EC3074

UNL TAPS
TESTING AG PERFORMANCE SOLUTIONS

Farm Management Competitions Report

2022

USDA United States Department of Agriculture
Natural Resources Conservation Service

EXTENSION

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The TAPS program is successful in large part due to the contributions of many affiliates. We greatly appreciate each of these people for their assistance with the program. Contributing members included University of Nebraska cohorts Cody Creech, Jenny Rees, Jessica Groskopf, Joe Luck, Julie Peterson, Mark Burbach, Sarah Sivits, Todd Whitney, Troy Ingram, Chris Proctor, Stephanie Kennedy and Chittaranjan Ray; Oklahoma State University cohorts Jason Warren and Brian Arnall; Colorado State University cohorts Joel Schneekloth and Amy Kremen; and Kansas State University counterpart Jonathan Aguilar. We would also like to thank our summer field assistants, Trenton Houston and Ceiden Childears.

Mission Statement

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

EXECUTIVE SUMMARY

It has been said that what happens in the future is based on what we do to prepare for it in the present. At the conclusion of its sixth year, the Testing Ag Performance Solutions (TAPS) program celebrates the end of another successful competition season. As the TAPS team, we are grateful to all who help us presently prepare for future programmatic growth. As we continue to move ahead, we look forward to continuing our efforts to facilitate increased connections among stakeholders, private industry, and the University. Furthermore, we will strive to seek more expansion opportunities, while still maintaining the environment of hands-on learning, networking, and advancement that has always set TAPS apart from other programming.

In the sixth year, TAPS competitions included six contests at three different sites in Nebraska and Oklahoma. The West Central Research, Extension & Education Center (WCREEC) in North Platte, NE, included three contests: Sprinkler Irrigated Corn, Subsurface Drip Irrigated (SDI) Corn, and Grain Sorghum, results of which are found in this report. The fourth contest, Winter Wheat held at the High Plains Ag Lab in Sidney, NE, was implemented by Panhandle Research, Extension & Education Center (PREEC) personnel and concluded its third year in 2022. The remaining two contests were administered by Oklahoma State University (OSU) and included Sprinkler Irrigated Corn and Cotton. The results of the PREEC and OSU affiliate competitions are reported separately at www.taps.unl.edu/reports.

The WCREEC competitions had more than 120 participants, with 33 sprinkler irrigated corn teams, 16 SDI corn teams, and 18 sorghum teams. Contestants represented three states: Nebraska, Colorado, and Kansas. Teams were comprised of many different agriculture sector members, including producers, government agency employees, college students, high school agricultural education teachers, and more, involving both first-time and returning participants.

It is with sincere appreciation that we recognize those who support the TAPS program, including producers, commodity boards, ag service providers and businesses, regulatory agencies, financial institutions, as well as many other organizations and personnel. This innovative and award-winning program continues to connect industry knowledge and Extension research to the personal experiences of growers by fostering relationships among all stakeholders in crop production.

The TAPS program specifically wishes to recognize the monetary sponsorship from the Nebraska Corn Board, Sorghum Checkoff, Nebraska Sorghum Board, and the USDA-NRCS Conservation Innovation Grant (CIG). In addition, the TAPS team appreciates the multitude of various organizations and entities who have provided time, effort, resources, technology, technical assistance, and innovative approaches to help deliver the TAPS program.

The future of the TAPS program shines with the possibility of seeing TAPS become a part of high school classrooms and being offered virtually for producers and others. We hope you continue to be a part of the program, as it continues to provide opportunities to learn, network, and advance.

Sincerely,

The TAPS Team

PROGRAM OVERVIEW

The three TAPS competitions facilitated at the WCREEC in North Platte, NE are the focus of this report. The competitions include the 6th annual Sprinkler Irrigated Corn competition, the 5th annual Sorghum competition, and the 4th annual Subsurface Drip Irrigated (SDI) corn competition. The sprinkler irrigated corn competition was facilitated under a Zimmatic by Lindsay, Variable Rate Center Pivot and the SDI corn competition was held on a field equipped with an Eco-Drip system. The sorghum competition consisted of an irrigated portion and a dryland portion. The irrigated sorghum was facilitated under a Zimmatic linear irrigation system, while the dryland was located south of WCREEC at the dryland farm. The sprinkler irrigated corn competition included 33 teams, while the sorghum had 18 teams and the SDI corn competition had 16 teams. In each competition, there is a Control, Farm 9, which did not receive any irrigation or Nitrogen (N) and was used to determine the efficiency of the competing teams. Each team was randomly assigned a set of three experiment-sized plots within the respective competition areas, totaling less than one-half of an acre per team, referred to as their "Farm". University personnel managed the competition plots under the supervision of the TAPS leadership team. A modified University of Nebraska budget was used to capture costs, as based on a per acre basis. Yields and costs from each "farm" were amplified to represent 3,000 acres for the sprinkler irrigated corn competition and 1,000 acres for the SDI competition. In the sorghum competition, yields and costs from each "farm" are amplified on a weighted average equal to 750 acres of dryland production and 250 acres of irrigated production. This magnification provided ample opportunity and motivation for competitors to develop strategies to market grain and consider the impact their decisions would have on a full-scale operation. These farm sizes are consistent with modern-sized farming operations and therefore enhance recognition of the effects even small decisions have on productivity and profitability.

In both corn competitions, participants controlled the original six decision types. New this year, in the SDI corn competition, participants also had the opportunity to decide on insecticide application. In the sorghum competition, participants made five decisions with the exclusion of the irrigation decision. These decisions have a direct effect on productivity, efficiency, and profitability.

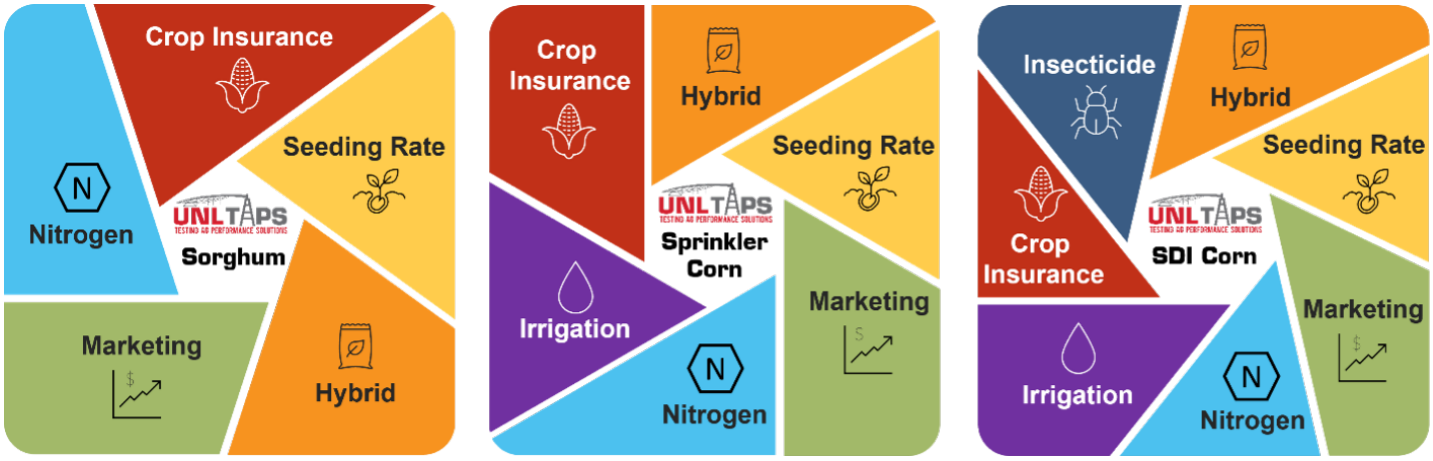

Figure 1. The management decisions varied in 2022 with each competition this year.

Hybrid Selection
(decision type #1)
and Seeding Rate
(decision type #2)

All competition teams were required to select their own seed hybrid and seeding rate. District Sales Managers (DSMs) of multiple seed companies (Advanta, Arrow, Big Cob, Channel, Dekalb, DynaGro, Fontanelle, Hoegemeyer, Pioneer, and Seitec) provided hybrid and seeding rate recommendations, which included 37 corn and 19 sorghum hybrids. These recommendations were based on location, production history, and characteristics of the field used in the competition. While each team had the option of selecting a DSM recommended hybrid, they were also free to select and use their own seed hybrid. Participants were also asked to specify seeding rate, regardless of the hybrid chosen. Participants who selected a recommended hybrid were provided seed by the respective DSM, otherwise participants provided the needed seed. The sprinkler and SDI corn competitions were harvested when the majority of hybrids reached a 17% moisture content, consistent with the maximum moisture content elevators allow at harvest. The sorghum competition was harvested when the majority of hybrids reached 16% moisture content. Corn farms were charged a drying fee of $0.04 per bushel for each percentage point above 15.5% moisture content. Sorghum farms were also charged a drying fee of $0.04 per bushel for each percentage point above 14% moisture at harvest. This ensured that all yields were measured equally for each contestant.

Crop Insurance
(decision type #3)

Participants were required to select a multi-peril crop insurance package from the following three options: Revenue Protection (RP), Revenue Protection with Harvest Price Exclusion (RP-HPE), or Yield Protection (YP), using either Optional Units (OU) or Enterprise Units (EU). The available levels of coverage were 65, 70, 75, 80, or 85%. The premium rates were specifically provided by Farm Credit Services for the competition area in North Platte, NE. Due to the risk involved in borrowing funds to cover operating costs, a minimum level of 65% multi-peril crop insurance was required. This minimum level of crop insurance also allows all participants to market the majority of their production before harvest.

Nitrogen Management
(decision type #4)

Participants were able to select the amount of pre-plant and/or in-season (via side-dress and/or fertigation) Nitrogen (N) fertilizer in the form of UAN 32%. All plots and competitions received a baseline of 5 gallons/acre of in-furrow starter fertilizer (10-34-0) at time of planting. Pre-plant N was available in all competitions and was applied using a double-coulter liquid applicator at about 1.0-inch depth and at a distance of 5 inches on both sides of the planted row. Side-dress N fertilizer was also available in all competitions and was applied at the ground surface neighboring each crop row using 360˚ Y-Drop (360˚ Yield Center, Morton, IL). Fertigation opportunities were available in the corn competitions. In the sprinkler corn competition, fertigation was applied through the center pivot using a variable rate injection pump (Agri-Inject, Yuma, CO) that maintained proper concentrations, as the irrigation system flow rate changed. In-season N was also available to the SDI plots using a constant rate injection pump. Maximum application of N was limited to a total of 180 pounds/acre for pre-plant, 180 pounds/acre for side-dress, and 30 pounds/acre for each fertigation event (i.e., total possible fertigation amount was 150 pounds/acre). Pre-plant, side-dress (V4-V6), and five fertigation events (V9, V12, VT/R1, R2, and R3) were available to the corn participants, whereas just pre-plant and side-dress events were available to the sorghum participants. An application cost of $7.00/acre, which did not include the cost of the fertilizer, was charged for pre-plant and side-dress operations, and $1.00/acre for each fertigation application.

Irrigation Management
(decision type #5)

The pivot irrigation system was operated every Monday and Thursday throughout the growing season. Participants had until 10 AM on the day of irrigation to submit their decision via their password protected online portal. If participants failed to indicate their intent to irrigate by 10 AM, irrigation was not applied. Irrigation depth per application could be as much as 1.0-inch, in intervals of 0.05 inches. The SDI system was operated likewise, every Monday and Thursday throughout the growing season. Participants had until 8 AM to submit their irrigation decision via their password protected online portal. Similarly, if participants failed to indicate intent to irrigate by 8 AM, irrigation was not applied for that event. Irrigation per application was as much as 1.0-inch, again in increments of 0.05 inches. If participants chose over 0.5 inches, then the irrigation event occurred over a 48-hour period, due to the capacity of the irrigation system. Sorghum participants did not make irrigation decisions, instead all plots were irrigated with the same amount of water at the discretion of university officials.

Grain Marketing
(decision type #6)

The option to market grain was available to participants in all competitions from April 1 through November 30. Each team had five different avenues to sell their grain. These five options were: 1) spot or cash sales, 2) forward contracts, 3) basis contracts with delivery at harvest, 4) simple hedge to arrive, and 5) hedging with futures contracts. Since this is a farm management contest, using the market to speculate was not allowed.

Insecticide
(decision type #7)

For the first time, in the SDI competition, participants had the opportunity to choose if their plots received an insecticide application. Each team could choose to forgo treatment, or had three product options, with two rates available with each product, including: 1) Prevathon at 14 or 20 fl oz/ac, 2) Hero at 1.76 or 4 fl oz/ac and 3) Brigade at 2.1 or 6.4 fl oz/ac.

Other Management Decisions

All other management decisions, (e.g., weed control, tillage practices, residue management, etc.), were determined and executed by the TAPS team and were uniformly applied to the study area. Three plots per team were randomized and managed identically with their chosen decisions. Each team freely made choices in the decision areas, as they sought to be the most profitable, efficient, and highest yielding farm. As noted, the TAPS team did the physical management of all farms (e.g., operation of machinery, irrigation systems, appli-

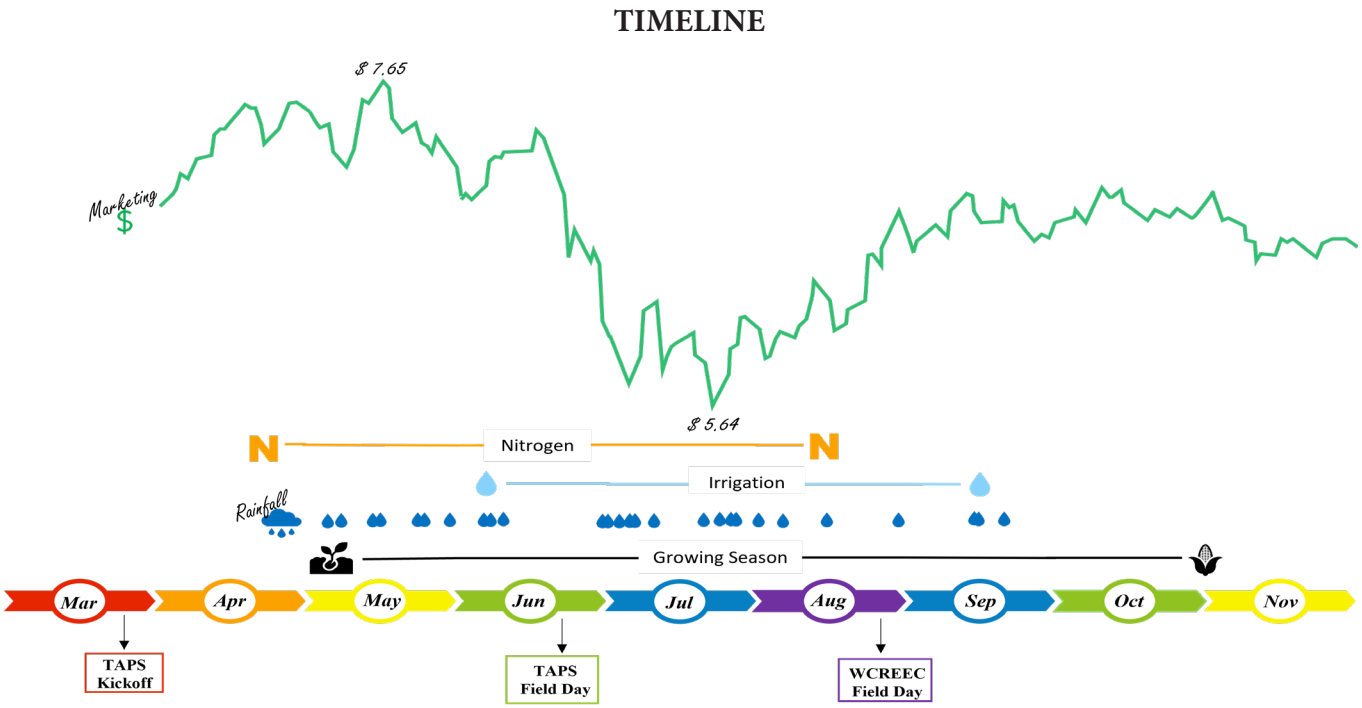

Figure 2. A brief look at the 2022 competition timeline, including marketing conditions and rainfall activity among the decision making and events.

cation of chemicals, and harvesting). Participants, however, were encouraged to actively observe their plots, install additional data collecting technology, and collect any additional data from their plots throughout the growing season, but at their own expense. No other inputs (e.g., fertilizers, additives, amendments, operations, sprays, etc.) were permitted.

Technology

One of the primary goals of the TAPS program is to provide contestants with an opportunity to use innovative technology and services in a financially risk-free environment. These innovations include equipment, ideas, strategies, new methods, etc. The core concept is for all involved to identify methods, technologies, and/or strategies that might bring financial and/or conservational value to their own operation(s) and to others who learn from them. Participants were provided access to a variety of technology, ideas, and methods that are designed to help inform production and marketing decisions. The technology provided included in-field and edge-of-field instrumentation, imagery products, sophisticated crop management models, and more. In addition, contestants had access to several agricultural services and recommendations provided by commercial soil labs, DSMs, and others.

Growing Conditions

North Platte has a semi-arid climate with the majority of annual precipitation occurring between late-April and mid-October. The predominant soil type at the site is a Cozad silt loam with approximately 1.5 inches/feet of lab-estimated plant available water (i.e., difference between field capacity and permanent wilting point). The 2022 growing season received 8.95 inches from May 1st to September 30th. As compared to the previous five years of TAPS competitions, this rainfall amount was less than the average of 15.15", and identical to the 8.95" received in 2020 and far less than the 21.2" received in 2019. Furthermore, the months of June, July, and August in 2022 averaged maximum daily temperatures of 92.0°F, which was much warmer than previous years for the same time period. There were no hail or wind events that caused damage during the growing season.

Figure 3. Participants were given the opportunity to use over ten technology companies' services, as well as provided a plethora of other data and research results.

DESCRIPTION OF AWARDS

Each competition had three cash awards, 1) Most Profitable Farm, $2,000, 2) Highest Input Use Efficiency, $1,000, and 3) Greatest Grain Yield, $500, adjusted by profitability score. Along with the monetary award, all winners also received a plaque, an oversized keepsake check, and a TAPS apparel item. Each award is described in detail below:

1. Most Profitable Award—Profit is the difference between total revenue minus total cost. The average per acre yield from each team's three plots was multiplied by their average market price and total number of acres; any government payments and insurance indemnities were then added to get total revenue. Costs were based on both fixed costs, as shown in the beginning budget, and variable expenses incurred during the season through the execution of their management decisions, which, when totaled, represented total cost. However, the costs of technology (e.g., sensors, imagery, and data collection) were not included in the profit equation. Since all farms in any one contest had the same number of acres, the farm with the most per acre profit was the most profitable.

2. Highest Input Use Efficiency Award—Efficiency was assessed using the Water-Nitrogen Intensification Performance Index (WNIPI, Lo et al., 2019) for the sprinkler and subsurface drip irrigated corn competitions and the Nitrogen Intensification Performance Index (NIPI, Lo et al., 2019) for the sorghum competition. The WNIPI and NIPI metrics were calculated as follows:

$$WNIPI = \frac{\left(\frac{Y_{Farm} - Y_{Control}}{Y_{Control}}\right)}{\left(\frac{ET_{Control} + I_{Farm}}{ET_{Control}}\right) \times \left(\frac{ANU_{Control} + N_{Farm}}{ANU_{Control}}\right)}$$

where, "Control" is a farm managed by UNL that receives no irrigation or N fertilizer (except for 10-34-0 at planting) and "Farm" referenced in the equation for yield, irrigation and Nitrogen is the farm managed by the participants. "Y" is yield in bushels/acre, "ET" is seasonal evapotranspiration in inch acre/acre, "I" is seasonal irrigation in inch acre/acre, "N" is total seasonal applied nitrogen in pounds/acre, and "ANU" is aboveground nitrogen uptake in pounds/acre. The farm with the highest value was determined the winner.

$$NIPI = \frac{\left(\frac{Y_{Farm} - Y_{Control}}{Y_{Control}}\right)}{\left(\frac{ANU_{Control} + N_{Farm}}{ANU_{Control}}\right)}$$

For the sorghum competition this was modified to not include the water portion of the formula since all farms in the irrigated portion received the same amount of irrigation water.

3. Greatest Grain Yield Award—adjusted by the winner's percentage of total possible profit. Total possible profit was the range of difference between the most and least profitable farms.

PARTICIPANTS

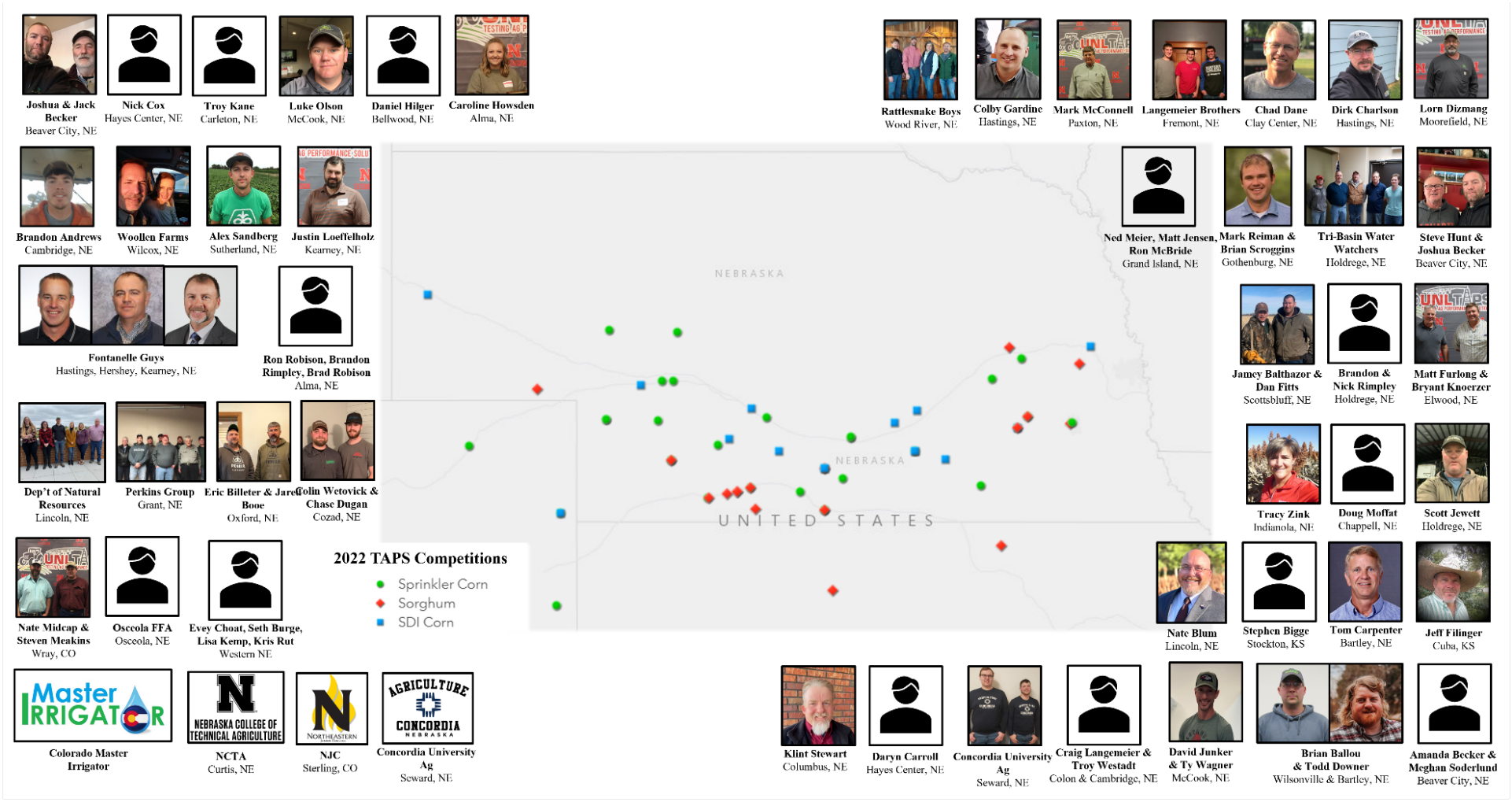

Figure 4. Location of the 2022 TAPS Farm Management Competition participants for the TAPS competitions administered in North Platte, Nebraska at WCREEC.

Figure 5. The TAPS program has seen continued success due to its partners and sponsors. Whether donating technology and time to install equipment, supplying seed, or making monetary donations, every one of these entities is greatly appreciated.

Sprinkler Corn Competition

In the 6th year of the sprinkler corn competition, 33 teams competed, including over 60 participants from throughout Nebraska, Colorado, and Kansas. In addition to the competitors, there were five non-competitive entities, along with the control farm used for determining contestant efficiency and UNL farms for benchmarking UNL recommendations and research. There was also a TAPS Crowdsourcing team that had all decisions determined by the public through polls on the TAPS website and Twitter.

FIELD DESIGN

As in past years, each team had three randomized plots, Figure 6, located at the intersection of Highway 83 and State Farm Road in North Platte, NE.

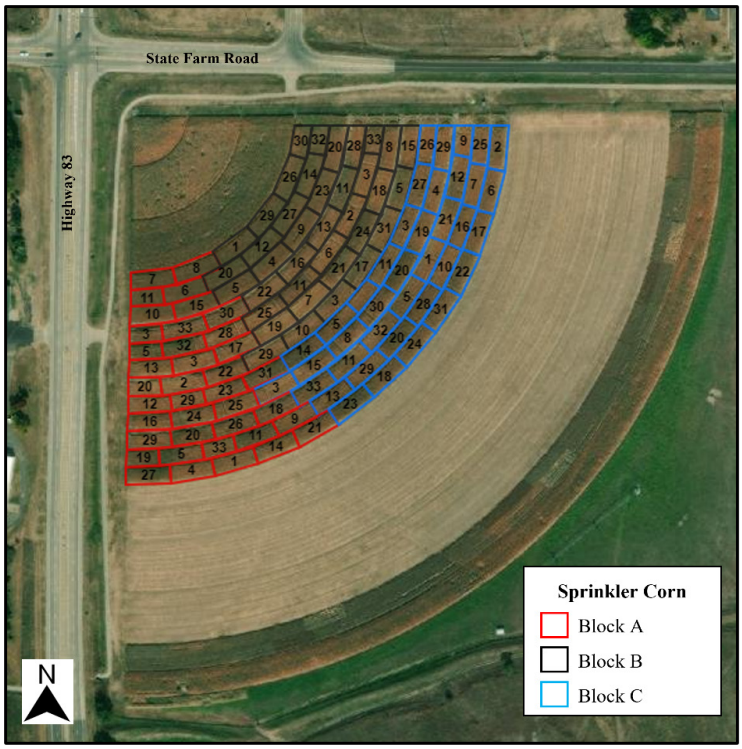

Figure 6. Farm numbers for the 2022 Sprinkler Corn Farm Management Competition held at the WCREEC in North Platte, NE. Each team was assigned a randomized plot in blocks A, B, and C.

PARTICIPANT DECISIONS

Participants were responsible for making economic and production management decisions, including multi-peril crop insurance coverage, hybrid type, seeding rate, nitrogen and irrigation amount and timing, and grain marketing. All decisions were submitted via forms on the TAPS website, through an online password protected portal that time-stamped all decisions. Participant selections are summarized on the following pages.

Agronomic Decisions

Agronomic decisions made by each team are shown in Table 1. Fourteen different corn hybrids were selected from seven seed companies (Table 1, Column 2). Five hybrids were selected by more than one team: Pioneer P1366AML, Pioneer P1185AM, Channel 214–22STXRIB, Big Cob B6562-VT2P and Dekalb DKC59–82RIB. Pioneer P1366AML was used by eleven teams, which made it the most used hybrid in the competition. One selected hybrid was from a company other than those providing seed, LG Seed 60C47. The Seitec 6433 variety had the lowest cost at $226 per bag, while Channel 214–22STXRIB had the highest cost at $285 per bag. Farm 23 had the lowest seeding rate at 27,500 seeds/acre and planted hybrid Pioneer P1366AML. The highest seeding rate of 36,000 seeds/acre was planted by Farm 30 with hybrid Pioneer P1185AM (Table 1, Column 3).

Total N fertilizer applied, excluding the control (Farm 9), ranged from 107 to 370 pounds/acre (Table 1, Column 11). In a modification from previous years, participants had a fifth fertigation opportunity at the R3 growth stage. On average, 28% of N was applied at pre-plant, 28% as a side-dress, and the remaining 44% was applied over the five fertigation options with 11.5%, 12.5%, 11%, 6% and 3% applied on July 8, 19, 29, and August 9 and 17, respectively. Nine teams chose to take advantage of the additional fifth fertigation option.

The irrigation season started June 9 and concluded on September 15. Teams were allowed to irrigate twice a week. Three irrigations in July were cancelled due to rainfall events. Excluding the control (Farm 9), seasonal irrigation ranged from 0.00 (Farm 20) to 22.24 inches (Farm 12), while the average irrigation applied per farm was 9.44 inches (Table 1, Column 12).

Table 1: Summary of select agronomic inputs from the 2022 TAPS sprinkler corn competition.

Farm #	Hybrid Name	Seeding Rate (1,000/ac)	Nitrogen Fertilizer								**Irrigation (in)
			Apr 28	Jun 16	Jul 08	Jul 19	Jul 29	Aug 9	Aug 17	Total	
			---------- (lbs/ac)----------								
1	Pioneer P0622AML	34	20	20	25	30	0	30	30	155	2.96
2	Pioneer P1563AML	34	0	50	30	30	30	30	30	200	9.83
3	Pioneer P1366AML	34	45	60	30	30	30	0	0	195	6.45
4	Pioneer P1366AML	32	80	60	20	0	30	0	0	190	14.53
5	Pioneer P1366AML	34	45	60	30	30	30	0	0	195	11.93
6	Pioneer P1185AM	35	50	20	20	30	20	20	10	170	10.75
7	Fontanelle 11D637	34	50	65	30	30	0	20	0	195	15.84
8	Channel 210–46VT2PRIB	34	100	120	30	30	30	30	30	370	7.33
*9	Pioneer P1366AML	34	0	0	0	0	0	0	0	0	0.00
10	Channel 214–22STXRIB	33	110	60	0	20	20	15	0	225	6.13
11	Pioneer P1366AML	34	45	60	30	30	30	0	0	195	14.92
12	Pioneer P1185AM	34	40	75	30	30	10	0	0	185	22.24
13	Big Cob B6562-VT2P	29	50	0	30	30	30	0	0	140	9.30
14	Dekalb DKC59–82RIB	34	100	0	30	0	30	0	0	160	7.63
15	Pioneer P1366AML	31	80	0	30	30	30	30	0	200	15.01
16	LG Seed 60C47	33	37	40	0	0	30	0	0	107	12.32
17	Pioneer P1185AM	33	75	30	0	30	30	30	30	225	13.46
18	Dekalb DKC59–82RIB	33	70	85	0	30	0	0	0	185	8.57
19	Seitec 6433	32	0	60	30	30	30	0	0	150	9.40
20	Pioneer P1366AML	34	60	92	0	0	0	0	0	152	0.00
21	Pioneer P1185AM	32	60	100	25	25	25	15	0	250	0.95
22	Channel 214–22STXRIB	33.5	100	100	20	30	20	10	10	290	15.95
23	Pioneer P1366AML	27.5	30	115	0	25	0	0	0	170	7.26
24	Pioneer P1185AM	35	0	100	30	30	30	30	0	220	15.01
25	Channel 214–78GDVT2PRIB	30	120	40	15	15	15	15	0	220	0.63
26	Pioneer P1185AM	33.25	60	60	30	20	0	30	0	200	11.84
27	Pioneer P1366AML	32	0	0	30	30	30	30	30	150	10.43
28	Dekalb DKC64–65RIB	33.5	100	0	30	30	30	20	0	210	9.91
29	Pioneer P1366AML	34	45	60	30	30	30	0	0	195	6.45
30	Pioneer P1185AM	36	50	55	25	15	10	10	5	170	5.43
31	Fontanelle 11DT591	33.5	40	90	15	15	15	0	0	175	9.47
32	Big Cob B6562-VT2P	32	0	0	30	30	30	0	25	115	1.21
33	Pioneer P1366AML	34	45	60	30	30	30	0	0	195	8.95

*Control ** "Irrigation" includes both irrigation and water applied with fertigation applications.

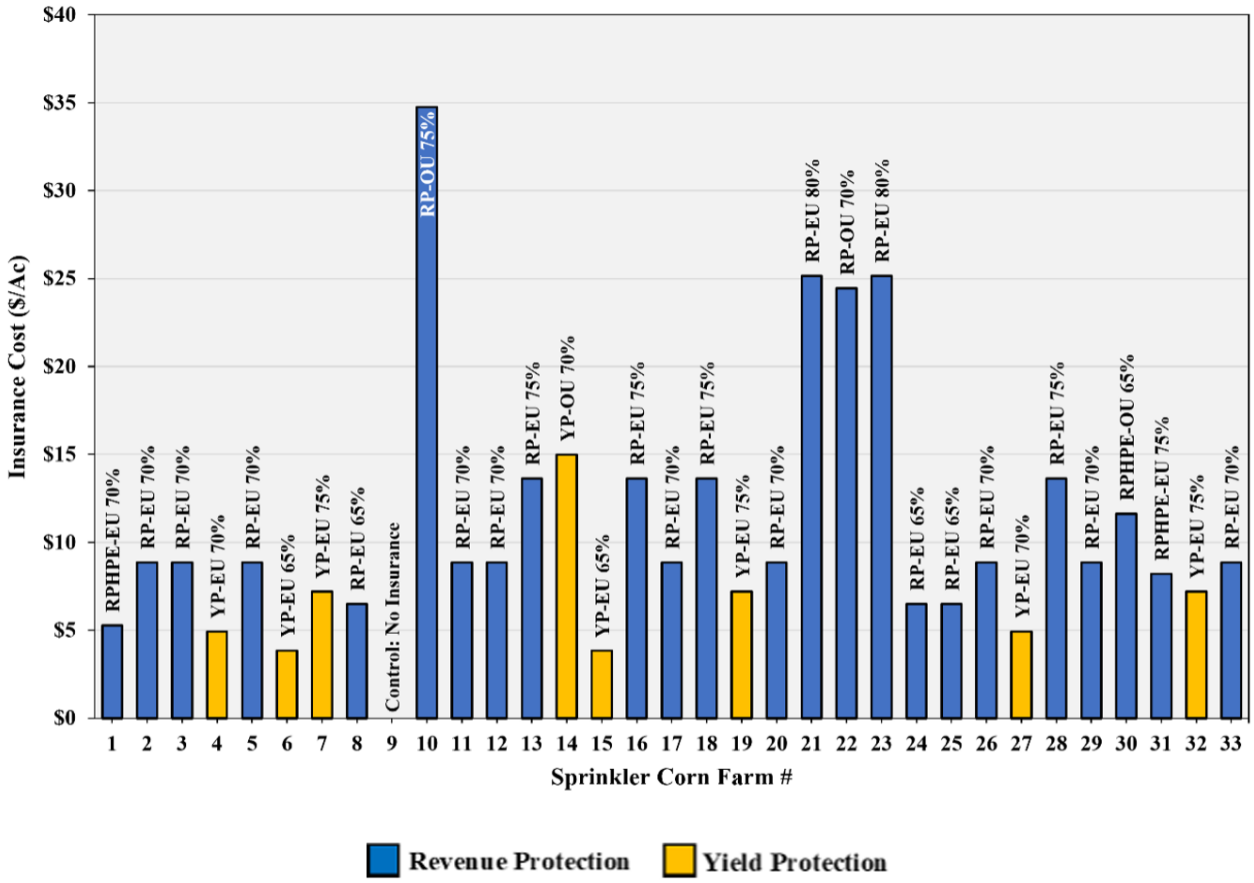

Figure 7. Insurance cost ($/acre) for the individual sprinkler irrigated corn competition teams. Policies offered included Revenue Protection (RP), Revenue Protection with Harvest Price Exclusion (RP-HPE), and Yield Protection (YP) with either Optional Units or Enterprise Units.

Economic Decisions

Participants were required to select a multi-peril crop insurance policy, either revenue protection (RP), yield protection (YP), or revenue protection with harvest price exclusion (RP-HPE), with at least 65% coverage. There were no hail or wind insurance options available. Twenty-one teams chose to purchase RP policies, three farms went with RP-HPE and eight chose YP policies (Figure 7). Of the teams, four used Optional Units (OU), while the other 28 teams purchased Enterprise Units (EU). Chosen by ten teams, RP-EU at 70% coverage was the most common selection. The average cost across all competitors was $10.98/acre. The least expensive policy was YP-EU at 65% coverage ($3.83/acre), selected by Farms 6, and 15. The most expensive was RP-OU at 75% coverage ($34.76/acre), Farm 10.

Contestants could market expected production, trend adjusted Average Production History (APH), from April 1 through November 30. There were five methods allowed for selling grain: 1) forward contracting, 2) basis contracting, 3) hedge-to-arrive contracting, 4) hedge using futures contracting, and 5) cash sales. The 2022 marketing year saw prices increase considerably from the previous year, due to the increased world demand. World demand for US corn increased due to dry regions of Europe, the war in Ukraine, and general world concern for commodity shortages. Stored crop grain cash prices were much higher than the December futures prices, and December futures never reached the highs of the May and July futures prices. The seasonal price variation, however, did follow a normal marketing year with high cash prices observed during the early summer.

The marketing decisions led to average prices received from $6.11 to $11.53/bushel (Figure 8). Farm 20, who sold all their grain using a spot cash sale on the last day of marketing, and received an indemnity payment due to low

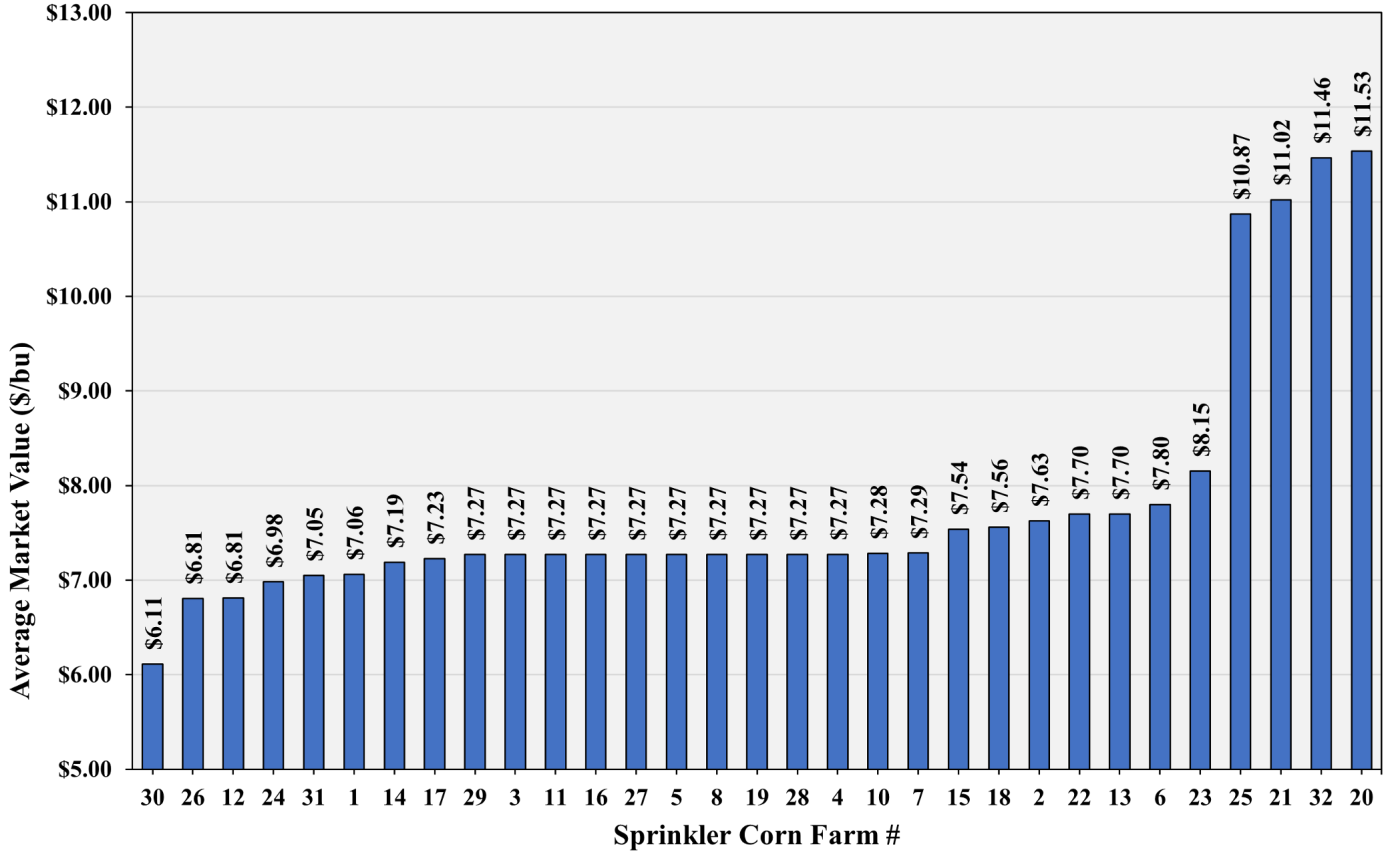

Figure 8. Average market value received ($/bushel) for the individual sprinkler irrigated corn competition teams.

yields, achieved the highest average price of the season. Nine teams chose not to sell any of their production during the season, therefore it was sold at the end of the competition at the November 30 price of $7.27/bushel. Any unsold grain after the close of the competition received a charge of $0.05/bushel. If a team sold more grain than was produced, those bushels were bought back at the $7.27/bushel price, along with a penalty of $0.10/bushel. Seven teams received indemnity payments based on their low yields and their crop insurance selection, including Farms 1, 10, 20, 21, 23, 25, and 32. This additional revenue ultimately increased their average market value drastically.

RESULTS AND RANKINGS

Grain Yield

Although the sprinkler corn grain yields averaged less than any other year, the greatest grain yield was just 3.3 bushels/acre less than last year's award winner. The grain yields for the competition averaged 199.7 bushels/acre, which was much below the field's APH of 240 bushels/acre (Table 2, Column 2). Eight teams had an average yield that exceeded the field's APH, including Farms 4, 6, 12, 15, 17, 22, 24 and 26. Excluding control Farm 9, the farms ranged from 102.3 bushels/acre (Farm 25) to 270.6 bushels/acre (Farm 24). Figure 9A shows the relationship between grain yield and total N fertilizer applied based on the decisions made by participants. The dispersion of the points indicates that another input was more limiting than N. Indeed, the grain yield had a strong response to irrigation amount with the seasonal irrigation explaining 93% of yield variability (Figure 9B). Maximum yield of 270.6 bu/acre by Farm 24 applied 15.01 inches of applied water, which was over 7 inches less than Farm 12 who had a similar yield of 267.6 bu/acre. The most efficient farm (Farm 16) applied 2.69 inches less water than the farm with the maximum yield (Farm 24). With the strong relationship between grain yield to irrigation response, the most efficient farm could have applied more water and seen an economical yield response.

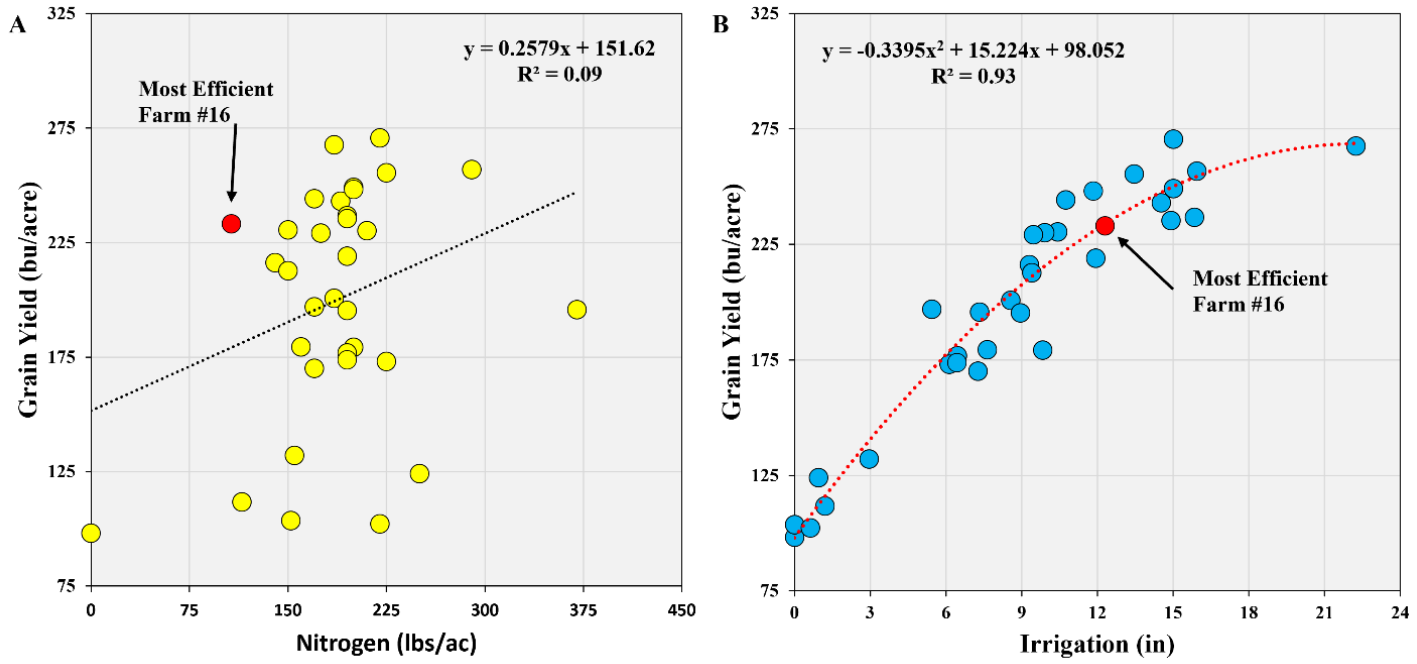

Figure 9. Sprinkler corn grain yield response to seasonal total nitrogen fertilizer (A) and irrigation (B) at the WCREEC in North Platte, NE. The most efficient farm (Farm 16) as measured by the Water Nitrogen Intensification Performance Index (WNIPI) is denoted in red.

Input Use Efficiency

The Water Nitrogen Intensification Performance Index (WNIPI, Lo et al., 2019), was used to quantify input use efficiency and is reported in Figure 10. It compares the effect of N and irrigation input on grain yield with respect to a control treatment. The control is a baseline and is used to measure the effect on yield of any added water or N fertilizer. Control Farm 9 had no added N or irrigation and yielded 98.2 bushels/acre. Farm 16 had the highest WNIPI score at 0.414 and therefore was the most N and water efficient (Table 2, Column 8). This farm applied 107 pounds of N/acre and 12.32 inches of irrigation water, resulting in a yield of 233.1 bushels/acre. Agronomic Efficiency (AE) measures the effect each added pound of N has in terms of bushels (Table 2, Column 6). Farm 16 yielded 134.9 bushels/acre more than the control Farm 9. When the yield difference is divided by the amount of additional applied N fertilizer, 107 pounds/acre, the AE is calculated to be 1.26 bu increase per lb of N. This is over double the competition average of 0.56 bushels/pound of N of all other farms, except the control farm. Irrigation Water Use Efficiency (IWUE) is measured in a similar manner, except that N is replaced with applied water input (Table 2, Column 7). Farm 16's IWUE was calculated to be 10.95 bushels/acre-inch. The overall average was 11.8 bushels/acre-inch.

Profitability

Profitability in the TAPS competition is derived from the same formula as in any operation, total revenue minus total cost equals profit. The average yield from each team's plots was multiplied by their average market price per bushel and any government payments, insurance indemnities, and/or losses were then added into this value to calculate total revenue. Costs were based on both fixed costs, as shown in the beginning budget, and variable expenses incurred during the season through the execution of their management decisions, which, when totaled, represented total cost. However, the costs of technology

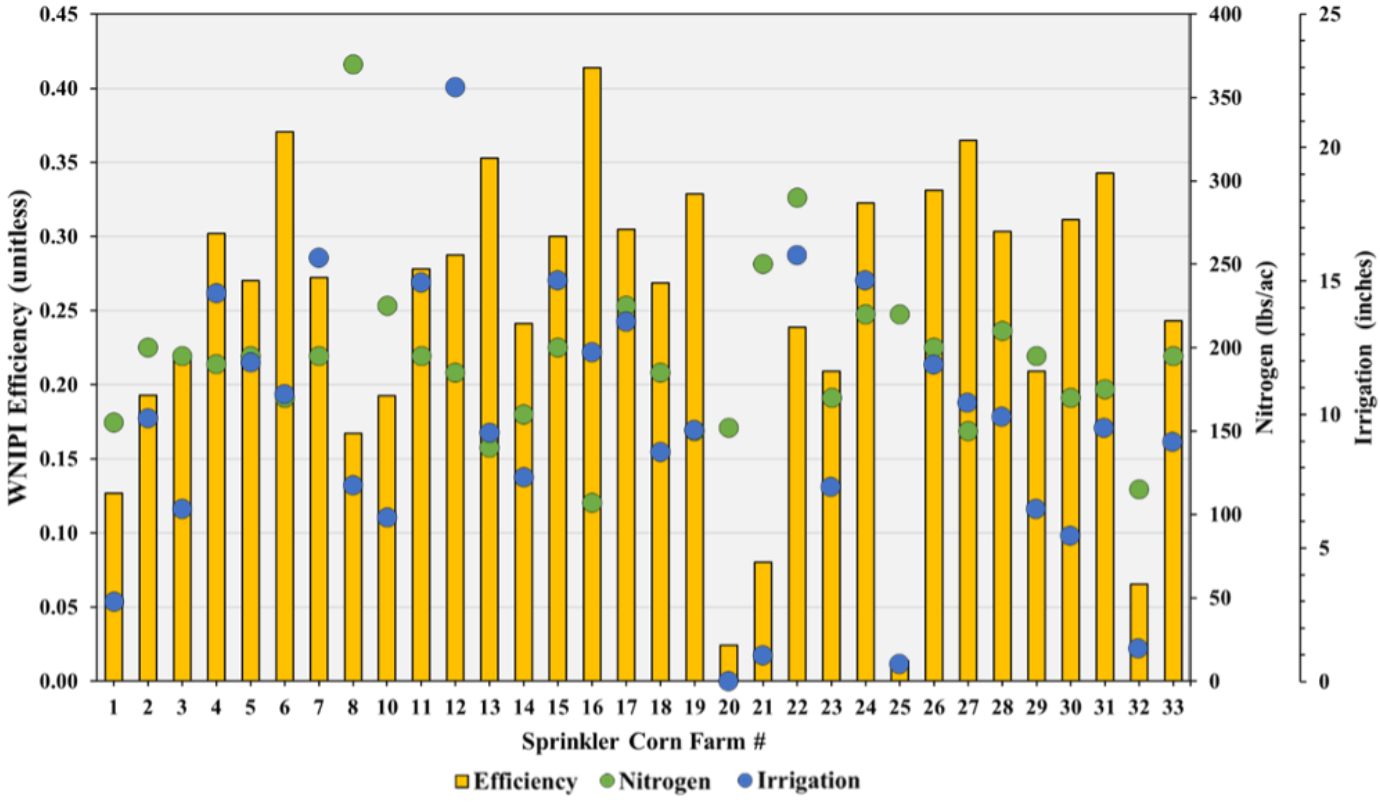

Figure 10. Input use efficiency (WNIPI) compared against irrigation (inches) and N fertilizer (lbs/acre) in the sprinkler corn competition.

(e.g., sensors, imagery, and data collection) were not included in the profit equation. Since all farms had the same number of acres, the farm with the most profit per acre was the most profitable.

Revenue ranged from a low of $6.11/bushel, Farm 30, to a high of $11.53/bu, Farm 20 (Table 2, Column 3). The lowest cost per acre was achieved by Farm 32 at $704/acre (Table 2, Column 4) and the highest cost per acre was Farm 22 at $1,002/acre.

Table 2: Summary of data from the 2022 TAPS sprinkler corn competition.

Farm #	Grain Yield ** (bu/ac)	Revenue ($/bu)	Cost ($/ac)	Profit ($/ac)	AE (bu/lbs)	IWUE (bu/ac-in)	WNIPI (Unitless)
1	132.0	$7.06	$775	$157	0.22	11.4	0.127
2	179.3	$7.63	$849	$519	0.41	8.2	0.193
3	176.8	$7.27	$831	$455	0.40	12.2	0.218
4	243.1	$7.27	$887	$881	0.76	10.0	0.302
5	219.0	$7.27	$871	$721	0.62	10.1	0.270
6	244.2	$7.80	$919	$985	0.86	13.6	0..371
7	236.7	$7.29	$893	$832	0.71	8.7	0.272
8	195.7	$7.27	$980	$443	0.26	13.3	0.167
*9	98.2	-	-	-	-	-	-
10	173.1	$7.28	$910	$351	0.33	12.2	0.192
11	235.4	$7.27	$893	$819	0.70	9.2	0.278
12	267.6	$6.81	$923	$899	0.92	7.6	0.288
13	216.2	$7.70	$835	$830	0.84	12.7	0.353
14	179.5	$7.19	$814	$477	0.51	10.7	0.241
15	249.2	$7.54	$877	$1,002	0.75	10.1	0.300
16	233.1	$7.27	$820	$875	1.26	11.0	0.414
17	255.4	$7.23	$906	$940	0.70	11.7	0.305
18	200.7	$7.56	$837	$680	0.55	12.0	0.269
19	212.7	$7.27	$800	$746	0.76	12.2	0.329
20	103.6	$11.53	$735	$460	0.04	-	0.024
21	124.1	$11.02	$843	$525	0.10	27.3	0.080
22	256.8	$7.70	$1,002	$976	0.55	9.9	0.239
23	170.1	$8.15	$817	$570	0.42	9.9	0.209
24	270.6	$6.98	$955	$934	0.78	11.5	0.323
25	102.3	$10.87	$796	$316	0.02	6.4	0.014
26	248.1	$6.81	$873	$816	0.75	12.7	0.331
27	230.5	$7.27	$819	$857	0.88	12.7	0.365
28	230.1	$7.27	$875	$798	0.63	13.3	0.303
29	173.7	$7.27	$821	$442	0.39	11.7	0.209
30	196.9	$6.11	$817	$386	0.58	18.2	0.311
31	229.1	$7.05	$848	$767	0.75	13.8	0.343
32	111.7	$11.46	$704	$576	0.12	11.2	0.065

*Control **Reported as 15.5% grain moisture content.

AE—Agronomic Efficiency (bushel/pound N applied)

IWUE—Irrigation Water Use Efficiency (yield increase over the control plot, bushel divided by inches of water applied)

WNIPI—Water-Nitrogen Intensification Performance Index

With revenue and cost considered, Farm 15 was the most profitabile with $1,002/acre profit, just $17/acre more than the second ranked team (Figure 11). The combination of the group's fifth place yield of 249 bushel/acre, along with a per acre revenue and cost of $1,879 and $877, respectively, were the main factors in winning the top award in the 2022 Sprinkler Corn competition.

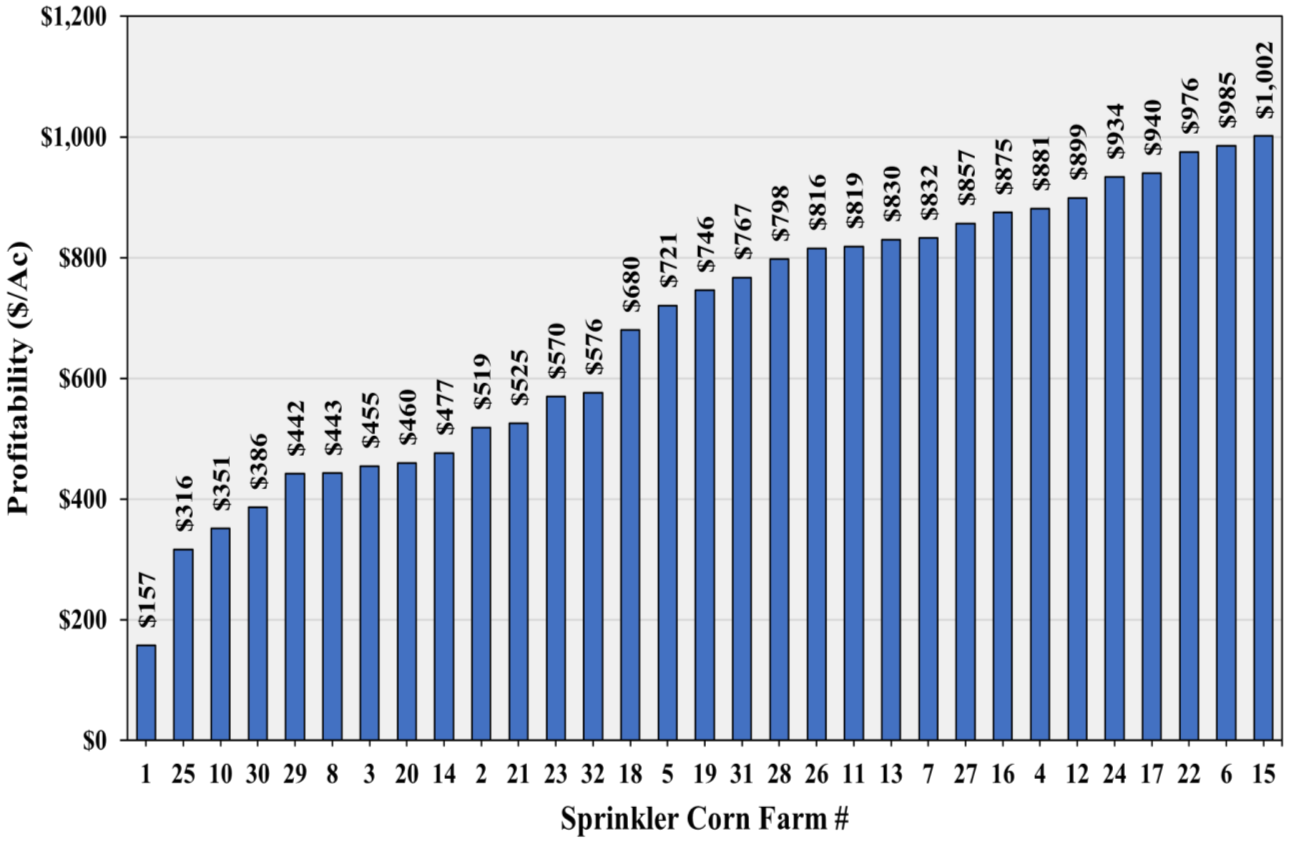

Figure 11. Profit per acre received for the individual sprinkler irrigated corn competition teams.

AWARD RECIPIENTS

Photo 1. The ***Greatest Grain Yield Award*** was won by Luke Olson of McCook, NE (Farm 24) with a yield of 270.6 bu/ac. Olson planted Pioneer P1185AM at 35,000 seeds/acre. Olson (right) is pictured with Matt Stockton (left).

Photo 2. The ***Highest Input Use Efficiency Award*** was presented to Woollen Farms (Farm 16). Shawn Woollen (left) is pictured with Chuck Burr (right). The team planted LG Seed 60C47 at a seeding rate of 33,000 seeds/acre and applied 107 pounds/acre of N and 12.32 inches/acre of irrigation water.

Photo 3. The Perkins Group from around the Grant, NE area (Farm 15), won the ***Most Profitable Award***. The team included Brent Gloy, Bruce Young, Curt Richmond, Jeremy Hagan, Nick Turner, Pat McGreer, Shawn Turner, Ted Tietjen, and Troy Kemling. The group planted Pioneer P1366AML at 31,000 seeds/acre. They applied 200 pounds/acre of N and 15.0 inches/acre of irrigation water, which led to a yield of 249.2 bushels/acre. The combination of the group's fifth place yield and average revenue of $7.54/bushel were the main factors in winning the top award in the 2022 Sprinkler Corn competition. Nick Turner (left) and Ted Tietjen (center) are pictured with Chuck Burr (right).

Subsurface Drip Irrigated Corn Competition

In the 4th year of the Subsurface Drip Irrigated (SDI) corn competition, 16 teams competed. There were 34 people who participated from across Nebraska and Colorado. One of the 16 teams, Farm 9, was the control farm used for determining contestant efficiency.

FIELD DESIGN

As in the past, each team had three randomized plots, Figure 12, located south of the WCREEC office, southwest of the Highway 83 and State Farm Road intersection in North Platte, NE.

PARTICIPANT DECISIONS

Participants were responsible for making economic and production management decisions, including insurance coverage, hybrid type, seeding rate, nitrogen and irrigation amount and timing, and marketing. For the first time in the competition's history, participants were provided an insecticide management decision, which included what product and at what amount. These decisions were submitted via a form through an online password protected portal that time-stamped all decisions. The decisions participants selected are summarized below.

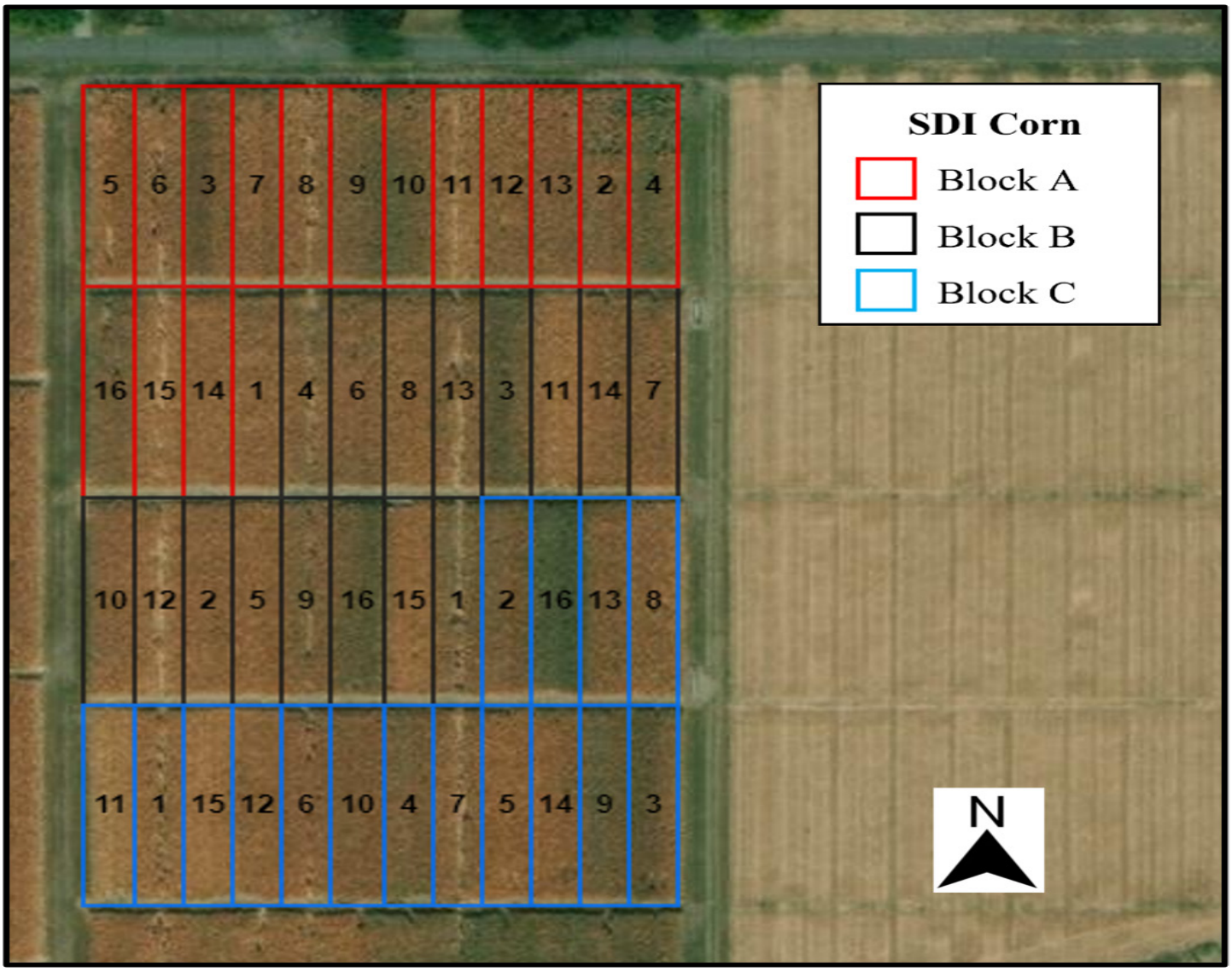

Figure 12. Plot layout for the 2022 SDI Corn Farm Management Competition held at the West Central Research, Extension, & Education Center in North Platte, NE. Each team had a randomized plot located in blocks A, B, and C.

Agronomic Decisions

All agronomic decisions made by each team are shown in Table 3. Thirteen different corn hybrids were selected from seven seed companies (Table 3, Column 2). Three teams selected Pioneer P1366AML, two teams chose Pioneer P1185AM, while all other hybrids were only chosen by one team. Seitec 6433 G2Pro had the lowest cost at $226 per bag and Pioneer P1742Q had the highest cost at $309 per bag. For seeding rate, Farm 11 had the lowest rate at 30,000 seeds/acre and planted hybrid Big Cob 6612 (Table 3, Column 3). The highest seeding rate was 38,000 planted by Farm 1 with hybrid Dekalb DKC59–82RIB.

The total N fertilizer applied, not including the control (Farm 9), ranged from 110 to 250 pounds/acre (Table 3, Column 12). In a modification from previous years, participants had a fifth fertigation opportunity at the R3 growth stage. On average, 17% of N was applied at pre-plant, 25% as a side-dress, and the remaining 58% was applied over the five fertigation options with 12.5%, 15%, 15.5%, 10% and 5% applied on July 6, 18, 25, August 1 and 10, respectively. Six teams chose to take advantage of the newly added fifth fertigation option.

The teams were given the option to irrigate, starting June 6 and concluding September 15. Excluding the control (Farm 9), seasonal irrigation ranged from 7.05 (Farm 14) to 17.15 inches (Farm 5), with an average of 11.03 inches (Table 3, Column 13). The average depth of irrigation per event, excluding fertigation, was 0.61 inches.

Table 3. Summary of select agronomic inputs from the 2022 TAPS SDI corn competition.

Farm #	Hybrid Name	Seeding Rate (1,000/ac)	Insecticide Product & Rate (oz/ac)	Nitrogen Fertilizer								**Irrigation (in)
				May 10	Jun 14	Jul 06	Jul 18	Jul 25	Aug 01	Aug 10	Total	
				(lbs/ac)								
1	Dekalb DKC59–82RIB	38	Hero (4)	60	0	30	30	0	25	20	165	8.80
2	Pioneer P1237AM	35	Brigade (6.4)	0	100	30	30	30	20	20	230	11.35
3	Pioneer P1563AML	32	None	0	35	0	30	30	25	0	120	12.20
4	Pioneer P1185AM	31	Hero (1.76)	30	50	0	0	30	0	0	110	11.45
5	Pioneer P1185AM	34	Brigade (6.4)	60	60	20	20	20	20	10	210	17.15
6	Fontanelle 12DT631	32	None	0	140	0	0	20	0	0	160	8.90
7	Hoegemeyer 8447AM	34	Brigade (2.1)	0	60	30	30	30	0	0	150	9.20
8	Pioneer P1742Q	34	Prevathon (14)	0	70	0	30	30	15	0	145	11.85
*9	Pioneer P1366AML	34	None	0	0	0	0	0	0	0	0	0.00
10	Seitec 6433G2Pro	32.5	Hero (4)	45	0	30	30	30	0	0	135	11.35
11	Big Cob 6612	30	None	50	0	30	30	30	30	0	170	8.45
12	Pioneer P1170	34	Hero (4)	80	0	30	30	25	0	0	165	10.85
13	Pioneer P1366AML	32	Brigade (6.4)	0	0	30	30	30	30	30	150	9.85
14	Dekalb DKC62–89	32	None	70	0	25	25	25	25	0	170	7.05
15	Pioneer P1366AML	33.3	Hero (4)	0	100	30	30	30	30	30	250	13.40
16	Prairie Valley 113V89	33	Hero (4)	40	0	30	30	30	30	20	180	13.55

* Control ** "Irrigation" includes both irrigation and water applied with fertigation applications.

In a change from past years, the teams were given the option to apply insecticides to their plots. Plots were scouted by UNL Associate Professor of Entomology, Dr. Julie Peterson, and her team for Western Bean Cutworm and reported to participants. Teams then had the option to select between three products, Brigade at 2.1 or 6.4 fl oz/acre, Hero at 1.76 or 4.0 fl oz/acre, or Prevathon at 14 or 20 fl oz/acre. Excluding the control (Farm 9), eleven teams chose to apply insecticide based on scouting reports (Table 3, Column 14). The most common choice chosen by five teams, Farms 1, 10, 12, 15 and 16, was Hero at a rate of 4 oz/acre. Further explanation of the insecticide scouting and decisions results can be found in the September 2022 issue of the TAPS newsletter on the TAPS website (www.taps.unl.edu/taps-digital-newsletter-archive).

Economic Decisions

Participants were required to select a multi-peril crop insurance policy, either revenue protection (RP), yield protection (YP), or revenue protection with harvest price exclusion (RP-HPE), with at least 65% coverage. There were no hail or wind insurance options available. Nine teams chose to purchase RP policies, one farm went with RP-HPE and five chose YP policies (Figure 13). Of the 15 competing teams, only one team used Optional Units (OU), while the other 14 teams purchased Enterprise Units (EU). Chosen by three teams each, RP-EU at 70% and 80% coverage were the most common selections. The average cost across all competitors was $11.85/acre. The least expensive policy was YP-EU at 65% coverage ($3.83/acre), selected by Farms 3, and 7. The most expensive was RP-EU at 80% coverage ($25.15/acre), chosen by Farms 10, 12 and 14.

Contestants could market expected production, trend adjusted Average Production History (APH), from April 1 through November 30. There were five methods allowed for selling grain: 1) forward contracting, 2) basis contracting, 3) hedge-to-arrive contracting, 4) hedge using futures contracting, and 5) cash sales. The 2022 marketing year saw prices increase considerably from the previous year, due to the increased world demand. World demand for US corn increased due to dry regions of Europe, the war in Ukraine, and general world concern for commodity shortages. Stored crop grain cash prices were much higher than the December futures prices, and December futures never reached the highs of the May and July futures prices. The seasonal price variation, however, did follow a normal marketing year with high cash prices observed during the early summer.

Six teams chose not to sell any of their production during the season, therefore it was sold at the end of the competition at the November 30 price of $7.27/bushel. Any unsold grain after the close of the competition received a charge of $0.05/bushel. If a team sold more grain than was produced, those bushels were bought back at the $7.27/bushel price, along

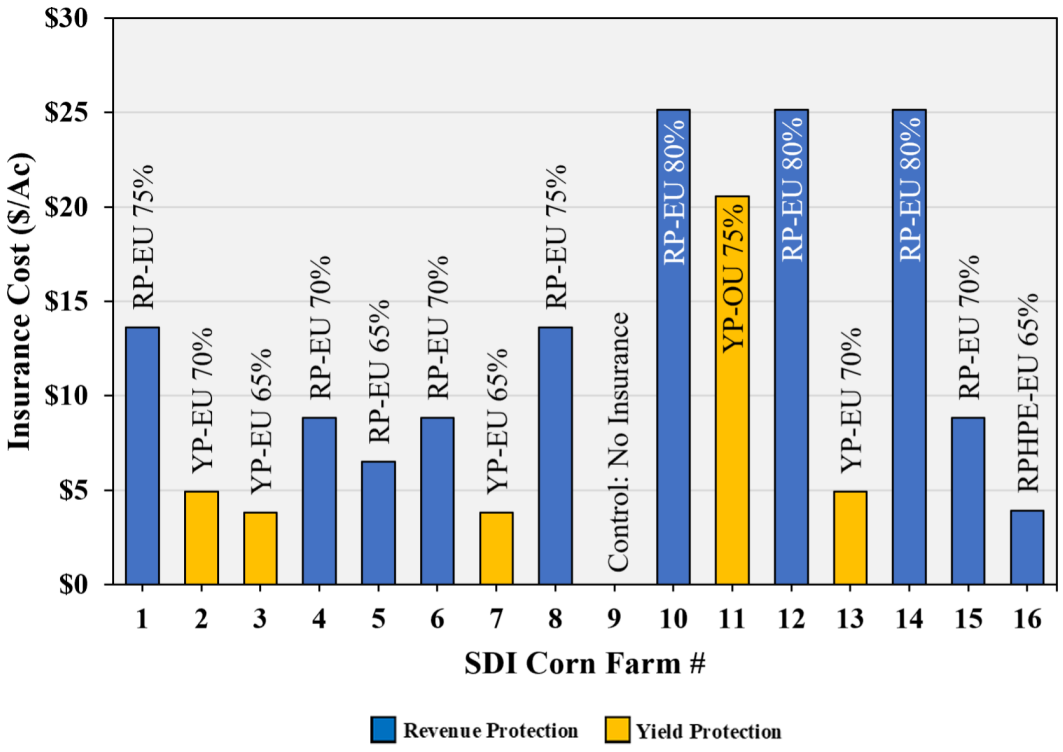

Figure 13. Insurance cost ($/acre) for the individual SDI corn competition teams. Policies offered included Revenue Protection (RP), Revenue Protection with Harvest Price Exclusion (RP-HPE), and Yield Protection (YP) with either Optional Units (OU) or Enterprise Units (EU).

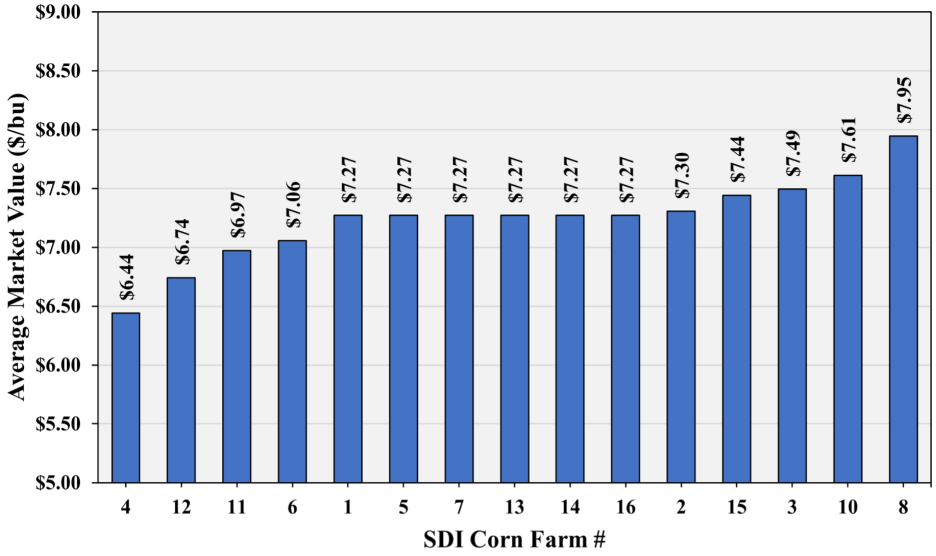

Figure 14. Average market value received ($/bushel) for the individual SDI corn competition teams.

with a penalty of $0.10/bushel. Four teams chose to sell using a combination of two methods, while one team used three methods, two teams used four methods and one team used all five methods. These marketing decisions led to the average price received ranging from a low of $6.44/bushel to a high of $7.95/bushel (Figure 14). Farm 8, who used multiple futures contracts and then sold grain using a basis contract and spot cash sale, received the highest price of the season at $7.95/bushel. The average price per bushel received for all teams was $7.24.

RESULTS AND RANKINGS

Grain Yield

Although the highest yield in the SDI corn competition was lower than the previous year, the average of all teams was quite similar. The grain yields for the SDI competition this year averaged 254.4 bushels/acre (Table 4, Column 2), which exceeded the field's APH of 240 bushels/acre. Only two of the teams fell short of meeting the field's APH (Farms 9, and 14), while the other 14 teams only deviated by 43 bushels/acre.

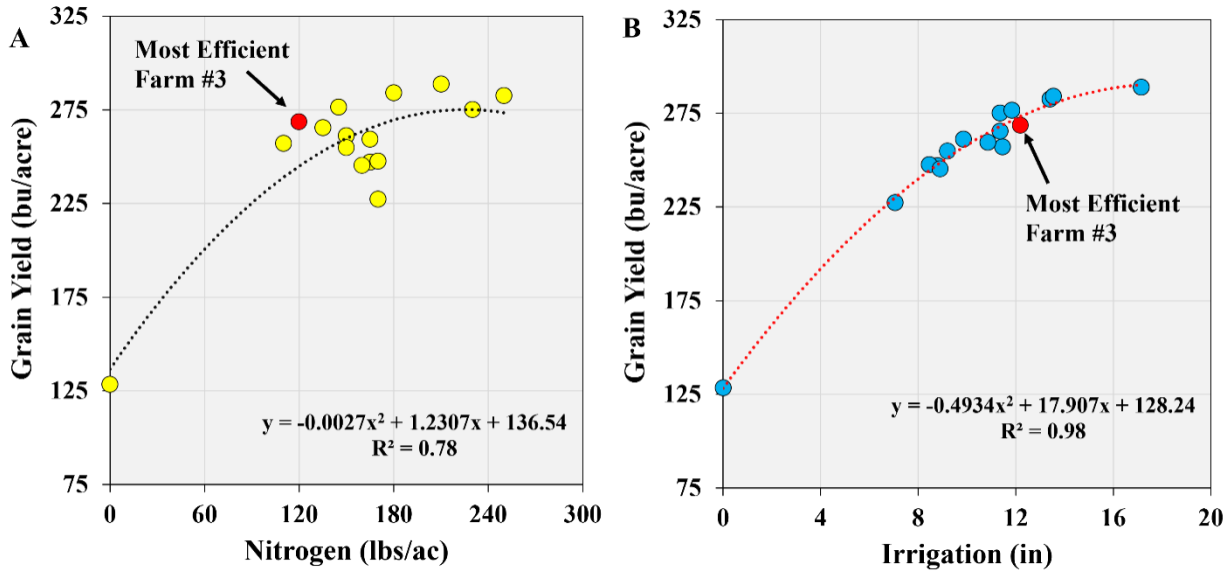

Figure 15. SDI corn grain yield response to seasonal total nitrogen fertilizer (A) and irrigation (B) at the WCREEC in North Platte, NE. The most efficient farm as measured by the Water Nitrogen Intensification Performance Index (WNIPI) is denoted in red.

Except for the control Farm 9, the farms ranged from 227.4 bushels/acre (Farm 14) to 288.9 bushels/acre (Farm 5). Figure 15A shows a slight grain yield response to total N fertilizer, however, that response is mostly driven by the control treatment (i.e., zero N fertilizer). Whereas, grain yield had a strong diminishing response to irrigation, explaining 98% of yield variability (Figure 15B). With the strong relationship between grain yield to irrigation response, the most efficient farm could have applied more water and seen an economical yield response.

Input Use Efficiency

The Water Nitrogen Intensification Performance Index (WNIPI, Lo et al., 2019), was used to quantify input use efficiency and is reported in the last Column in Table 4. It compares the effect of N and irrigation input on grain yield with respect to a control treatment. The control is a baseline and is used to measure the effect of any added water or N fertilizer. The contest control was Farm 9, which had no added N or irrigation and produced 128.5 bushels/acre. The farm with the highest efficiency for this year with a WNIPI of 0.341 was Farm 3. This farm applied 120 pounds of N/acre and 12.2 inches of irrigation water resulting in a yield of 268.5 bushels/acre. Agronomic Efficiency (AE) measures the effect each added pound of N has in terms of bushels. Farm 3 yielded 140 bushels/acre more than the control Farm 9. When the yield difference is divided by the amount of applied N fertilizer, 120 pounds/acre, the AE is calculated to be 1.17 bushels for every pound of N fertilizer applied (Table 4, Column 6). This is higher compared to the average of 0.83 bushels/pound of N of all other farms, except the control farm. Irrigation Water Use Efficiency (IWUE) is measured in a similar manner, except pounds of N are replaced with acre-inches/acre of applied water (Table 4, Column 7). Farm 3's IWUE was calculated to be 11.5 bushels/acre-inch. The overall average was 12.4 bushels/acre-inch.

Profitability

Profitability in the TAPS competition is derived from the same formula as it is in any operation, total revenue minus total cost equals profit. The average yield from each team's three plots was multiplied by their average market price per bushel; any government payments, insurance indemnities, and/or losses were then added into this value to calculate total revenue. Costs were based on both fixed costs, as shown in the beginning budget, and variable expenses incurred during the season through the execution of their management decisions, which, when totaled, represented total cost. However, the costs of technology (e.g., sensors, imagery, and data collection) were not included in the profit equation. Since all farms had the same number of acres, the farm with the most per acre profit was the most profitable.

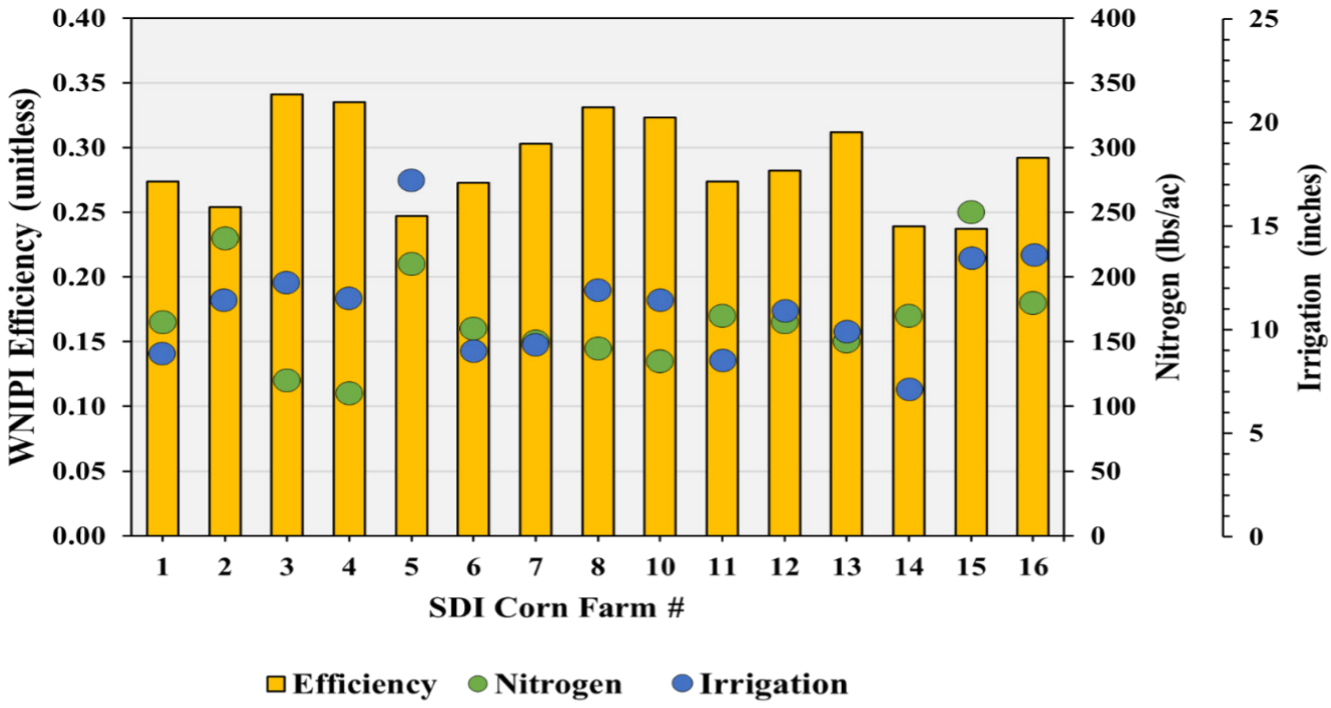

Figure 16. Input use efficiency (WNIPI) compared against irrigation (inches) and N fertilizer (lbs/acre) in the SDI corn competition.

Table 4: Summary of data from the 2022 TAPS SDI corn competition.

Farm #	Grain Yield** (bu/ac)	Revenue ($/bu)	Cost ($/ac)	Profit ($/ac)	AE (bu/lbs)	IWUE (bu/ac-in)	WNIPI (unitless)
1	247.1	$7.27	$1,010	$786	0.72	13.5	0.274
2	275.2	$7.30	$1,011	$1,000	0.64	12.9	0.254
3	268.5	$7.49	$923	$1,089	1.17	11.5	0.341
4	257.2	$6.44	$923	$734	1.17	11.2	0.335
5	288.9	$7.27	$1,057	$1,044	0.76	9.4	0.247
6	245.3	$7.06	$922	$809	0.73	13.1	0.273
7	254.8	$7.27	$924	$928	0.84	13.7	0.303
8	276.6	$7.95	$1,005	$1,192	1.02	12.5	0.331
*9	128.5	-	-	-	-	-	-
10	265.5	$7.61	$949	$1,072	1.01	12.1	0.323
11	247.6	$6.97	$933	$793	0.70	14.1	0.274
12	259.5	$6.74	$1,004	$745	0.79	12.1	0.282
13	261.3	$7.27	$937	$963	0.89	13.5	0.312
14	227.4	$7.27	$929	$724	0.58	14.0	0.239
15	282.6	$7.44	$1,063	$1,040	0.62	11.5	0.237
16	284.2	$7.27	$994	$1,072	0.86	11.5	0.292

*Control **Reported as 15.5% grain moisture content

AE—Agronomic Efficiency (bushel/pound N applied)

IWUE—Irrigation Water Use Efficiency (yield increase over the control plot, bushel divided by inches of water applied)

WNIPI—Water-Nitrogen Intensification Performance Index

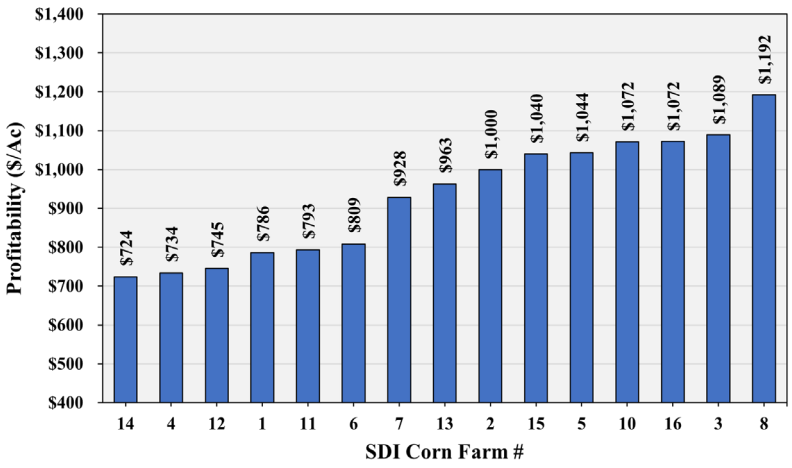

Figure 17. Profit per acre received for the individual SDI corn competition teams.

Revenue ranged from a low of $6.44/bushel, Farm 4, to a high of $7.95/bushel, Farm 8 (Table 4, Column 3). The top farm, Farm 8, had a profit of $1,192/acre, which was $103/acre higher than the second place team. The lowest cost per acre was achieved by Farm 6 at $922/acre and the highest cost per acre was Farm 15 at $1,063/acre (Table 4, Column 4).

With revenue and cost considered, Farm 8 was the most profitabile with $1,192 per acre profit, which was $103 per acre more than that of the second place team (Farm 3), which earned $1,089/acre (Figure 17). The cost per acre for the winning farm was $1,005, which was above the average of $972 for the competition.

Photo 4. The ***Greatest Grain Yield Award*** was won by Lorn Dizmang of Dizmang Ag (Farm 5) of Moorefield, NE with a yield of 288.9 bu/ac. Dizmang planted Pioneer P1185AM at 34,000 seeds/acre. Dizmang (left) is pictured with Taylor Reynolds of EcoDrip (right).

Photo 5. The ***Highest Input Use Efficiency Award*** was presented to Tri-Basin Water Watchers (Farm 3) of Holdrege, NE. The team included Pat Nott, Chris Ecklun, Reed Philips, Rick Reinsch, Logan Reed, Darrin Swanson and Curtis Scheele. They planted Pioneer P1563AML at a seeding rate of 32,000 seeds/acre and applied 120 pounds/acre of N and 12.2 inches/acre of irrigation water with a final yield of 268.5 bu/ac.

Photo 6. The Rattlesnake Boys (Farm 8) from Wood River, NE, won the ***Most Profitable Award***. The team included Jay Johnson, Kevin and Amy Harsch, and Jeremy Gewecke. The group planted Pioneer P1742Q at 34,000 seeds/acre. They applied 145 pounds of N and 11.85 inches of irrigation water, which led to a yield of 276.6 bushels/acre. The group's average revenue of $7.95/bushel combined with their yield was the driving factor in winning the top award in the 2022 SDI Corn competition.

Sorghum Competition

The 2022 sorghum competition, in its 5th year, had 18 teams, including 22 people from Nebraska, as well as Kansas. One of the 18 teams, Farm 9, was the control farm used for determining contestant efficiency. The sorghum competition included both an irrigated and dryland portion for the second year in a row.

FIELD DESIGNS

Each team had three randomized plots in the irrigated sorghum field, Figure 18, and the dryland sorghum field, Figure 19. The irrigated field is located west of Highway 83 just south of State Farm Road, and the dryland field is located east of the highway and south 3 miles from the Highway 83 and State Farm Road intersection, both in North Platte, NE.

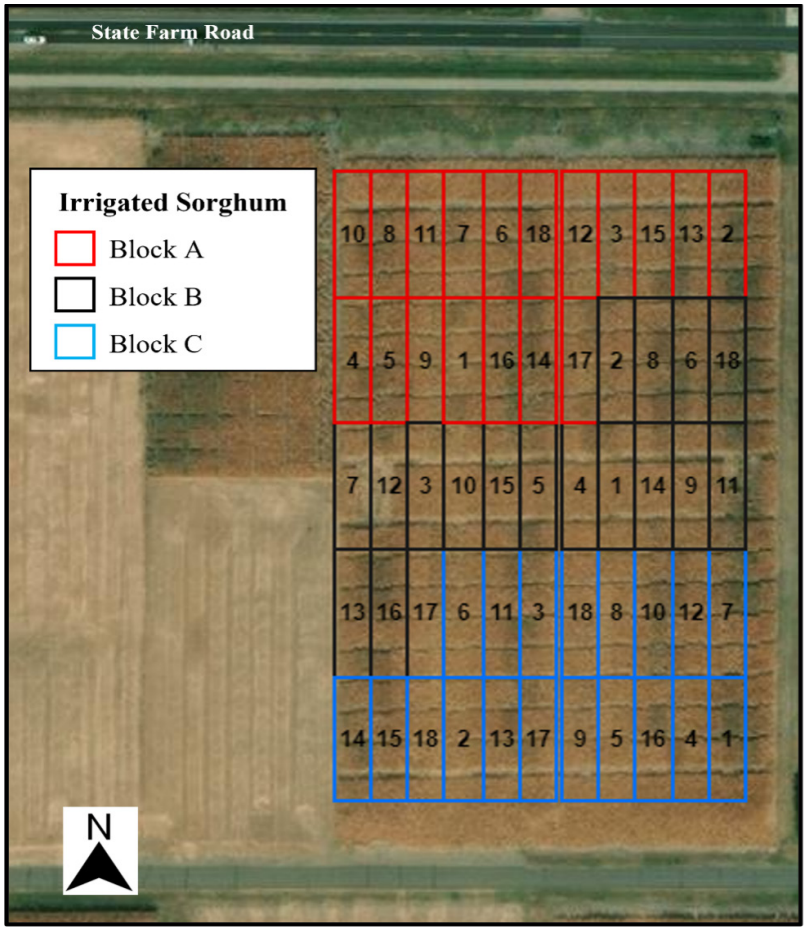

Figure 18. Farm layout for the 2022 Irrigated Sorghum Farm Management Competition held at the WCREEC in North Platte, NE. Each team was assigned three randomized plots.

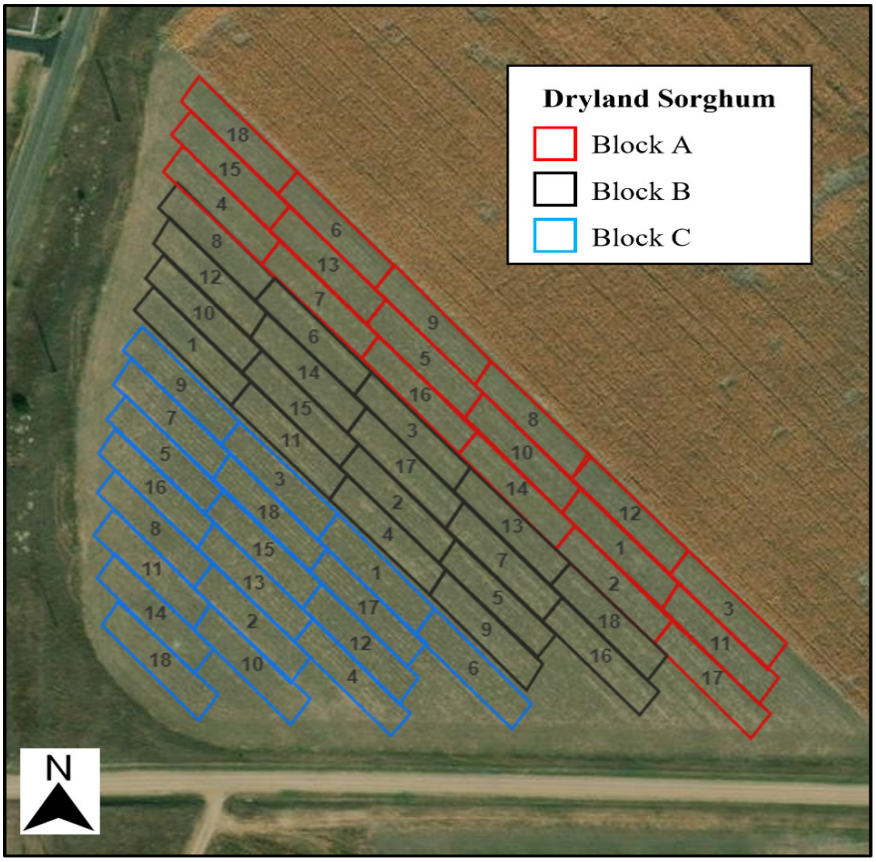

Figure 19. Farm layout for the 2022 Dryland Sorghum Farm Management Competition held southeast of WCREEC's main office in North Platte, NE. Each team was assigned three randomized plots.

PARTICIPANT DECISIONS

Participants were responsible for making economic and production management decisions, including insurance coverage, hybrid type, seeding rate, nitrogen amount and timing, and marketing. Since the linear irrigation system was not equipped with variable rate sprinklers, participants were not able to make the irrigation decisions. The crops were fully irrigated by the TAPS team. The decisions were submitted via a form through an online password protected portal that time-stamped all decisions, which are summarized below.

Agronomic Decisions

In the irrigated portion of the competition, nine sorghum hybrids were selected from six seed companies (Table 5, Column 2), including one hybrid that was not included on the recommended list of hybrids from sponsoring companies. Channel 6B95 was the participant favorite, planted by six of the 18 farms. The Channel 6B55 hybrid had the lowest cost per bag at $100 and the Advanta G2168IG had the highest cost per bag at $224. The lowest seeding rate, 50,000 seeds/acre, was planted by Farm 11 with the Advanta AG1401. The highest seeding rate, 110,000 seeds/acre, was planted by Farm 4 with hybrid Channel 6B55 (Table 5, Column 3).

In the dryland portion of the competition, twelve sorghum hybrids were selected from nine seed companies (Table 6, Column 2), including two hybrids that were not included on the recommended list of hybrids from sponsoring companies. Channel 6B55 and Arrow AS248FG/SC were the participant favorites, each planted by three of the 18 farms. Fontanelle G4550 had the lowest cost per bag at $97 and the Advanta AG1401 had the highest cost per bag at $190. The lowest seeding rate, 40,000 seeds/acre, was planted by Farm 3 with the DynaGro M59GB94 hybrid. The highest seeding rate, 90,000 seeds/acre, was planted by Farm 4 with hybrid Channel 6B55 (Table 6, Column 3).

Participants selected their nitrogen management on both irrigated and dryland fields. The options included up to 180 pounds/acre of N at pre-plant and/or side-dress. There were no fertigation applications offered. The total N fertilizer applied to the irrigated plots, not including the control Farm 9, ranged from 30 to 250 pounds/acre (Table 5, Column 6) with an average of 140 pounds/acre. On average, half of the total fertilizer applied to the irrigated plots was done as pre-plant and the other half through side-dress application. The total N fertilizer applied to the dryland plots, not including the control Farm 9, ranged from 30 to 180 pounds/acre (Table 6, Column 6) with an average of 93 pounds/acre. On average, nearly sixty percent of the total fertilizer applied to the dryland plots was done as pre-plant with the other 40 percent applied via side-dress application.

All irrigated sorghum plots received a total of 10 inches throughout the season. The first irrigation was on June 16th and the final on September 7th.

Economic Decisions

Participants were required to select a multi-peril crop insurance policy, either revenue protection (RP), yield protection (YP), or revenue protection with harvest price exclusion (RP-HPE) with at least 65% coverage for both the dryland and irrigated crops. There were no hail or wind insurance options available. In the irrigated portion, 11 teams chose to purchase RP policies, two farms went with RP-HPE and four chose YP policies (Figure 20). All of the 17 competing teams purchased Enterprise Units (EU). Chosen by five teams, RP-EU at 70% coverage was the most common selection. The average cost across all competitors for the irrigated portion was $12.85/acre. The least expensive policy was YP-EU at 65% coverage ($7.76/acre), selected by Farms 2 and 13. The most expensive was RP-EU at 75% coverage ($18.88/acre), chosen by Farms 5, 7 and 16. In the dryland portion, 11 teams chose to purchase RP policies, two farms went with RP-HPE and four chose YP policies. All of the 17 competing teams purchased EU. The average cost across all competitors for the dryland portion was $16.10/acre. The least expensive policy was YP-EU at 65% coverage ($9.31/acre), selected by Farms 2, 13 and 15. The most expensive was RP-EU at 85% coverage ($49.54/acre), by Farm 14.

Table 5. Summary of select agronomic inputs from the 2022 TAPS irrigated sorghum competition.

Farm #	Hybrid Name	Seeding Rate (1,000/ac)	Nitrogen Fertilizer		
			May 09	Jun 30	Total
			--------- (lbs/ac)---------		
1	Channel 6B95	82	170	0	170
2	Channel 6B95	95	70	75	145
3	Dekalb DKS38–16	90	50	70	120
4	Channel 6B55	110	80	170	250
5	Channel 6B95	72	100	70	170
6	Channel 6B95	95	60	150	210
7	Pioneer 88P71	85	0	70	70
8	Pioneer 88P71	70	70	70	140
*9	Channel 6B95	85	0	0	0
10	Hoegemeyer H6064	95	90	80	170
11	Advanta AG1401	50	90	75	165
12	Advanta G2168IG	90	70	50	120
13	Channel 6B95	70	80	60	140
14	Pioneer 86P20	100	40	40	80
15	Pioneer 86P20	80	80	40	120
16	Dekalb DKS38–16	100	60	100	160
17	Arrow AS248FG/SC	85	30	0	30
18	Arrow AS248FG/SC	85	30	100	130

*Control

Table 6. Summary of select agronomic inputs from the 2022 TAPS dryland sorghum competition.

Farm #	Hybrid Name	Seeding Rate (1,000/ac)	Nitrogen Fertilizer		
			May10	Jun 30	Total
			---------- (lbs/ac)----------		
1	DynaGro M60GB31	46	110	0	110
2	Channel 6B55	45	35	70	105
3	DynaGro M59GB94	40	50	0	50
4	Channel 6B55	90	50	130	180
5	Channel 6B55	50	89	0	89
6	Channel 6B95	46	40	100	140
7	Pioneer 88P71	65	0	55	55
8	Pioneer 86P20	47.5	55	60	115
*9	Channel 6B95	65	0	0	0
10	Hoegemeyer H6064	50	60	45	105
11	Advanta AG1401	50	90	75	165
12	Arrow Seed AS248FG/SC	50	60	0	60
13	Rob See Co GS6446	45	60	30	90
14	Pioneer 86P20	60	40	0	40
15	Fontanelle G4550	55	100	0	100
16	Dekalb DKS28–05	62	0	60	60
17	Arrow AS248FG/SC	50	30	0	30
18	Arrow AS248FG/SC	50	30	50	80

*Control

Contestants could market expected production, trend adjusted Average Production History (APH), from April 1 through December 19. There were five methods allowed for selling grain: 1) forward contracting, 2) basis contracting, 3) hedge-to-arrive contracting, 4) hedge using futures contracting, and 5) cash sales. While grain sorghum prices historically follow the corn market, sorghum usually is sold at a discount relative to corn. However, in most recent times, a premium has been observed, due to increased export demand, primarily driven by the Chinese market. Grain sorghum does not have a futures market and requires using corn contracts to cross hedge. The 2022 marketing year followed the corn market and had prices increase considerably from the previous year, due to the increased world demand. World demand for US corn increased due to dry regions of Europe, the war in Ukraine, and general world concern for commodity shortages. Stored crop grain cash prices were much higher than the December futures prices, and December futures never reached the highs of the May and July futures prices. The highest forward contract price in the competition was from Farm 13 in October for $7.21/bushel.

Eleven teams relied on their entire crop selling on the last day of competition at the closing price of $6.62/bushel on December 19. Any unsold grain after the close of the competition received a charge of $0.05/bushel. If a team sold more grain than was produced, those bushels were bought back at the $6.62/bushel price, along with

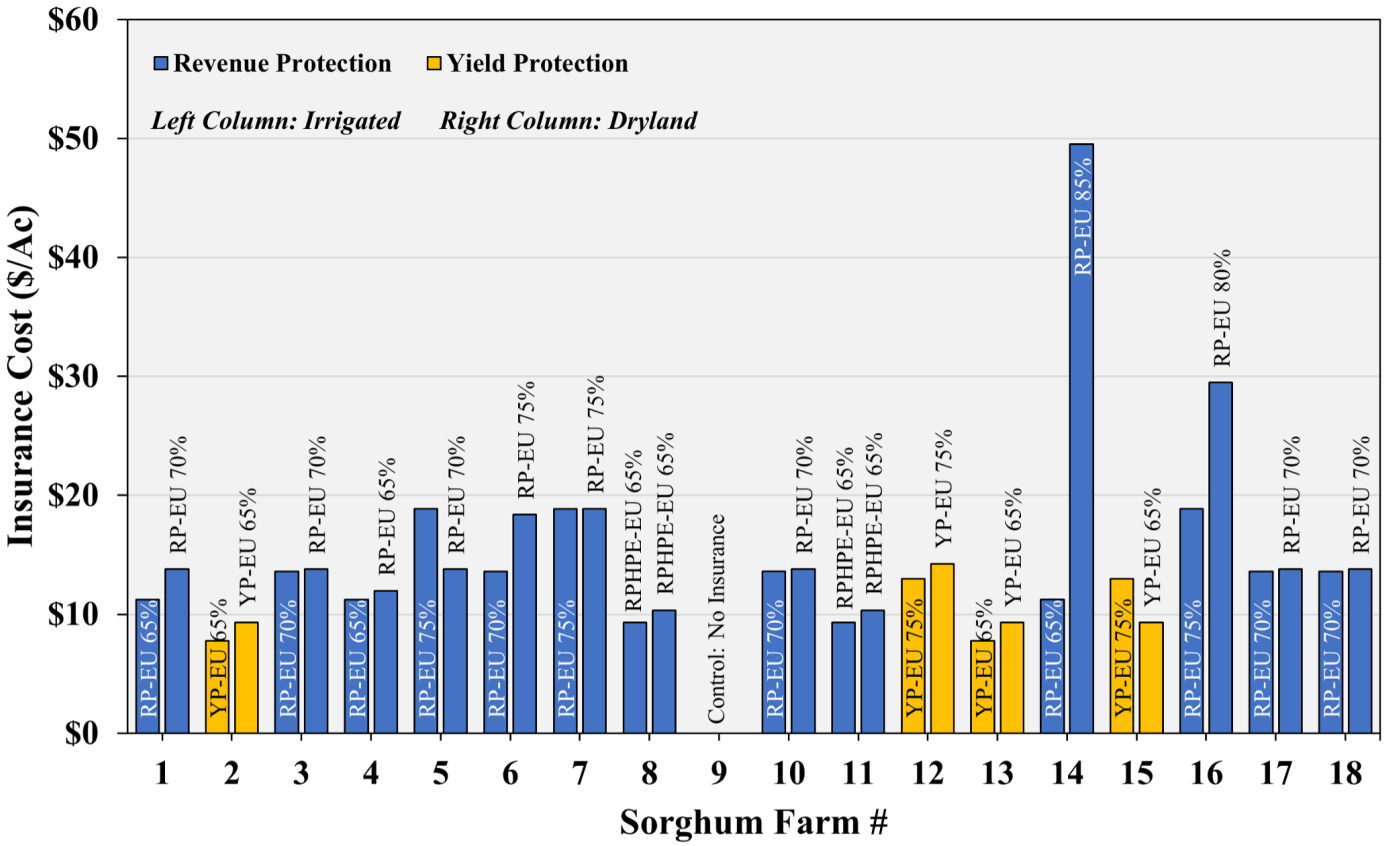

Figure 20. Insurance cost ($/acre) for the individual sorghum competition teams. Policies offered included Revenue Protection (RP), Revenue Protection with Harvest Price Exclusion (RP-HPE), and Yield Protection (YP) with either Optional Units (OU) or Enterprise Units (EU). The yellow and blue bars represent Yield Protection and Revenue Protection, respectively.

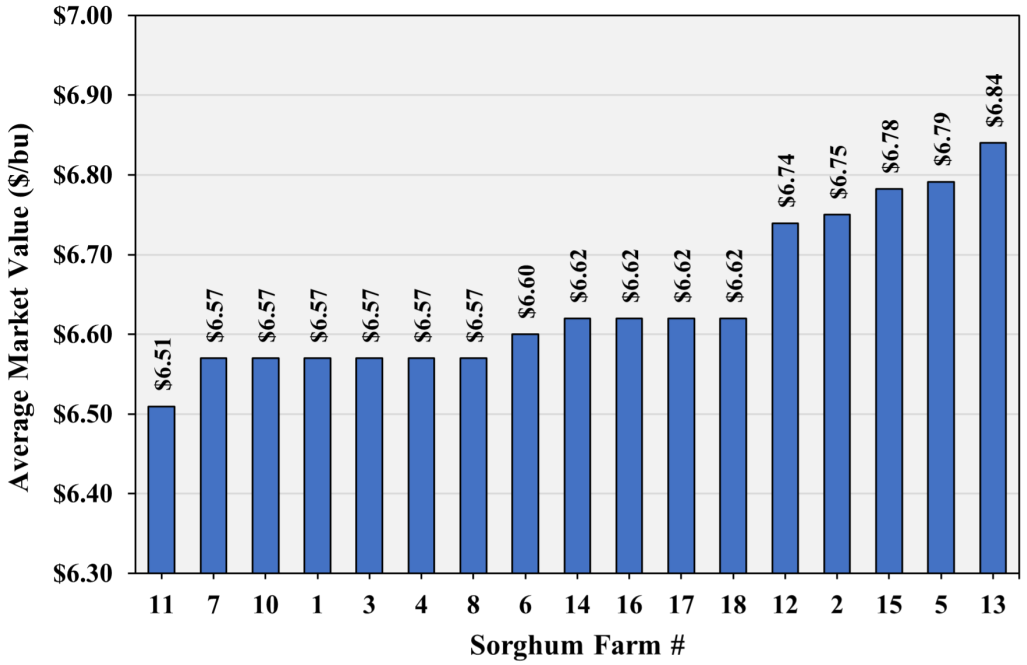

Figure 21. Average market value received ($/bushel) for the individual sorghum competition teams.

a penalty of $0.10/bushel. Three teams chose just one of the five marketing methods to sell their commodity. Two teams chose to sell using a combination of two methods, with one of those involving cash sales on the final day. Two teams used three methods, including one using a final sell of unsold grain by the TAPS organizers. These marketing decisions led to average prices received from $6.51 to $6.84/bushel (Figure 21). Farm 13, which used a combination of forward contract, and spot cash sales, received the highest average price of the season at $6.84/bushel. The average price per bushel received for all teams was $6.64.

RESULTS AND RANKINGS

Grain Yield

Sorghum grain yields were calculated for each field and then figured for the 750 acres of dryland production and 250 acres of irrigated production to determine the competition results. Grain yields were greater under irrigated as compared to dryland. The irrigated yields ranged from a low of 140.0 bushels/acre, Farm 7, to a high of 174.9 bushels/acre, Farm 2 (Table 7, Column 2). Excluding the control, the average irrigated yield was 160.3 bushels/acre. Eleven of the 18 farms

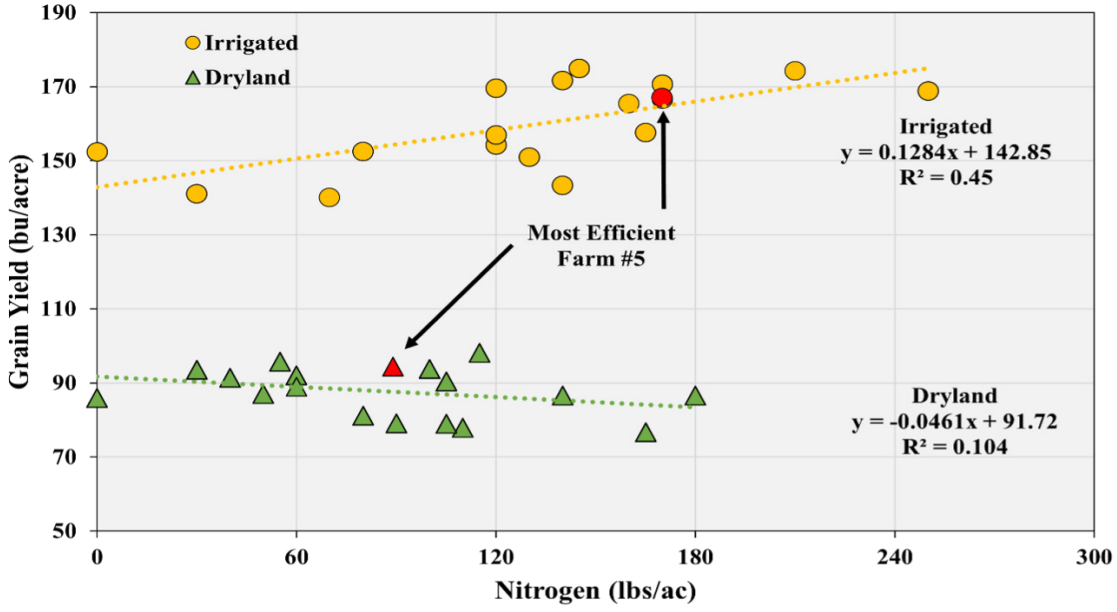

Figure 22. Dryland and irrigated sorghum grain yield response to seasonal nitrogen fertilizer at the WCREEC in North Platte, NE. The most efficient farm as measured by the Nitrogen Intensification Performance Index (NIPI) is denoted in red.

exceeded the irrigated field's APH of 155 bushels/acre. The dryland yields ranged from a low of 76.7 bushels/acre, Farm 11, to a high of 98.1 bushels/acre, Farm 8 (Table 7, Column 3). Excluding the control, the average dryland yield was 87.8 bushels/acre. All 18 farms fell short of reaching the dryland field's APH of 100 bushels/acre. The relationships between dryland and irrigated grain yields versus season total N fertilizer are shown in Figure 22. Grain yield had a positive response to N fertilizer under irrigation with an R^2 of 0.45; however, a weak and slightly negative relationship existed under dryland conditions. Based on the 750 acres of dryland and 250 acres of irrigated production, the combined (i.e., farm average) weighted average competition yields ranged from 96.9 bushels/acres, Farm 11, to 112.5 bushels/acre, Farm 5.

Input Use Efficiency

Since participants did not make the decisions for their irrigation amounts and timing in the sorghum competition, water was not used as a factor in the efficiency award. The Nitrogen Intensification Performance Index (NIPI) (Lo et al., 2019) was used to quantify input use efficiency related to N and is reported in the last Column in Table 7. It compares the effect of N on grain yield with respect to a control treatment. The control is a baseline and is used to measure the effect of any added N fertilizer. The controls, Farm 9 in both portions of the competition, had no added N and produced 86.0 and 152.4 bushels/acre of sorghum for the dryland and irrigated farms, respectively.

In the dryland portion, Farm 7 had the highest efficiency with a NIPI of 0.07. This farm applied 55 pounds of N/acre, resulting in a yield of 95.7 bushels/acre. Agronomic Efficiency (AE) measures the effect each added pound of N has in terms of bushels. Farm 7 yielded 9.7 bushels/acre more than the control Farm 9. When the yield difference is divided by the amount of additional applied N fertilizer, 55 pounds/acre, the AE is calculated to be 0.177. This is much higher than the average of 0.043 bushels/pound of N of all other farms except the control farm.

In the irrigated portion, Farm 2 had the highest efficiency this year with a NIPI of 0.08. This farm applied 145 pounds of N/acre, resulting in a yield of 174.9 bushels/acre. Farm 2 yielded 22.5 bushels/acre more than the control Farm 9. When the yield difference is divided by the amount of additional applied N fertilizer, 145 pounds/acre, the AE is calculated to be 0.16. This is also much higher compared to the average of 0.02 bushels/pound of N of all other farms except the control farm.

When the efficiency results are multiplied by the weighted average of 750 acres dryland production and 250 acres irrigated production, Farm 5 won the efficiency award with a combined NIPI of 0.046.

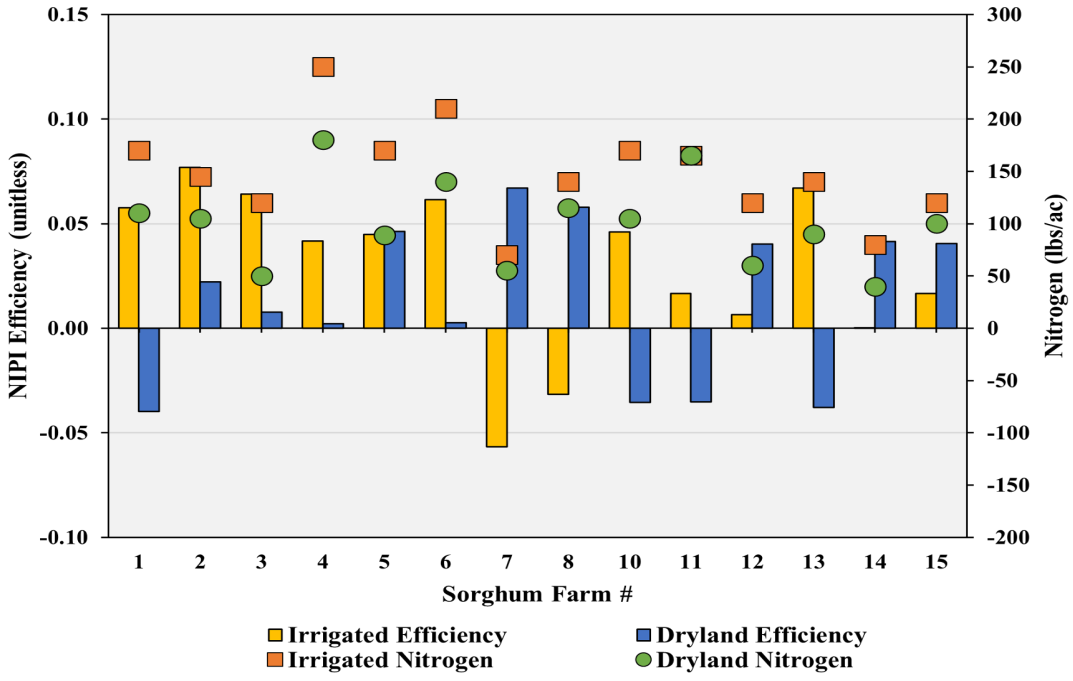

Figure 23. Input use efficiency (NIPI) compared against N fertilizer (lbs/acre) in each portion of the sorghum competition.

Profitability

Profitability in the TAPS competition is derived from the same formula as it is in any operation, total revenue minus total cost equals profit. The weighted average yield from each team's plots was multiplied by their average market price; any government payments, insurance indemnities, and/or losses were then equated into this value to get total revenue. Costs were based on both fixed costs, as shown in the beginning budget, and variable expenses incurred during the season through the execution of their management decisions, which, when totaled, represented total cost. However, the costs of technology (e.g., sensors, imagery, data collection) were not included in the profit equation. Since all farms had the same number of acres, the farm with the most per acre profit was the most profitable.

Revenue ranged from a low of $6.57/bushel, Farms 1, 3, 4, 7, 8, and 10, to a high of $6.84/bushel, Farm 13 (Table 7, Column 5). The lowest cost per acre, excluding the Control (Farm 9), was achieved by Farm 17 at $383/acre (Table 7, Column 6), and the highest cost per acre was Farm 4 at $512/acre.

With revenue and cost considered, Farm 5 earned the award for profitability with $323/acre profit (Figure 24). The cost per acre for the winning farm was $441, which was just above the competition average of $436. The revenue per bushel sold for the winning team was $6.79/bushel, which was the second highest in the competition, thus having an impact on profit, when combined with the higher yields achieved.

Table 7: Summary of data from the 2022 TAPS sorghum competition.

Farm #	Irrigated Grain Yield** (bu/ac)	Dryland Grain Yield** (bu/ac)	Combined Grain Yield** (bu/ac)	Revenue ($/bu)	Cost ($/ac)	Profit ($/ac)	Combined NIPI (unitless)
1	170.7	77.9	101.1	$6.57	$449	$215	-0.015
2	174.9	90.4	111.5	$6.75	$444	$308	0.036
3	169.6	87.1	107.7	$6.57	$416	$291	0.022
4	168.8	86.6	107.2	$6.57	$512	$192	0.012
5	166.7	94.4	112.5	$6.79	$441	$323	0.046
6	174.2	86.6	108.5	$6.60	$485	$231	0.017
7	140.0	95.7	106.8	$6.57	$408	$293	0.036
8	143.4	98.1	109.4	$6.57	$450	$269	0.035
*9	152.4	86.0	102.6	-	-	-	-
10	167.0	78.9	101.0	$6.57	$457	$206	-0.015
11	157.6	76.7	96.9	$6.51	$486	$145	-0.022
12	154.2	92.0	107.6	$6.74	$421	$304	0.032
13	171.7	79.1	102.2	$6.84	$435	$264	-0.012
14	152.5	91.3	106.6	$6.62	$425	$281	0.031
15	156.9	93.8	109.6	$6.78	$433	$311	0.035
16	165.4	89.0	108.1	$6.62	$436	$280	0.026
17	141.1	93.5	105.4	$6.62	$383	$315	0.032
18	151.0	81.1	98.6	$6.62	$436	$217	-0.022

*Control **Reported as 14% grain moisture content.

NIPI—Nitrogen Intensification Performance Index

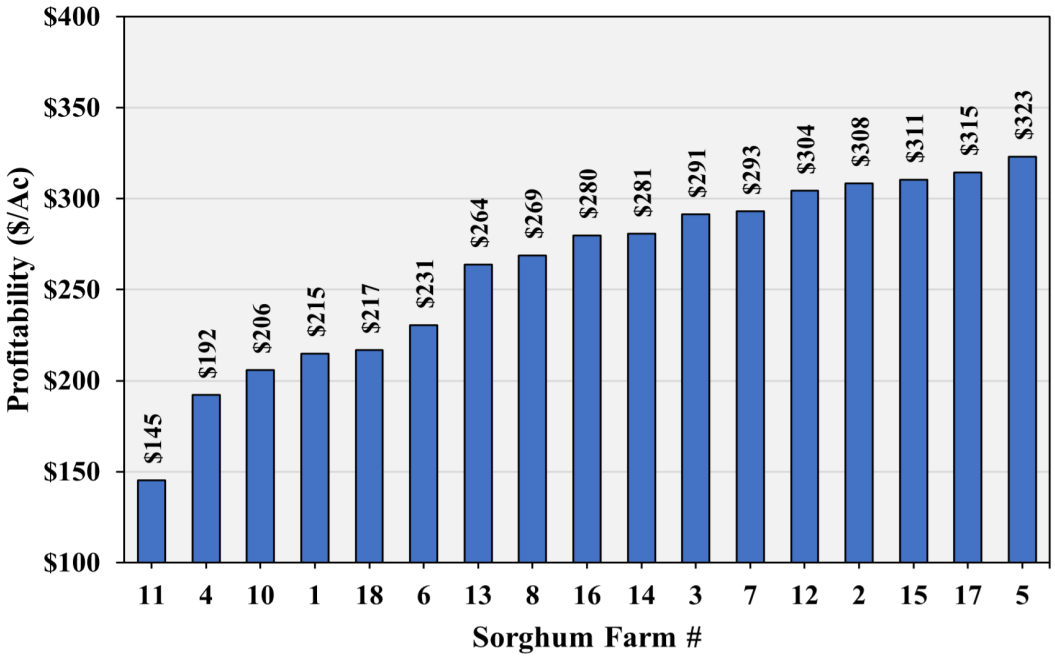

Figure 24. Profit per acre received for the individual sorghum competition teams.

AWARD RECIPIENTS

Photo 7. All three awards, ***Greatest Grain Yield***, ***Highest Input Use Efficiency and Most Profitable Farm,*** were won by Tracy Zink (Farm 5) of Indianola, NE. She chose to plant Channel 6B55 at a population of 50,000 seeds/acre in her dryland plots and Channel 6B95 at a population of 72,000 seeds/acre in her irrigated plots. Tracy applied 89 lbs/acre of N to her dryland plots and 170 lbs/acre to her irrigated plots. Her award winning weighted average yield of 112.5 bu/acre combined with her average revenue per bushel of $6.79 earned her the top award. Zink (left) is pictured with Daran Rudnick (right).

CONCLUSION

At the close of the 2022 season, it is evident that this year's competitions provided another year of valuable data, experiences, and interaction among competitors, industry and ag. service providers, researchers, and others. Realistic to any agricultural operation, participants faced various environmental and marketing conditions in 2022. Outcomes of the competitions allow competitors to benchmark and reflect on their use of available information, effectiveness and performance of new technologies, management practices, and strategies used during the season. As we prepare for the future, we maintain a present focus on our wealth of data, building toward the discovery of better practices, and the application of new ideas and technologies. The TAPS team greatly appreciates all who take part in this program, from participants to partners and sponsors. We extend our congratulations to everyone involved in this year's success and applaud the 2022 winners.

As another year concludes, we would also like to acknowledge Amy Kremen, who was selected to receive the "Outstanding TAPS Advocate Award." This annual award honors a person, group, or business, who advocates for the TAPS program, either behind the scenes or publicly. We are grateful for Amy's years of helping to promote the TAPS program in multiple states, particularly serving as a Colorado State University cohort on the received USDA-NRCS CIG project, and for her work as part of the Ogallala Water Coordinated Agriculture Project (OWCAP). Thank you, Amy!

The success of the TAPS program in the time ahead is reliant on continuously preparing for its future. New competitions are being planned for other locations in Nebraska, efforts are on the horizon for a virtual TAPS program, and so is implementation of TAPS into high school ag. courses, as well as other universities planning to create their own programs based on the TAPS model. We are excited to see where the future takes the program, and we look forward to having all of you present with us.

SUPPORT

The TAPS program continues to be successful due to the commitment and support provided by our participants, partners, and sponsors (Figures 1 and 2). The 2022 competitions were supported through the following grants: USDA-NRCS Conservation Innovation Grant under award number NR203A750013G011, Nebraska Corn Board under award number 88-R-1819–10, National Sorghum Checkoff under award number CI021–22, and the Nebraska Sorghum Board.

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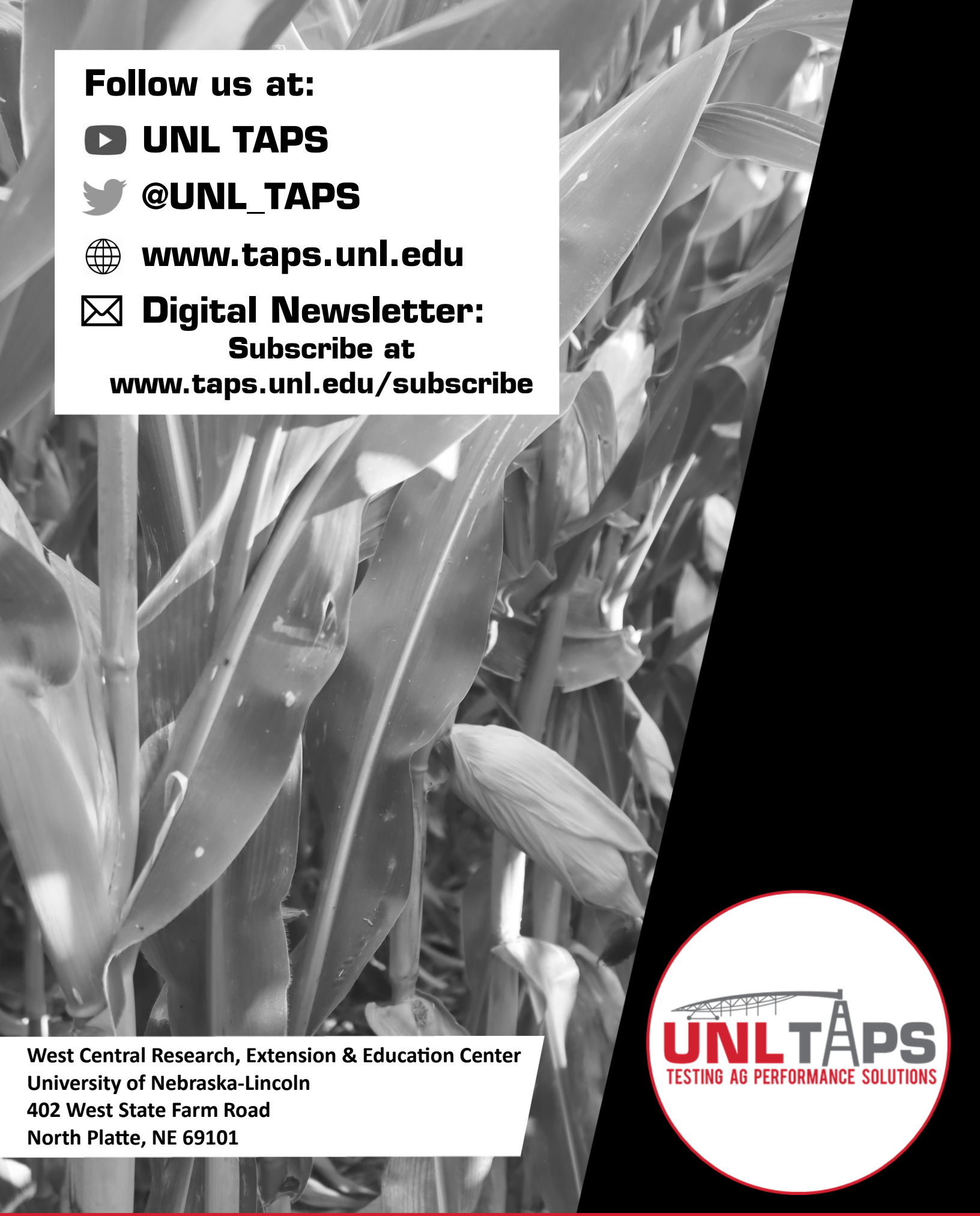

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