The plot layout for the sprinkler irrigated corn competition in North Platte, NE, is shown in Figure 1. All farm plots were managed by University personnel. 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. Description of each management decision can be found on the TAPS website at taps.unl.edu.

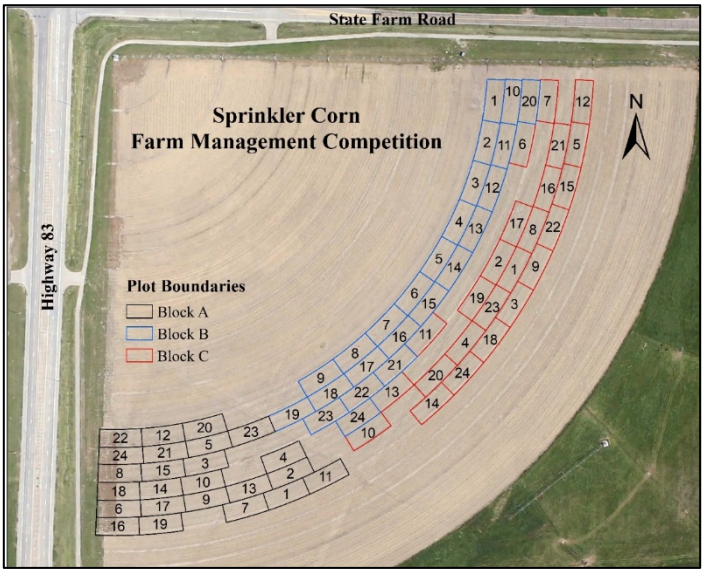

Figure 1. Plot layout for the 2019 Corn Farm Management Competition held at the West Central Research and Extension Center in North Platte, NE. Each team had a randomized plot located in blocks A, B, and C. The

RESULTS AND DISCUSSION

Oklahoma 2019

The 2019 growing season proved to be a challenge for irrigation crop production in the Oklahoma Panhandle with early season temperatures being below average and rainfall through the late winter and spring months being above average. Figure 2 shows that starting May 20th temperatures were below average until July 15th when they increased to at or above the average temperature and remained high until the first of October. Figure 2 shows rainfall collected at the competition site from the Eva mesonet (operational since 2018), along with the long-term average rainfall collected from the Goodwell Mesonet. This rainfall data shows that the Eva location received above average rainfall until the end of June, and below average rainfall in July and August. Consequently, delaying irrigation

demand as compared to average years. The irrigation was started on June 26 and the last application was applied September 3.

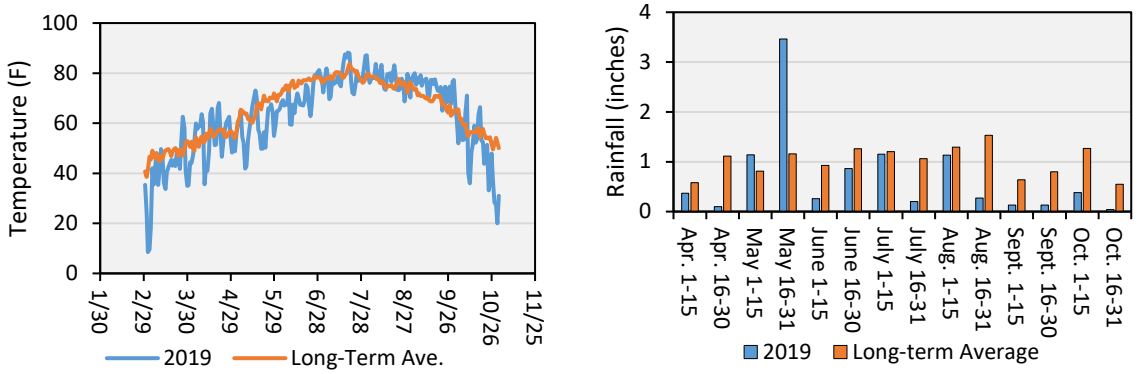

Figure 2: The average long-term temperature and rainfall at goodwell, OK mesonet and the temperature and rainfall at the Eva, OK mesonet in 2019.

The irrigation system was nozzled to deliver 600 gpm with a maximum irrigation application schedule set to apply 1.27 inch every 5 days. This allowed for a maximum of 17.8 inches of irrigation available to the competitors during the 70-day irrigation period. This amount of irrigation included applications made with fertigation. If a producer chose not to fertigate, their maximum allowable irrigation was 16.3 inches. The cumulative ET estimated by the Mesonet at Eva was 23.3 inches and the rainfall received during this period was 2.8 inches.

This thin water budget caused by below average rainfall during reproductive growth made this year's yield very responsive to irrigation applied. The maximum amount of water applied by a competitor was 17.3 inches (Figure 3), which maximized yield at 207 bu acre^{-1} (Figure 5). The lowest water application rate was 13.7 inches, which produced 152 bu acre^{-1}. The importance of irrigation can also be seen in the yield produced by the "Check" treatment, meant to receive no irrigation or nitrogen (Figure 5). This treatment was flashing leaves by mid-July, therefore it was irrigated with 1.25 inches applied on July 19 and 0.63 inches was on July 25. This check treatment achieved a yield of 16 bu acre^{-1}. The yields appeared to be much less effected by the N rates applied (Figure 4) as indicated by the observation that farm 1 produced the highest yield with only 150 lbs N acre^{-1}.

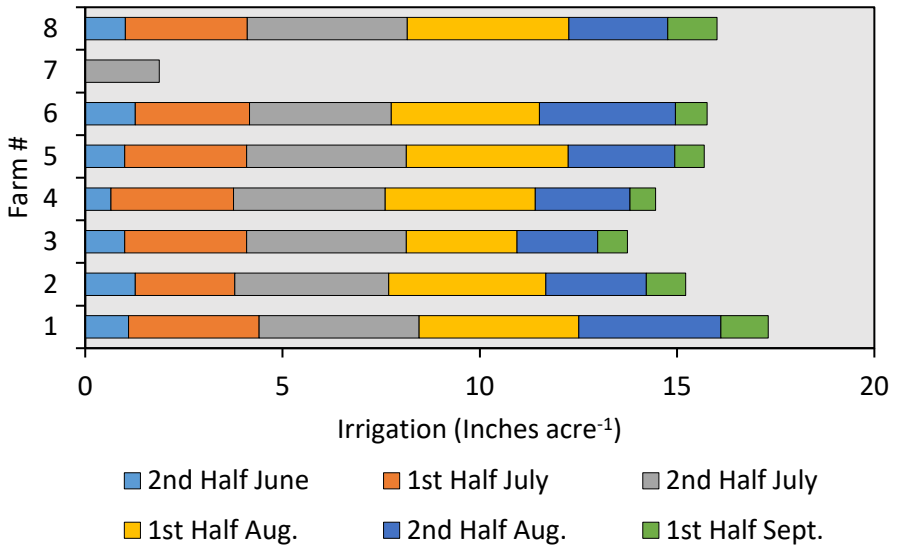

Figure 3: Irrigation Water applied for each corn farm during each 2-week period of the irrigation season, which started on June 26 and ended on Sept. 3.

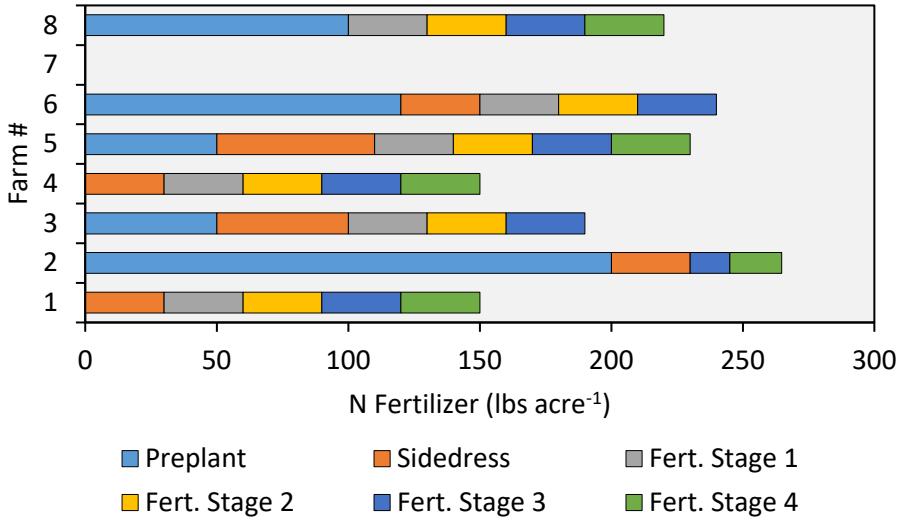

Figure 4: Nitrogen amount and method for each corn farm at Eva, OK. OSU Extension managed farm 8.

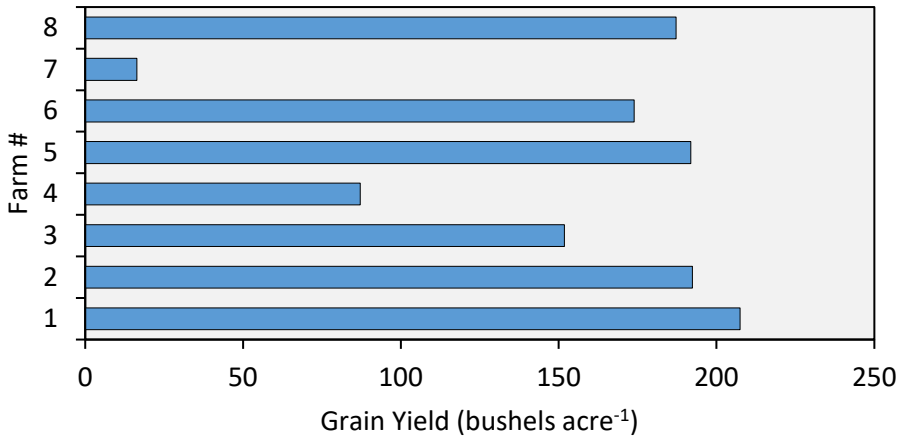

Figure 5: Grain Yield for each competition farm at Eva, OK. OSU Extension managed farm 8.

The net revenue presented in figure 6 represents the return to land and management because in our analysis we have not yet included land rental, which would the same for each farm and therefore would only impact the magnitude of the number and not the relative differences. Farm 1 was the most profitable (Figure 6). This was not only due to it maximizing yield and efficiency but also due to marketing. This farm sold 87% of its production on June 6 at a cash bid price of $4.70/bu to hog feed mill located 36 miles from the farm location. Therefore, the average price received by this producer was $4.63 minus $0.27 for trucking. Whereas, the remaining farms sold their grain at a nearby coop with a transportation cost of $0.09, however the second best average price per bushel was only $4.24 for farm 4, which sold 124% of their production prior to harvest. In fact, the low yield of 87 bu $acre^{-1}$ triggered an indemnity payment from crop insurance for this farm, which had the lowest net revenue (Figure 6).

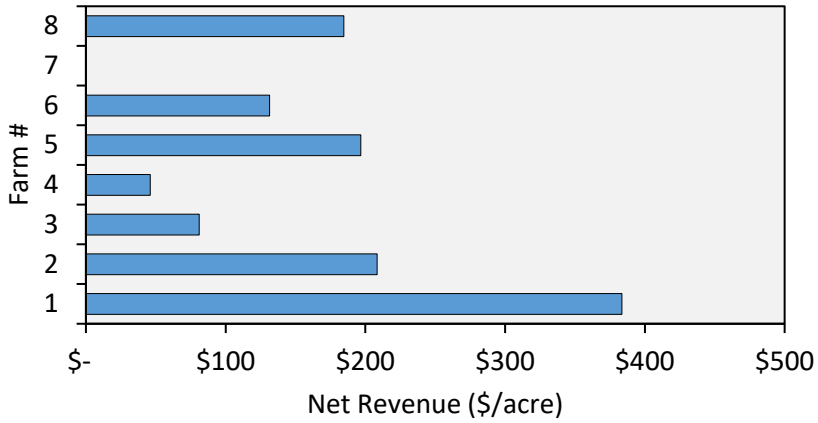

Figure 6: Net revenue for each farm at Eva, OK. OSU Extension managed farm 8.

Nebraska 2019

The TAPS site in North Platte, NE, received above normal rainfall in 2019 (figure 7). In fact, the seasonal rainfall from May 1 to Sept. 30 for the past three years (2017, 2018, and 2019) of 18.2, 14.9, and 21.2 inches (Nebraska State Climate Office (https://nsco.unl.edu/)) has exceeded the long-term (1986-2015) average rainfall of 12.5 inches (High Plains Regional Climate Center's Automated Weather Data Network (HPRCC-AWDN; www.hprcc.unl.edu/awdn).

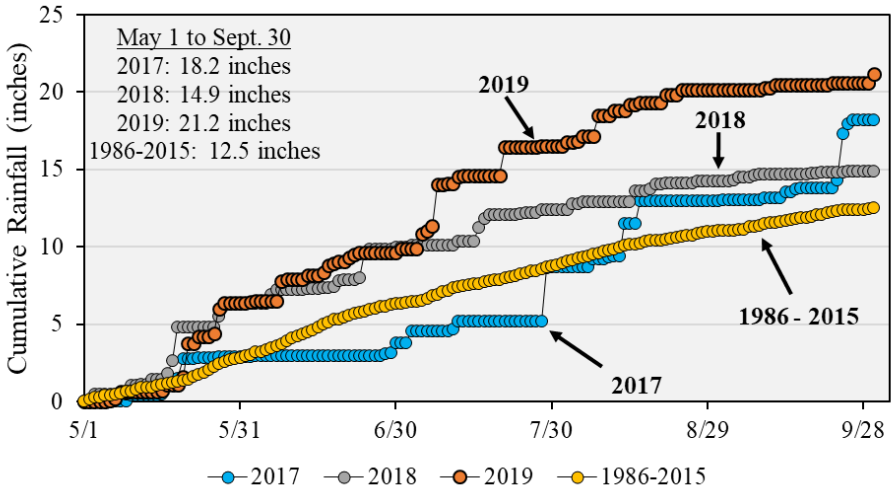

Figure 7. Cumulative rainfall (inches) from May 1 to Sept. 30 for 2017, 2018, 2019, and long-term (1986-2015) at the field site in North Platte, NE.

Corn was planted on May 13, 2019, using a six row precision planter. There were 9, 12, and 15 different hybrids selected across the contestants. Planting costs ranged from $77 to $118 per acre. The range in irrigation and nitrogen fertilizer decisions made across producers are presented in Figures 8 and 9, respectively. The range in applied irrigation was from 0.30 to 9.90 inches with a median of 3.30 inches. A noticeable spread in total applied N fertilizer was observed ranging from 140 to 270 lbs acre^{-1}. However, the median of N fertilizer was 180 lbs acre^{-1}, which was less than the 205 to 210 lb acre^{-1} recommendation provided by a commercial soils lab (Ward Laboratories, Kearney, NE) prior to planting with a yield goal of 280 bushels acre^{-1}. Similar to the 2017 and 2018 sprinkler corn competitions, all teams opted to split apply their N fertilizer with all teams applying at least 30 lbs acre^{-1} as fertigation. We encourage the reader to visit the TAPS.unl.edu website to download the TAPS reports to obtain a more detailed and complete description of the production and economic decisions made by the participating teams.

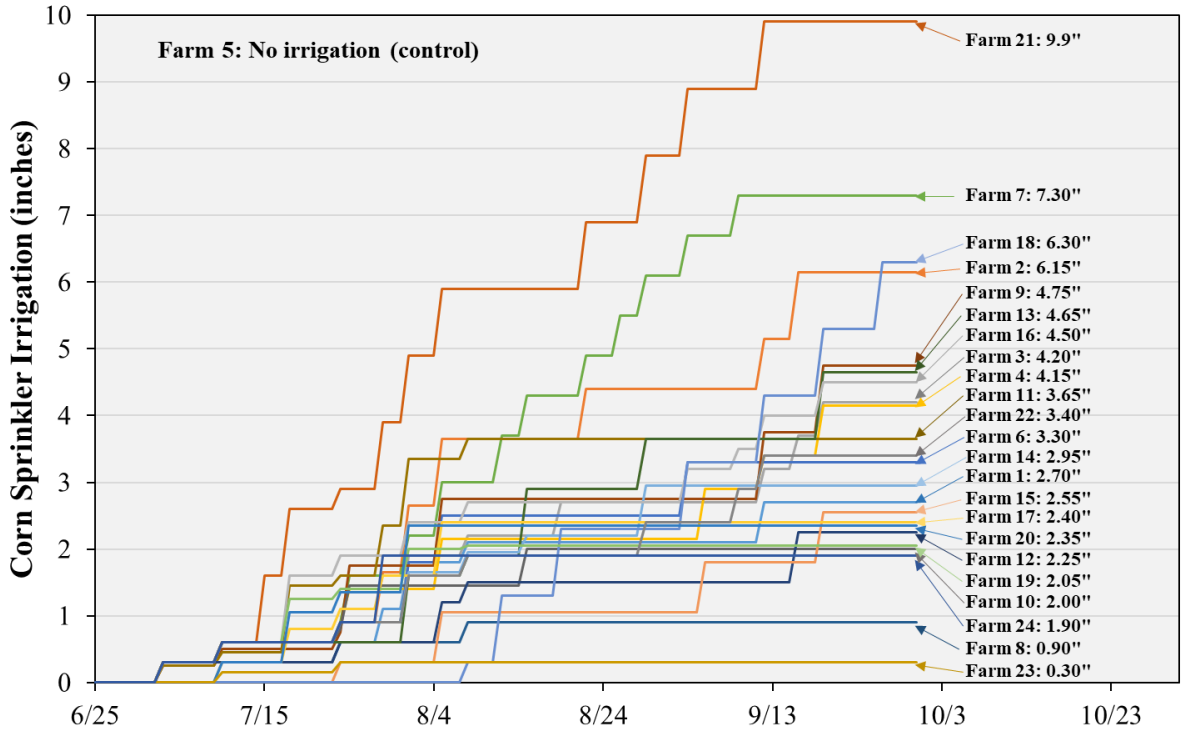

Figure 8. Irrigation amounts (inches acre^{-1}) for individual farms competing in the 2019 sprinkler irrigated corn competition in North Platte, NE.

There were noticeable differences in grain yield response across the producer teams with yield ranging from 193 to 241 bu acre^{-1} (Figure 10). In general, grain yield had a positive, yet weak, response to irrigation with a coefficient of determination (R2) of 0.21. A contributor to the weak response was the fact that there was a considerable range in hybrid performance in the middle range of applied irrigation. For example, between 2 and 3.5 inches of applied water yields ranged from 198 bu acre^{-1} (2.95 inches) to 241 bushels acre^{-1} (2.55 inches). The authors suspect the poor relationships observed between grain yield and irrigation and N fertilizer in the TAPS data are due to the influence of other attributes (hybrid selection, seeding rate, growing conditions) and their collective interactions. This emphasizes the true challenge growers' face in optimizing management practices of various inputs (seed, water, fertility, etc.). Consequently, further work is needed to better account for the individual and interacting contributions of each input, so that growers can make economically and environmentally conscientious decisions. Nevertheless, following current best management practices as well as the use of responsive technologies (soil water sensors, canopy reflectance sensors, etc.) to guide inputs as compared to solely relying on fixed or seasonal decisions can help avoid over- or under-application of inputs.

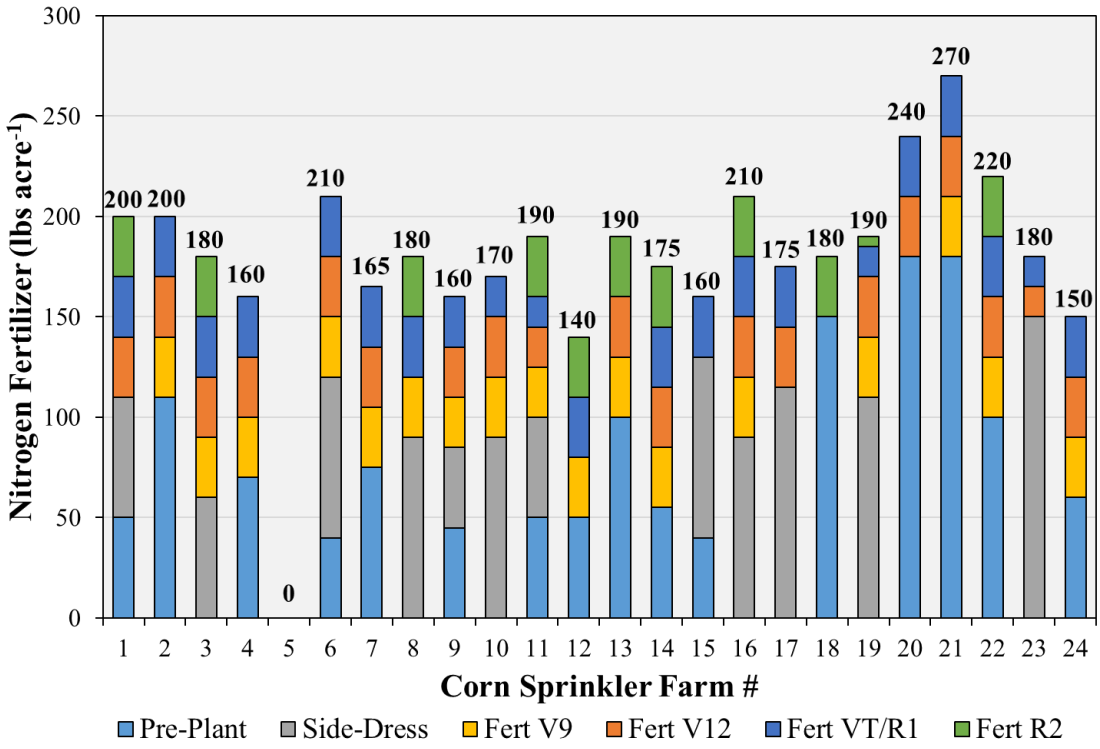

Figure 9. Nitrogen fertilizer (lbs acre^{-1}) applied as pre-plant, sidedress, and fertigation for individual farms competing in the 2019 sprinkler irrigated corn competition in North Platte, NE.

All producer teams generated a profit ranging from $57 to $293 per acre (Figure 11). Excluding the control (Farm #5) the production costs ranged from $627 to $750 per acre. There were noticeable differences in grain marketing where several teams took advantage of favorable prices, whereas, other farms sold at market close at a price of $3.65 per bushel. For example, the most profitable farm (#17) sold 190,000 bushels in May on the futures for $4.13 per bushel, 180,000 bushels in June on the futures for $4.36 per bushel, and a hedge to arrive contract for 120,000 bushels at $4.66 per bushel. The collective results of the TAPS competitions illustrate that overall profitability is dependent upon marketing accompanied by efficient agronomic management.

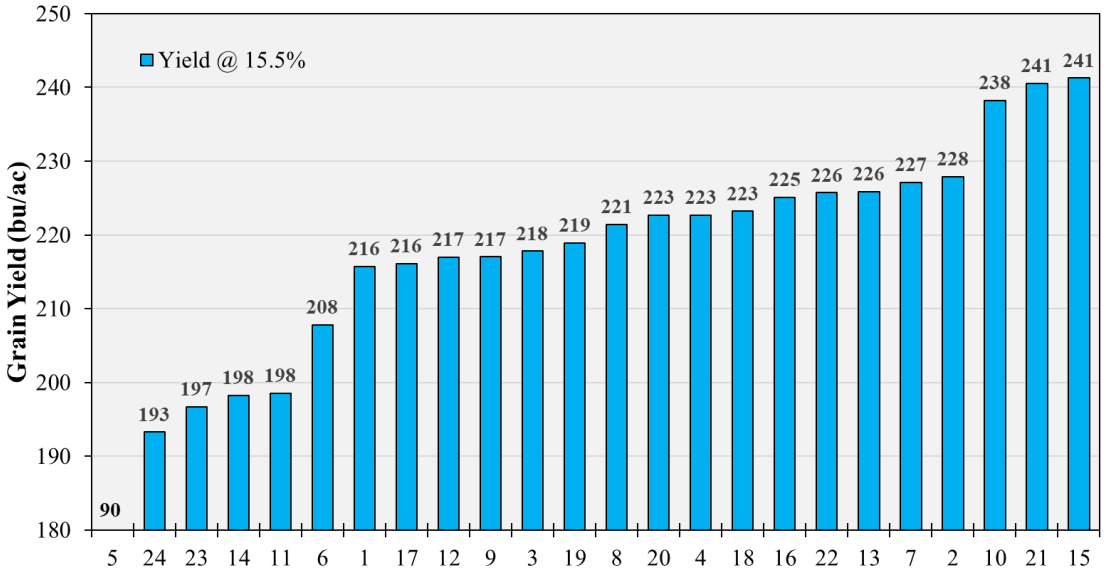

Figure 10. Grain yield (bushels acre^{-1}) for individual farms competing in the 2019 sprinkler irrigated corn competition in North Platte, NE.

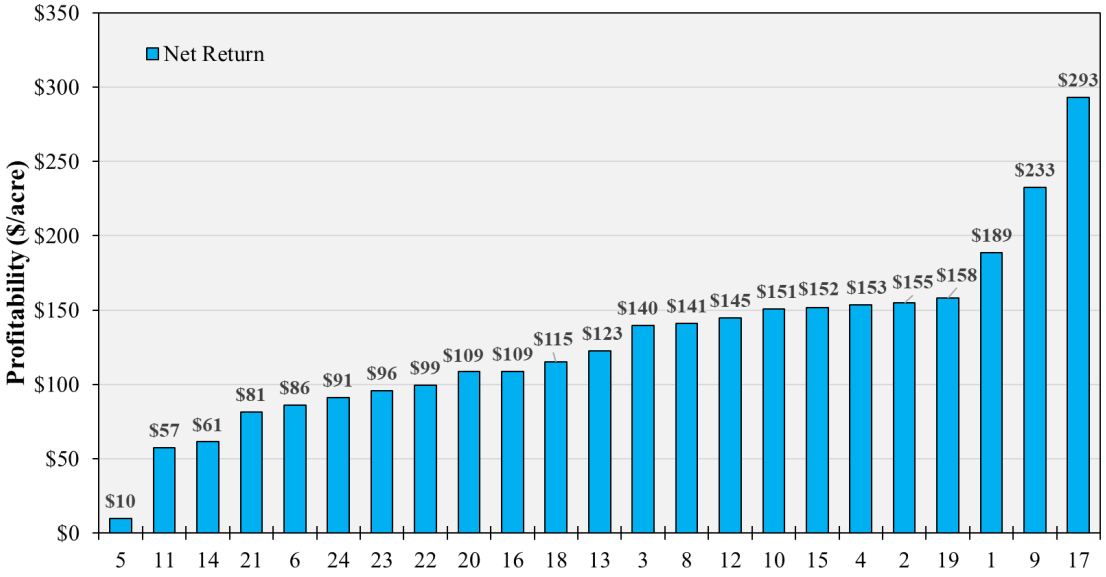

Figure 11. Net income ($ acre^{-1}) for individual farms competing in the 2019 sprinkler irrigated corn competition in North Platte, NE.

SUMMARY

The TAPS Farm Management Competitions provide insight into various management strategies that can lead to profitable and efficient grain production. In addition, the competitions highlight the challenges associated with accounting for and managing various inputs. This proceedings article serves as a brief summary of the management decisions made and the resulting outcomes of the 2019 sprinkler irrigated corn competitions hosted in North Platte, NE, and Eva, OK. The authors encourage the reader to visit the TAPS website at taps.unl.edu or to contact the authors to learn more about the program and the results.