EXTENSION

EC3043

UNL TAPS
TESTING AG PERFORMANCE SOLUTIONS

2017 FARM MANAGEMENT COMPETITION REPORT

taps.unl.edu

West Central Research and Extension Center
University of Nebraska–Lincoln
402 West State Farm Road
North Platte, NE 69101

Mission Statement: To fully engage agriculturalists, scientists, educators, students, and industry in an innovative endeavor, to TAP into the University of Nebraska-Lincoln's potential to facilitate and create an environment for all stakeholders to work together in finding solutions through innovation, entrepreneurialism, technology adoption, new managerial applications, improved techniques and cutting-edge methodologies for farms, farm businesses, and farm families to maintain profitability, sustainability, and productivity.

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Reference

Lo, T., D.R. Rudnick, C.A. Burr, M.C. Stockton, and R. Werle. 2019. Approaches to evaluating grower irrigation and fertilizer nitrogen amount and timing. Agricultural Water Management 213: 693-706.

EXECUTIVE SUMMARY

The TAPS education and solutions program was created out of the need to incorporate and engage agricultural research, agricultural technology, industry, and producers in an interactive real-world way to increase productivity, sustainability, and profitability. TAPS is an acronym that stands for Testing Ag Performance Solutions. With the many challenges related to and faced in agricultural production there is a need for a deeper level of engagement among all the stakeholders. Not surprisingly, many entities have contributed in many different ways to the program's development.

University of Nebraska–Lincoln research and extension personnel and facilities act as the common ground and host the program. This structure provides the necessary oversight and neutrality needed to maintain a healthy objective environment for producers, researchers, and industry suppliers to innovate, test, adopt, learn about and develop new technologies, try new management practices and techniques, and make the needed adjustments in the efficient and profitable production of corn.

2017 is the TAPS inaugural year and as such has been more successful than could have been hoped. The TAPS program is based on a competitive model in which participants (individuals and/or groups) compete in the production and marketing of corn. Each team or farm competes for three possible awards, the most prestigious being the most profitable farm, followed by an efficiency for nitrogen and water use award, and an award for productivity (highest yield).

Competitors make many input and management choices, which include crop insurance selection, planting choices of both population and hybrid, all marketing decisions, irrigation scheduling and quantity, and fertilizer timing, amount, and method. Unlike a simple yield contest, the management objectives of the contest relate directly to the management and relationship of resource allocation to profitability and sustainability. Competitor's choices are made in an environment where real-time information regarding field conditions is available, using new and emerging technologies. Opportunities for stakeholders to meet and discuss outcomes, challenges, and to share their experiences are a large part of the contest. Communication, learning, and innovation are enhanced by continuous communication and direct yearlong interaction of all those involved in the program as well as the publication and sharing of the project results and take-home lessons, which are shared year-round.

This program's design has many benefits, including; 1) University researchers and extension professionals are in direct competition with farmers under real-world conditions, 2) Farmers are able to use new and emerging methods and tools creating innovative opportunities and serving as role models and teachers, and 3) Industry personnel become observers of technology application and its many interactions, leading to further development of technology and making all three groups an active part of the innovative and problem-solving team.

We thank all those who have actively participated and given of their time and/or treasure. We look forward to adding new partners in the coming seasons and anticipate the discovery of many new friends, innovations, and solutions that come from such an effort.

Sincerely,

TAPS Executive Board
PARTICIPANTS

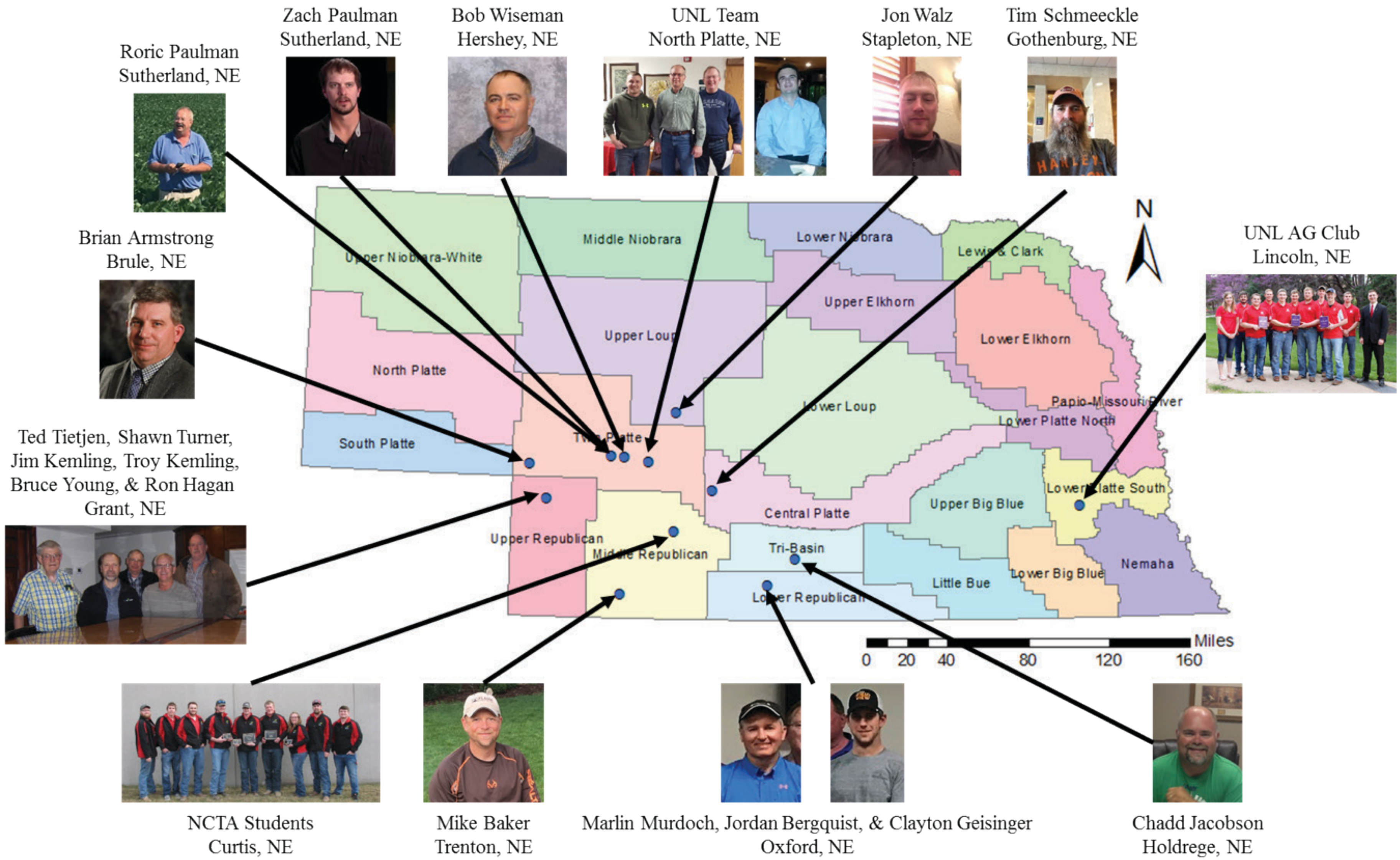

Figure 1. Location of the 2017 UNL TAPS farm management competition contestants and their respective Natural Resources Districts.

PROGRAM OVERVIEW

The first annual farm management competition was established under a variable rate center pivot at the West Central Research and Extension Center (WCREC) in North Platte, Nebraska. The competition included 15 teams for 2017. WCREC specialists/educators also competed; however, they were not eligible to win the cash awards. Each "farm" on paper included 3,000 harvested acres for the purposes of making decisions. The farm decisions made by each team were imposed on three randomized plots, and the average of the three plots was used for collecting yield data. Participants had control over six parameters:

1. Irrigation management – Amount and timing of application
2. Nitrogen management – Application method (preplant, sidedress, and fertigation) and amount
3. Hybrid selection – Provided seed or used default hybrid
4. Seeding rate – Seeds planted per acre
5. Grain marketing – Used various marketing tools to price grain from March 20 to Nov. 22
6. Crop insurance – Selected yield and/or price protection as well as hail and wind insurance

All other management decisions, such as pesticide use, tillage, residue management, etc., were fixed by the university and were the same for all plots (farms). The WREC staff conducted the actual physical management, such as the operation of machinery, irrigation system, application of chemicals, and harvesting. Participants were allowed to observe, install their own equipment, and/or collect additional data from their plots throughout the growing season at their own expense and risk. However, no additional inputs, such as fertilizers, additives, etc., were allowed to be applied to the individual plots.

DESCRIPTION OF AWARDS

The participants competed for three awards, 1) Most Profitable Farm, 2) Highest Input Use Efficiency, and 3) Greatest Grain Yield. Description of each award follows.

1. Most Profitable Farm ($2,000) – included average yield from the plots, marketing decisions, and cost of production based on the management decisions.
2. Highest Input Use Efficiency ($1,000)

$$\text{Input Use Efficiency} = \text{Rank}\left[\frac{(ET_{Farm} - ET_C)}{\text{Irrigation}_{Farm}}\right] + \text{Rank}\left[\frac{(GNU_{Farm} - GNU_C)}{\text{Nitrogen Applied}_{Farm}}\right] + \text{Rank}\left[\frac{\text{Yield}_{Farm}}{\text{Yield}_C}\right]$$

where "C" is a control farm managed by UNL that receives no irrigation or nitrogen fertilizer (except for 10-34-0 at planting), "ET" is evapotranspiration for the individual and control farms, and "GNU" is nitrogen taken up in the grain. With disparity in the range of values observed across the three efficiency components, a composite ranking was performed. Each term was ranked from highest to lowest with the highest value receiving one point and the lowest value receiving 14 points. The final score was determined by summing up the points for each farm, and the lowest number was deemed the winner.

3. Greatest Grain Yield Award ($500) – adjusted by the winner's percent of total possible profit. Total possible profit is the range of difference between the most and least profitable farms.

TIMELINE

The competition started with a kickoff meeting on March 20th at WCREC in North Platte, NE, where the rules and regulations of the competition were described. Field operations began on May 5th when preplant nitrogen fertilizer was applied using a double coulter nitrogen applicator and concluded with combine harvest on November 2nd. Several workshop and field tours were conducted throughout the growing season,

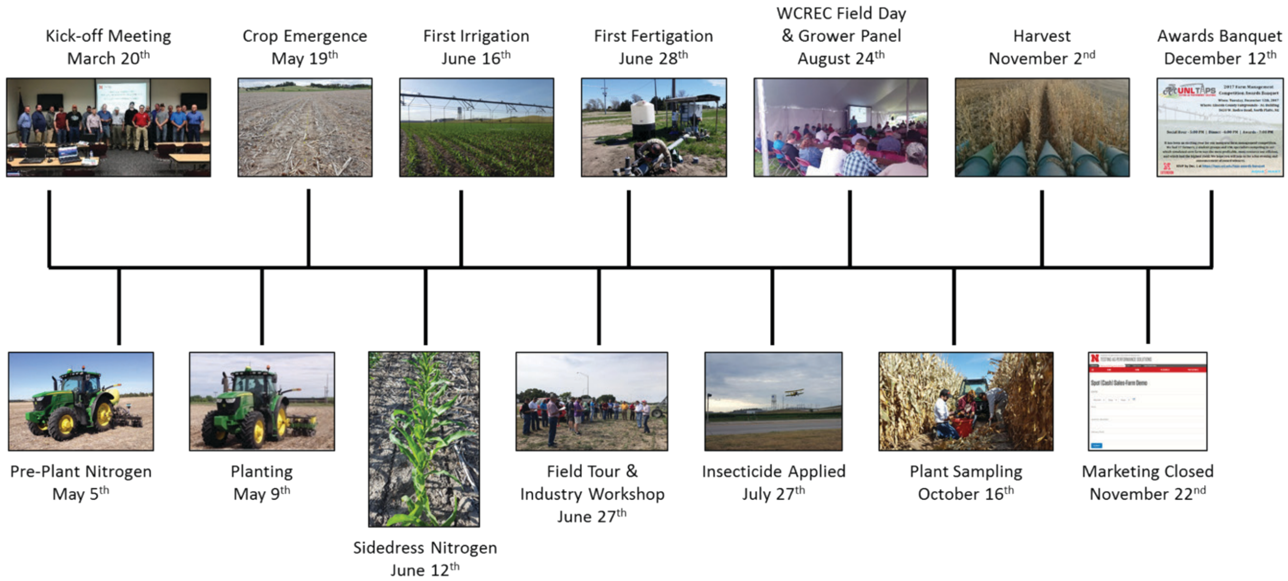

Figure 2. Timeline of events for the 2017 UNL TAPS farm management competition.

including a field tour and industry workshop on June 27th and a grower's panel and field tour on August 24th. The field events provided an opportunity for growers to interact with each other as well as UNL faculty and industry personnel. The competition officially ended on November 22nd, which was the final day for the participants to market their grain. Results and awards were presented at a banquet on December 12th.

MANAGEMENT DECISIONS

Weather Conditions

The WCREC received ample rainfall in late July/early August and again during late September, but had two extended dry periods with minimal rainfall from May 21 to June 27 and from August 17 to September 22 (Figure 3). The seasonal rainfall from planting to physiological maturity (May 9 to October 10) was 21.36 inches, which exceeded the long-term (1960-2010) average rainfall of 13.3 inches for the same time period (National Weather Service's Cooperative Observer Program (COOP) accessed through the High Plains Regional Climate Center (HPRCC) archive at www.hprcc.unl.edu). However, three dates (July 29, August 13, and September 24) had rainfall that exceeded 2 inches per day with a cumulative total of 8.5 inches.

Crop Insurance

Participants were able to choose a revenue or yield insurance plan with either enterprise or optional units with a level of coverage from 65 to 85%. They were also able to select one of 15 hail plans and its level of coverage as well as wind insurance. To determine indemnity payments we used the report of crop insurance claims for Lincoln County from the Risk Management Agency for 2017. From the reports it was determined that about 1.7% of the corn acres in Lincoln County were hailed at 100% loss. Indemnity payments were calculated accordingly for each farm, and therefore, 35 of the 3,000 acres were indemnified. Figure 4 shows the net cost per bushel of insurance including the value of

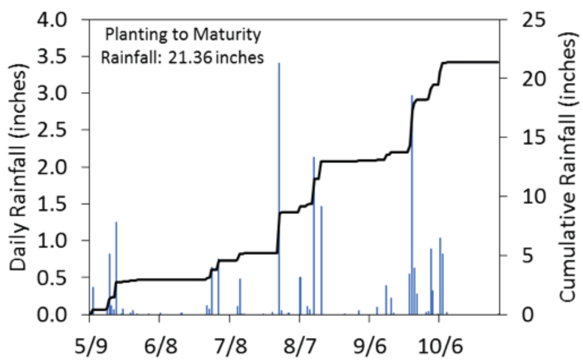

Figure 3. Daily and cumulative rainfall (inches) from planting (5/9/17) to physiological maturity (10/10/17).

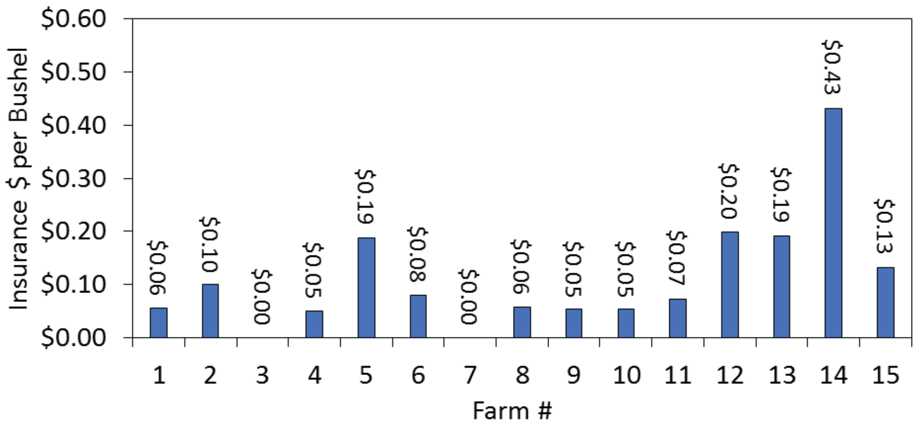

Figure 4. The cost of crop insurance minus indemnity payment per bushel produced for individual farms.

indemnity. The insurance cost per bushel ranged from 0.00 to 0.43 dollars with an average of 0.11 dollars.

Hybrid Selection and Seeding Rate

The cost of seed has increased dramatically over the years as new traits and trait packages have been developed and marketed to growers. This year 11 hybrids were selected by the participants, including seed from Dyna-Gro, Pioneer, NuTech, Dekalb, Channel, Renk, Fontanelle, and Golden Harvest. Seed cost per bag (i.e., 80,000 seeds) ranged from $220 to $294 with an average of $253. In addition to hybrid selection, seeding rate is also an important management decision as it affects cost of production and can impact grain yield. The bushels of grain produced for every 1,000 seeds planted are show in Figure 5, along with seeding rate for each farm. If you exclude Farm 7, which was the UNL Control farm, the results ranged from 6.57 to 8.50 bushels per acre for 1,000 seeds planted.

Cost of seed per bushel produced is presented in Figure 6. This calculation incorporates the cost of seed, seeding rate, and grain yield. Costs per bushel produced ranged from $0.32 to $0.53. The observed difference of over $0.20 per bushel can make the difference between profit and loss. It is extremely important to work with your seed supplier to determine the correct hybrid and the optimum seeding rate for that hybrid, since most hybrids respond positively to increasing populations up to a certain point. Crop variety testing on a small area before hybrid selection for a larger number of acres is one method to reduce risk and assure hybrid performance.

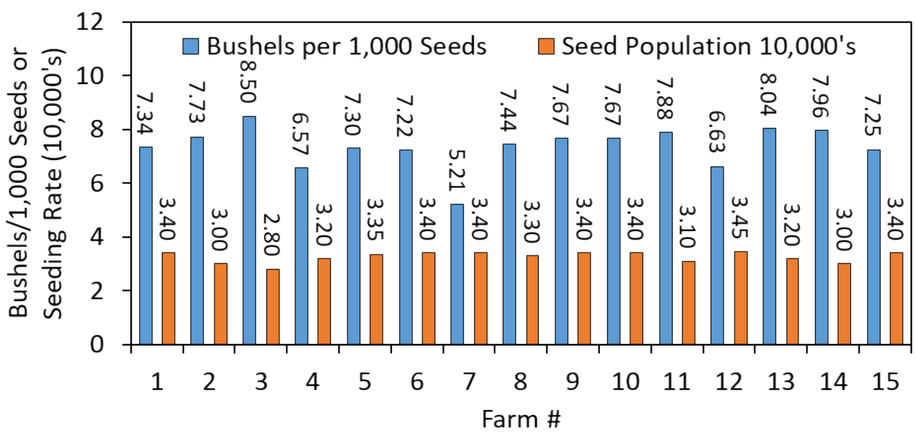

Figure 5. Bushels produced for every 1,000 seeds planted per acre and seeding rate for individual farms.

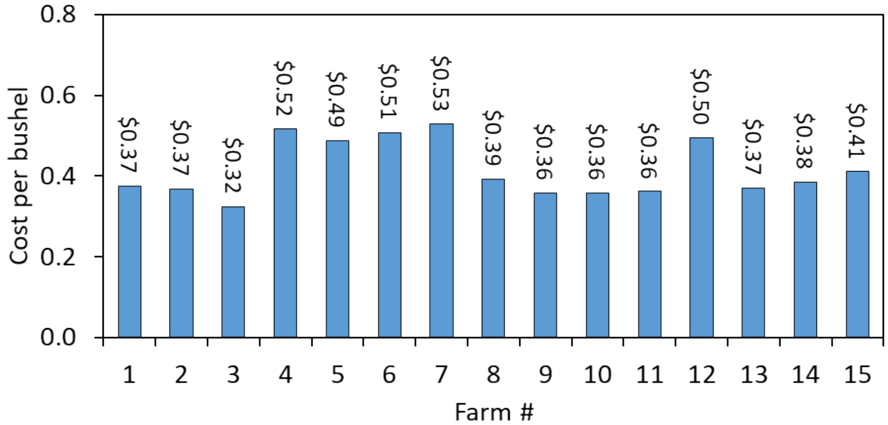

Figure 6. Total cost of seed per bushel of grain produced for individual farms.

Irrigation Scheduling

Participants had the opportunity to apply 0 to 1 inch of irrigation twice a week during the growing season. Irrigation water was also applied during fertigation operations at a maximum rate of 0.30 inches with 30 pounds of nitrogen. The variable cost to pump an acre-inch of water was $7.80. Total irrigation applied ranged from 2.50 to 10.75 inches for the season. The majority of the participants applied a significant portion of their water during the month of July (Figure 7) due to limited rainfall during that time (Figure 3) as well as to avoid water stress during critical growth stages of tasseling (VT) and silking (R1). Also, most participants applied little irrigation water during September, which corresponded to the late reproductive period that is less susceptible to water stress. Furthermore, allowing the crop to extract more stored soil water late in the growing season may allow for reduced irrigation pumping.

Nitrogen Application

Participants had the opportunity to apply nitrogen fertilizer in the form of UAN 32% using three application methods, 1) preplant, 2) sidedress, and 3) fertigation. The preplant and sidedress applications were performed using a double coulter nitrogen applicator and were administered on May 5 and June 12, respectively (Figure 2). Four fertigation application options of up to 30 lb per acre per event were made available to the participants, excluding the control farm, targeting the 9 leaf (V9), 12 leaf (V12), tasseling(VT)/silking (R1), and blister (R2) growth stages. The range in nitrogen applied was 0 to 140 lb per acre as preplant, 0 to 125 lb per acre as sidedress, and 30 to 120 lb per acre as fertigation (Figure 8). Every farm opted to apply a portion of its nitrogen fertilizer as fertigation with the intent to be more efficient by applying nitrogen when the crop needed it most. Five farms opted to apply fertigation at all four

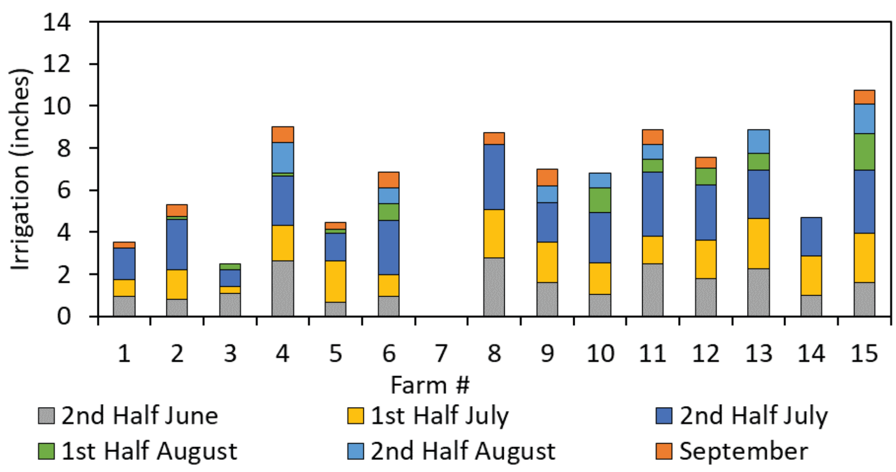

Figure 7. Cumulative irrigation (inches) for half months for individual farms.

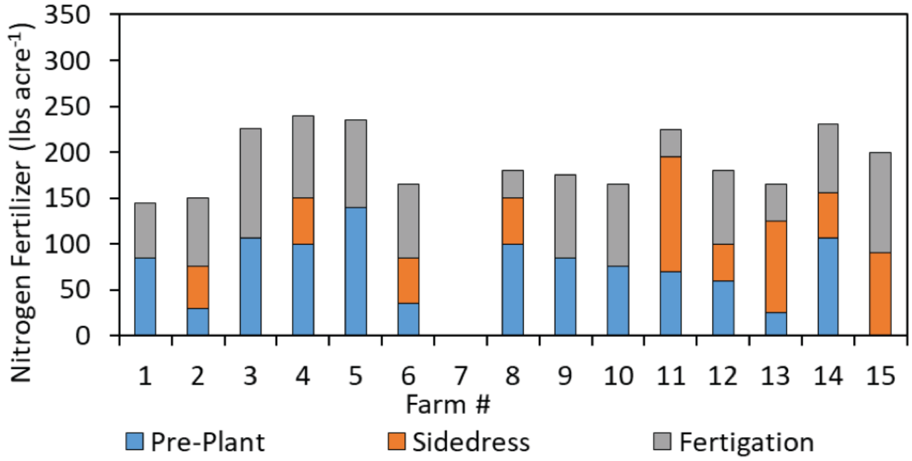

Figure 8. Nitrogen application method and amount (lb per acre) for individual farms.

growth stages (V9, V12, VT/R1, and R2); whereas, two farms (Farms 8 and 11) opted to only apply fertigation at a single growth stage (Figure 9). The range in fertigation applied was from 30 (Farm 8) to 120 (Farm 3) lb per acre, which represented 17 and 53% of their total applied nitrogen fertilizer. Leaf tissue samples were collected at V14 growth stage and stalk nitrate samples were collected at physiological maturity (R6) to identify nitrogen sufficiency for each farm.

Marketing

It was duly noted in our project description last March that grain marketing would likely have the greatest impact on profitability, and this was prominently demonstrated this year. The producers who "delivered" their grain to Ag Valley Coop in North Platte on November 22 received $3.03 per bushel. Only five farms produced grain at an input cost of less than $3.03 per bushel. Farms that used the marketing tools of forward contracts, basis contracts, and futures market were able to significantly increase revenue per bushel and ultimately profitability. Figure 10 shows the pricing opportunities that producers had available during 2017. A suggested trigger point of $4.00 per bushel is highlighted in Figure 10, along with two periods when the price reached the trigger point.

RESULTS AND DISCUSSION

Greatest Grain Yield

The "Greatest Grain Yield" award was granted to Tim Schmeeckle, Farm #10, with a yield of 260.7 bushels per acre. Tim selected hybrid Dyna-Gro D53VC55RIB with a seeding rate of 34,000 plants per acre, which is marketed for the western Corn Belt. Tim's farm ranked 6th in "Farm Profitability," and he received a cash award of $320.

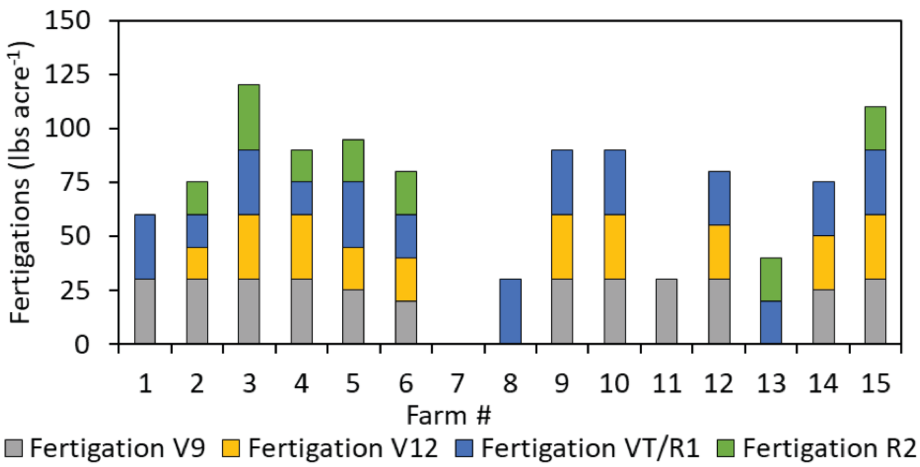

Figure 9. Nitrogen amount (lb per acre) for individual fertigation applications for individual farms.

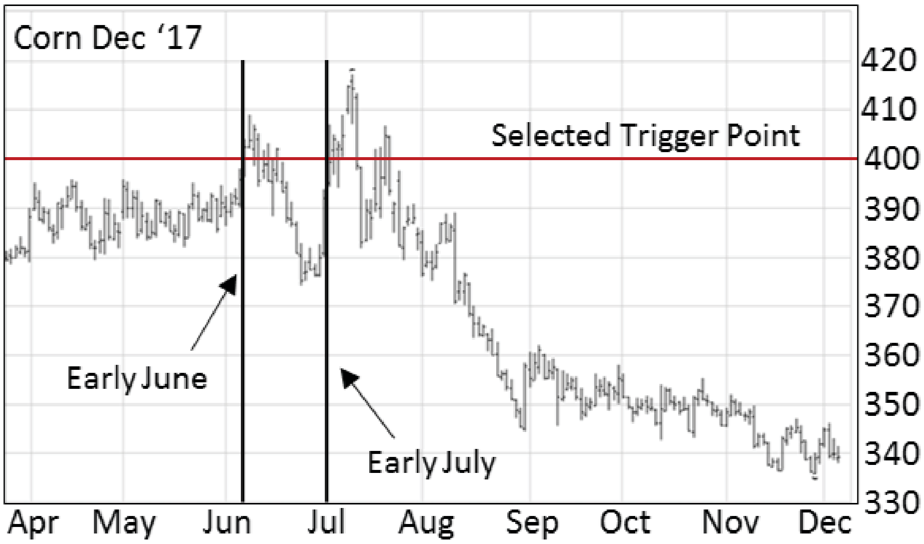

Figure 10. 2017 December futures contract for corn with June and July periods when $4.00 trigger price was reached. Figure adapted from barchart.com.

Highest Input Use Efficiency

The "Highest Input Use Efficiency" award had three components: irrigation, nitrogen, and yield response. All three terms of the efficiency calculation were based on a control treatment (Farm 7) that received no irrigation and nitrogen fertilizer. This efficiency index promotes effective irrigation and nitrogen practices without sacrificing production and profitability. The efficiency index penalizes irrigation water and nitrogen fertilizer that is applied to the field but is not taken up by the crop. For example, the irrigation component of the efficiency term decreases if irrigation water does not translate into evapotranspiration (ET), in other words, if irrigation water is left in the soil profile, percolated below the root zone, and/or runs off the field. It is possible for the irrigation term to exceed 1.0 if the applied irrigation prevents lasting effects of water stress on crop performance, allowing the crop to extract more available water (precipitation and stored water) than the amount of irrigation applied. For example, Farm #1 applied 3.5 inches of irrigation; however, the ET amount exceeded the control treatment by nearly 6 inches due to careful timing of irrigation, which allowed the crop to avoid the lasting effects of water stress experienced by the control treatment.

The values for the irrigation, nitrogen, and yield component terms of the efficiency calculation are presented in Table 1. The irrigation efficiency term ranged from 0.64 to 1.79. In general, irrigation was well managed by the contestants with the average and median efficiency values being 1.05 and 0.95, respectively, which supports that most of the irrigation applied translated into increased consumptive use (i.e., ET). The grain nitrogen uptake efficiency (GNUE) term ranged from 0.18 to 0.44 with an average of 0.30. In general, GNUE decreased with total applied nitrogen fertilizer and increased with grain yield. The yield ratio ranged from 1.19 to 1.47 with an average of 1.37.

The "Highest Input Use Efficiency" award of $1,000 was granted to Tim Schmeeckle, Farm #10, with a composite score of 11. Tim selected hybrid Dyna-Gro D53VC55RIB with a seeding rate of 34,000 plants per acre. His nitrogen management practices consisted of applying 75 lb per acre (45% of total) as preplant and 90 lb per acre (55% of total) as fertigation administered in three applications of 30 lb per acre at the growth stages of 9 leaf, 12 leaf, and tasseling/silking. His irrigation schedule included applying 15.4, 57.4, and 27.2% of his total irrigation of 6.8 inches in the months of June, July, and August, respectively. As a result, his GNUE value was 0.42 with a ranking of 3 and his ETUE was 1.04 with a ranking of 6. Tim was also awarded the "Greatest Grain Yield" with a yield of 260.7 bushels per acre, which had a yield ratio of 1.47 and a ranking of 2. This demonstrates that efficient use of

Farm #	ETUE (unitless)	GNUE (unitless)	Yield Ratio	Composite Score
Farm 1	1.70	0.44	1.41	8
Farm 2	0.64	0.22	1.31	36
Farm 3	1.79	0.32	1.35	18
Farm 4	0.77	0.18	1.19	39
Farm 5	1.30	0.21	1.38	24
Farm 6	0.88	0.31	1.39	21
Farm 8	0.64	0.40	1.39	24
Farm 9	1.10	0.44	1.47	7
Farm 10	1.04	0.42	1.47	11
Farm 11	0.80	0.22	1.38	30
Farm 12	1.03	0.21	1.29	33
Farm 13	0.85	0.37	1.45	17
Farm 14	1.40	0.22	1.35	22
Farm 15	0.74	0.29	1.39	25

Table 1. Input use efficiency components, including evapotranspiration use efficiency (ETUE), grain nitrogen uptake efficiency (GNUE), and yield ratio for the individual farms. Each component was ranked and assigned a number from 1 to 14, with 1 being the highest value and 14 the lowest. The three rankings were summed to determine a composite score for each farm, and the lowest score was considered the highest input use efficient farm.

irrigation and nitrogen fertilizer does not have to come at the expense of yield.

Most Profitable Farm

Farm profitability ranged from a positive $145.19 per acre to a negative $147.24 per acre (Figure 11). Eight farms showed a net profit ranging from $22.94 to $145.19 per acre, and seven farms showed a net loss ranging from $26.69 to $147.24 per acre. Three farms (6, 8, and 10) did not utilize any marketing tools (i.e., sold at market close on November 22 at $3.03 per bushel). Farms 6 and 8 had a net loss. Farm 10 showed a profit of $38.65 due to low production costs. Two farms (4 and 14) had the greatest loss. This was primarily attributed to lower yields with relatively high input costs.

The “Most Profitable Farm” was not the highest yielding nor the lowest input cost, but did receive the most revenue per bushel due to an aggressive marketing strategy. This participant forward contracted 30% of their production on April 1, 30% of their production on July 11, 6% of their production on August 28, and the re-

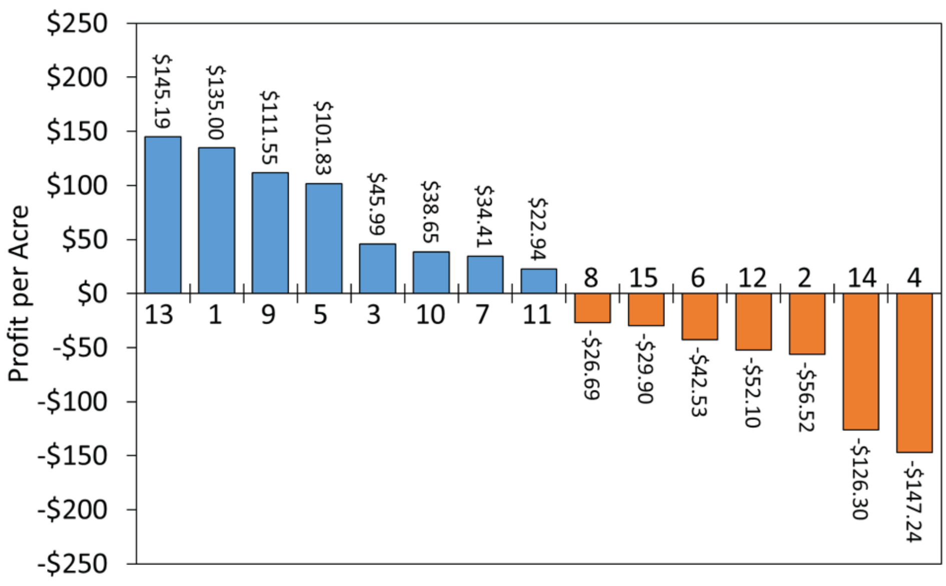

Figure 11. Profitability ($ per acre) for individual farms ranked from highest to lowest.

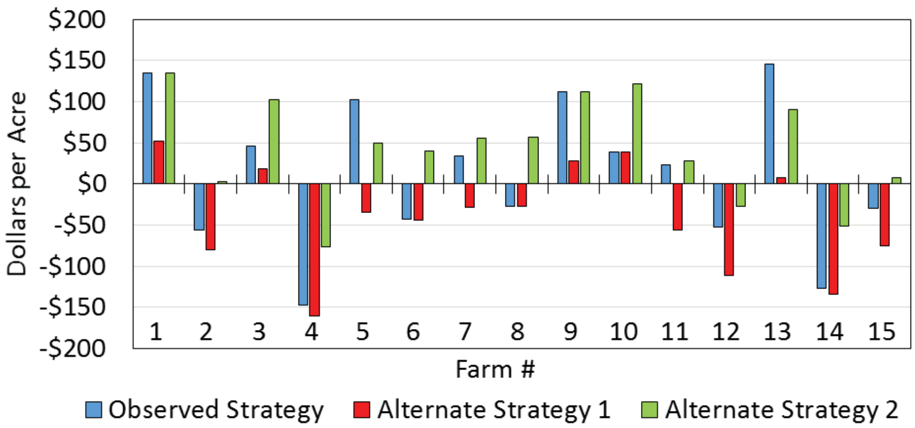

Figure 12. Comparison of profitability for individual farms between observed and two strategies, 1) crop was marketed for all farms on November 22 at $3.03 per bushel, and 2) 80% of the crops APH (200 bushels per acre) was marketed at $3.55 per bushel during June.

maining 34% on November 22. The participant also arranged for on-farm pick up at a reduced basis and eliminated transportation costs. The "Most Profitable Farm" award of $2,000 was granted to Roric Paulman, Farm 13.

Alternative Scenarios

It is worth noting that during this growing season the grain markets gave producers a couple of opportunities to market their grain at a profit. In Figure 12, the red bars show profit results if all the crop were marketed at the 3.03/bu level (Strategy 1). The green bars indicate the approximate level of profits that would be expected had 80% of the crops APH (200 bushels per acre) been marketed at $3.55 during the month of June (Strategy 2). Strategy 2 adds just under $250,000 over Strategy 1. The blue bars represent the calculated profit based on each farm's individual strategy (Strategy 3 or Observed Strategy). In all instances, Strategy 3 and Strategy 2 were better than Strategy 1. Strategy 1 resulted in a total negative profit of over 1.8 million dollars. Strategy 2 resulted in a total increase in profits to over 1.9 million dollars. The Observed Strategy led to a total of nearly 0.5 million dollars of profits. Five of the 15 farms would have been profitable if they had used Strategy 1. Eight of the 15 farms were profitable using their Observed Strategies. Eleven of the 15 farms would have had a positive profit had they applied Strategy 2. In two of the 15 farms, the Observed Strategies had a higher profit than Strategy 2. Following Strategy 2 increased on average the market value of grain to $3.39 per bushel versus the ending market value of $3.03 per bushel on November 22, 2017.

SUMMARY

As described through this report, there are considerable differences in producer decisions, ranging from seed selection and population density, to scheduling and prescribing nitrogen and irrigation amounts. A scientific evaluation of these management practices is especially valuable to producers, since it provides a thorough understanding of grower-based management practices as they compare against their peers as well as against university recommendations. In addition, this information can be evaluated with economics, allowing producers to identify sustainable practices that do not sacrifice profitability.

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