Florida Stakeholder Engagement Program (STEP)

2022 STEP Corn Competition Annual Report

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UF | IFAS Extension
UNIVERSITY of FLORIDA

FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
EST. 1868

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Introduction:

Pursuant to the Florida Watershed Restoration Act (FWRA), section 403.067(7)(c)3, F.S., the FDACS, Office of Agricultural Water Policy (OAWP), develops, adopts, and assists with the implementation of agricultural BMPs to protect and conserve water resources. Funding for BMP projects that complement the OAWP's mission is consistent with FWRA objectives. In this regard, the University of Florida's, Institute of Food and Agricultural Sciences (UF/IFAS) continues to play an important role in assisting the industry with implementing BMPs. To this end, the Florida Innovative Stakeholder Engagement Program aims to provide science-based education and outreach on BMPs through farm management competition focusing on input-use efficiency and profitability that assists agricultural producers with the implementation of water quality and water conservation BMPs.

Practicing ineffective irrigation and nitrogen (N) management can have a negative impact on the quality and quantity of water resources as well as the environmental and financial sustainability of an area. There are many best management practices (BMPs) and technologies available to growers to irrigate and fertilize crops which vary in their effectiveness. As a result, extension services (University of Florida, UF) and water conservation programs [e.g., Natural Resources Conservation Service (NRCS) EQIP; Florida Department of Agriculture and Consumer Services (FDACS) and Florida Water Management Districts (WMD) cost-share program] have promoted and incentivized the use of the more promising techniques. Over the years extension professionals have assisted growers in the adoption of BMPs, with an aim to bring the most current science and technology to growers and to understand the issues, challenges, and obstacles stakeholders face (Ryan et al., 2018). Traditional methods of extension, which are mostly educational in nature (such as lectures, demonstration sites, and one-day field tours), have and will continue to serve us well in many instances, but remain short in changing paradigms or motivating internal changes in understanding (Rudnick et al., 2020).

To facilitate engagement at a higher level and to create real change in thinking and performance, requires several things, including producers' involvement and

commitment, action-oriented learning, involvement of the private sector, etc. In general, growers are often treated as students or learners and as a result, the university is missing opportunities for valuable feedback informed by the power of their individual understanding, focus, and expertise. In addition, they are not always convinced that extension information presented by the university or regulatory agencies applies to them or their situation. Therefore, to address these challenges, we propose the development of a well-designed, coordinated, and effective Florida Agricultural Stakeholder Engagement Program (STEP) to incorporate and engage producers, industry, agricultural research, and agricultural technology in an interactive real-world system to increase productivity, sustainability, and profitability.

Objectives:

The main goal of this project is to develop the Florida Innovative Stakeholder Engagement Program (STEP) through farm management competitions focusing on input use efficiency and profitability. Specific objectives include:

- Host farm management competitions that promote profitability and efficiency through peer-to-peer interaction and allows growers to test, observe, experiment, and implement new and emerging water and fertilizer conservation technologies and management techniques.
- Quantify the operational and economic benefits and challenges of BMPs.
- Foster peer-to-peer interaction by integrating all members of the agricultural sector, including producers, industry, regulatory agencies (FDACS, WMD), NRCS personnel, local extension agents/educators, and university researchers, to develop and disseminate effective educational, outreach, and training material that will lead to acceptance of recommended water management strategies.

Program Overview:

The first annual corn management competition was established under the variable rate sprinkler for corn at the University of Florida, North Florida Research and

Educational Center, Suwannee Valley (UF-NFREC-SV) (Figure 1). The competition included 10 teams, including a team of UF-IFAS specialists/agents (Figure 2). Each competing team was assigned four randomized plots as part of a randomized complete block experimental design that provides statistical evaluation to determine the winners. Participants had control over six production parameters (Figure 3), including

- Crop hybrid type,
- Seeding rate,
- Irrigation management,
- Nitrogen management
- Insurance selection, and
- Grain marketing.

Each "farm" on the paper included 1,000 harvested acres for the purposes of making decisions. All other management decisions, such as pesticide use, tillage, residue management, etc., were fixed by the university and were the same for all teams. The STEP project team conducted the actual physical management, such as the operation of machinery, irrigation system, application of chemicals, and harvesting.

These decisions were made in real-time by the participating teams using a secure online submission form (STEP Website; https://step.ifas.ufl.edu/) provided to participating teams at the start of the competition. For irrigation management, one set of soil moisture sensors (as per the teams' choice) was installed in one replication. For nutrient management, soil EC, soil samples, tissue samples (FDACS, BMPs), and photographs were taken at regular intervals throughout the growing season. All the collected data was provided to participating teams via the STEP website.

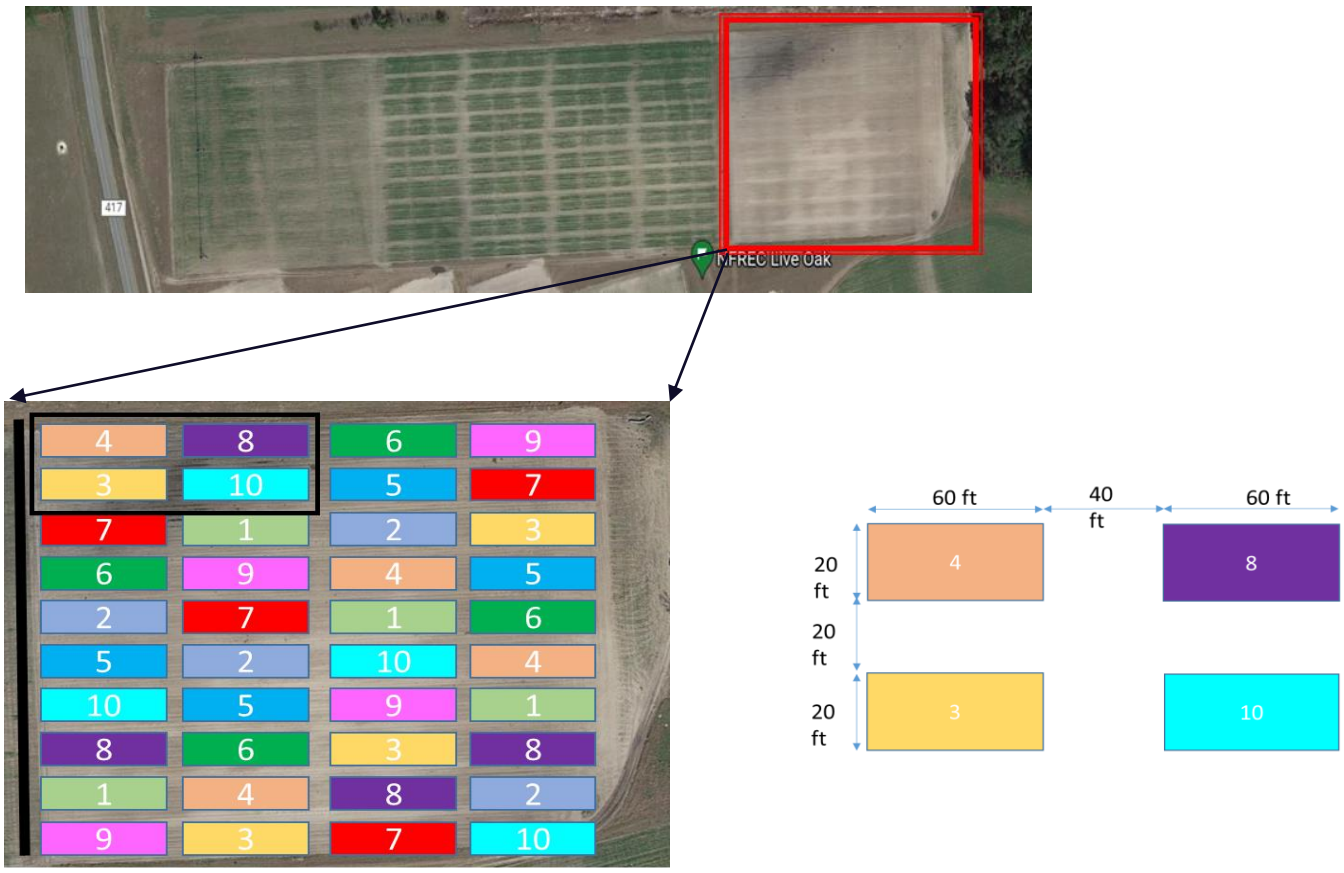
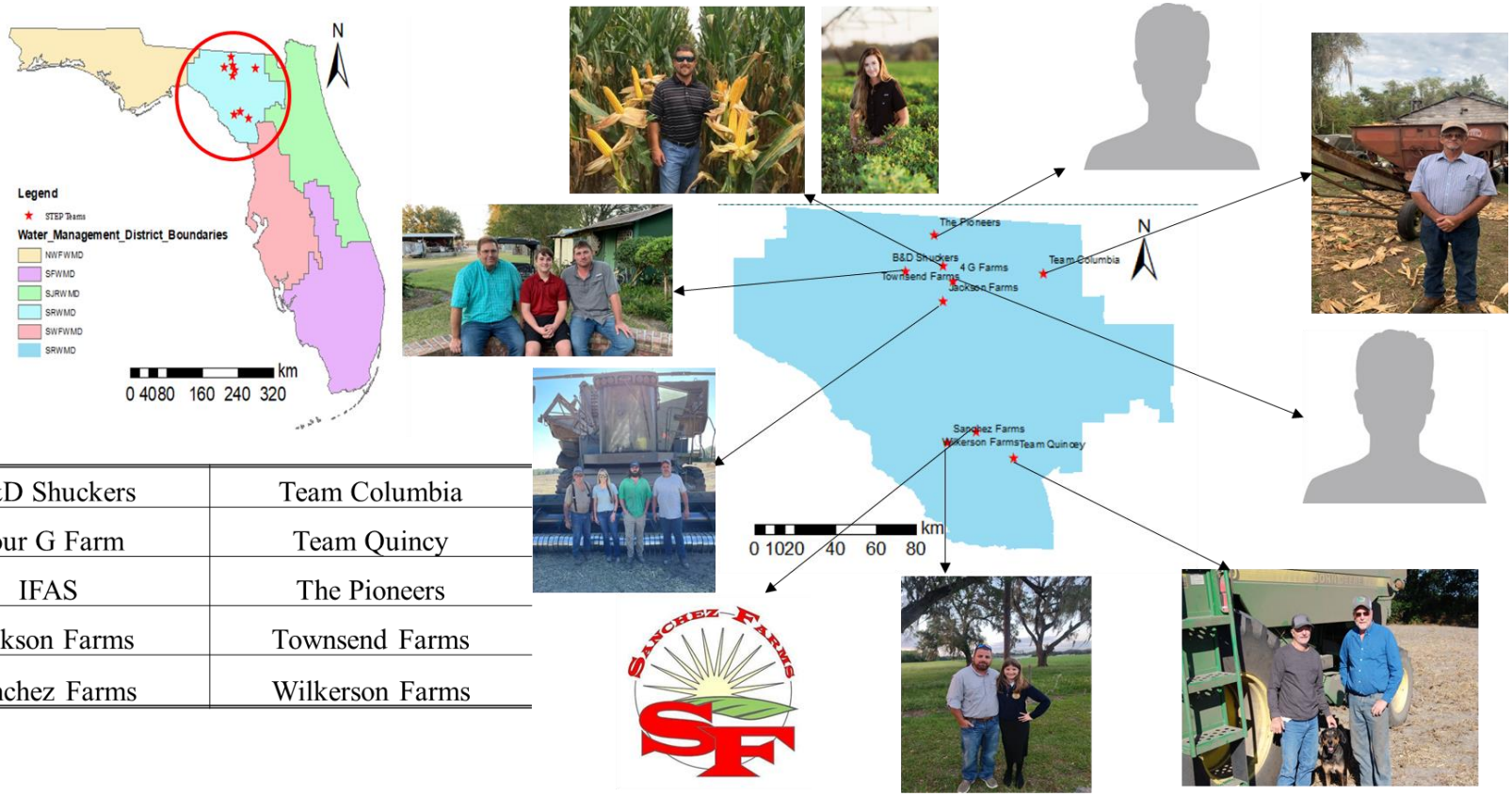


Figure 1. Plot map for the 2022 Florida Stakeholder Engagement Program (STEP) competition held at the North Florida Research and Extension Center-Suwannee valley (NFREC-SV).

The teams competed for three awards:

- Most profitable,
- Highest input use efficiency, and
- Lowest cost per bushel.

Winners were awarded $2000 in each category along with plaques. In addition, $1000 was awarded to the overall competition runner-up.



B&D Shuckers	Team Columbia
Four G Farm	Team Quincy
IFAS	The Pioneers
Jackson Farms	Townsend Farms
Sanchez Farms	Wilkerson Farms

Figure 2. Team names and the location of the 2022 STEP competition participants.

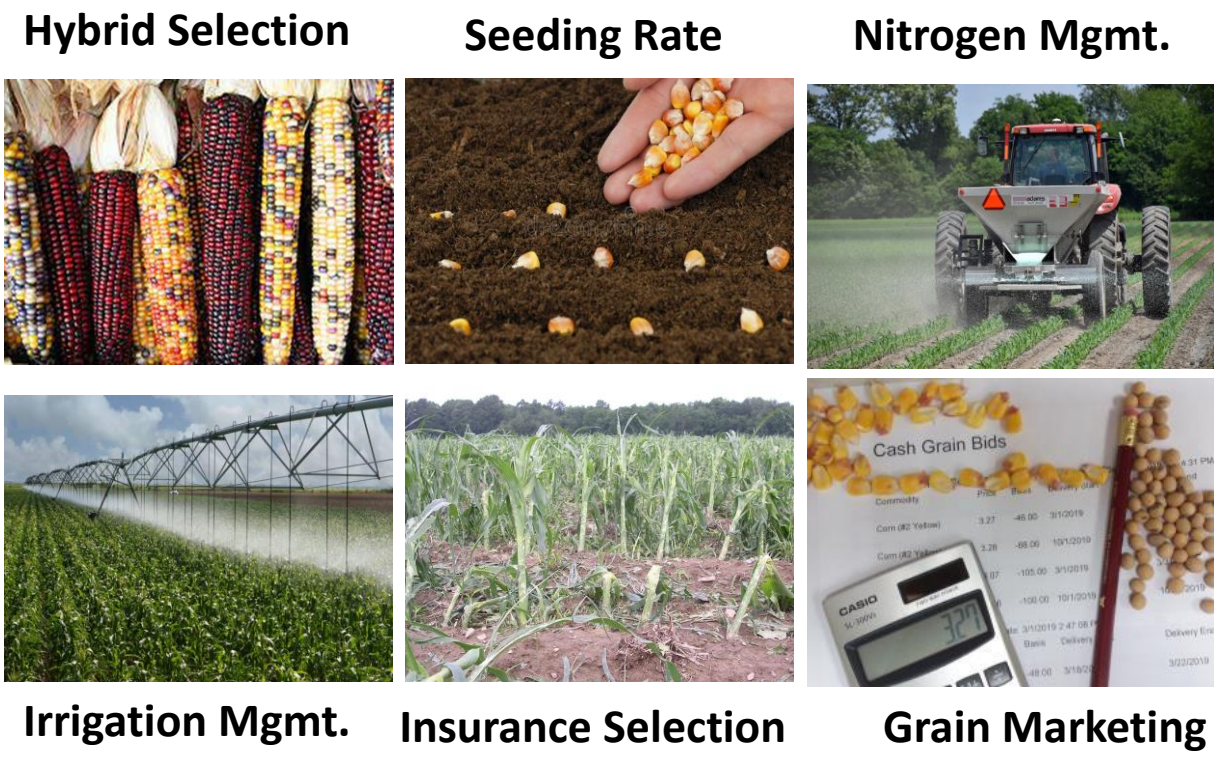


Figure 3. Management Decisions for 2022 STEP Competition.

Competition Rules:

1. Hybrid Selection and Seeding Rate:
    a. Each team was required to select their seed hybrid and seeding rate.
    b. Teams are allowed to work with multiple local seed companies for hybrid selection.
    c. Teams are allowed to choose any plant population between 26K to 36K, in the increment of 2K.
    d. Teams were allowed to choose one of the four default hybrids listed below or source their seed. If sourcing their own seed,15 lbs of seed must be delivered at the North Florida Research and Education Center by March 10th. Teams are required to provide documentation of the retail price for any seed that they source.

    Competition Default Hybrids:

        i. LC1577VT2P – Local Seed
        ii. P2042YHR - Pioneer
        iii. P1870YHR - Pioneer
        iv. A6659VT2RDB – AgriGold
2. Nitrogen Management:

Start-up Fertilizer: All the plots received 13 gals/ac (~ 30-40 lb/ac of N) of startup fertilizer (23-9-0) at the time of planting. Teams can choose:

a. Conventional fertilizer program - In-season fertilizer applications of dry ammonium nitrate (34-0-0) and UAN 28% (28-0-0-5),
b. Controlled-Release Fertilizer (CRF) program – CRF blend of 43-0-0.

In-season Fertilizer Management: Two options were provided:

a. Conventional fertilizer program

   The in-season application occurred in two stages:

   i. Planting to V10,
   ii. V10 to Tasseling

   From Planting to V10, Dry application of Ammonium Nitrate (up to 100 lbs/ac of N) in single or split applications (maximum of 3 applications) can be applied via broadcast or side-dressed.

   From V10 to Tasseling, Fertigation can be applied once each week on a fixed day (Thursday) with an amount ranging from 30 to 60 lbs/ac of N per event of UAN 28% (28-0-0-5), using the high clearance rig with installed "raindrop" brand applicator nozzles to simulate a fertigation event.

b. Controlled Release Fertilizer Program:

   For the CRF program, teams were allowed choose any CRF blend 43-0-0 (Harrells) at a rate ranging from 150 to 300 lbs/ac of N. All the CRF applications were applied at planting.

In case of a leaching rain event (determined by the project management team), an additional application of 30 lbs/ac was allowed.

3. Irrigation Management:

The team had three options for irrigation management: a. Soil moisture-based irrigation scheduling, b. Evapotranspiration-based irrigation scheduling, or c. pre-determined calendar-based irrigation scheduling. One set of soil moisture sensors was installed per

team for soil moisture monitoring. Teams were allowed to choose one of the following types of soil moisture sensors:

a) Sentek drill and drop probe (Ag holder)
b) BMP logic
c) AquaSpy
d) High Yield Ag Solution - KTS

Irrigation Selection Criteria:

- Select the irrigation amount (depth) in 0.05-inch increments at least one day before the application.
- From planting to harvest, the maximum irrigation depth per application is 0.5 inches.
- No irrigation was applied if no selection is made.

4. Insurance Selection:

Teams must select a crop insurance policy by March 15th. Two types of crop insurance options were offered:

a. Revenue Protection
b. Yield Protection.

Yield Protection crop insurance protects against yield losses caused by adverse weather conditions, failure of irrigation water supply (if caused by an insured peril), fire, insects, or plant disease (but not damage due to insufficient or improper application of control measures), and wildlife. Revenue Protection crop insurance protects against loss of revenue due to yield losses and price changes. Revenue Protection has higher insurance premiums than Yield Protection.
Available coverage levels are 50%, 55%, 60%, 65%, 70%, 75%, or 80%. Higher coverage levels have higher premiums but provide higher minimum thresholds for grower revenue.

5. Marketing Selection:

Teams must make marketing selections for the simulated 1,000-acre farm. The total number of bushels marketed was the average yield per acre harvested from their research plots times 1,000 acres. Simulated delivery of the harvested grain corn was assumed to take place on the actual research plot harvest date.

No postharvest (storage) marketing was allowed for this competition. Teams may choose flat-price or basis contracts in 10,000-bushel increments (for August/September delivery) between the competition start date and July 29th. Contract prices are determined by the daily closing Chicago futures price plus a local basis posted weekly on the STEP webpage (https://step.ifas.ufl.edu/).

Any bushels not sold through contracts (total bushels harvested for the simulated 1,000-acre farm minus the number of bushels contracted) was "sold" at the spot market price on the date of harvest. If more bushels are contracted than harvested, the team was charged the difference between the spot market price and highest contract price (if the spot market price is higher), plus a $0.20/bu handling fee, on the number of bushels over contracted.

Award Calculations:

1. Most Profitable:

The "most profitable" award went to the team with the highest simulated profit per acre. Gross profit per acre was calculated as follows.

Gross profit per acre =

+ Yield (bu/acre) times average farm-gate price ($/bu)
- STEP variable costs per acre
- Fixed production costs per acre

Average farm-gate price = weighted average delivered price minus $0.30/bu hauling charge.

Yield (bu/acre) was calculated based on the average yield from each team's corn plots, at 15.5% moisture. The average delivered price per bushel was determined by each team's marketing choices. Material and application costs for seed, fertilizer and irrigation were determined by each team's management choices.

2. Most efficient:

Input use efficiency was calculated based on the Water-Nitrogen Intensification Performance Index (WNIPI) which is an integrated index of water intensification performance index and nitrogen intensification performance index (Lo et al., 2019). The

WNIPI promotes effective irrigation and nitrogen management without sacrificing production and profitability. It essentially evaluates the increase in yield above the control farm's, relative to the increase in inputs above the control farm's water use (evapotranspiration, ET) and aboveground nitrogen uptake. A higher WNIPI value indicates higher efficiency, and a lower value indicates lower efficiency. The WNIPI equally weights the influence of irrigation and nitrogen fertilizer on efficiency; therefore, both inputs have to be managed well to receive a high value and calculated as:

$$WINIP = \frac{\left[\frac{Y - Y_n}{Y_n}\right]}{\left[\frac{ET_n + I}{ET_n}\right] * \left[\frac{G_n + N}{G_n}\right]}$$

Where, Y = grain yield of the farm under evaluation; Yn = grain yield of the zero-input treatment; ET = crop evapotranspiration of the farm under evaluation; ETn = crop evapotranspiration of the zero-input treatment; Gn = grain nitrogen uptake of the zero-input treatment; and N = fertilizer nitrogen applied by the farm under evaluation. Yield (bu/acre) was calculated based on the average yield from each team's corn plots, at 15.5% moisture. ETn was calculated using the water balance approach.

3. Lowest Cost Per Bushel Award

The "lowest cost per bushel" was calculated based on the production cost per bushel as:

$$Cost\ per\ bushel = \frac{Total\ production\ cost}{Yield\ (bushels)}$$

Total production cost includes:

- Nitrogen material
  - Ammonium nitrate: $1.10 per lb of N
  - UAN 28% with sulfur: $1.14 per lb of N
  - Controlled release (43-0-0): $1.77 per lb of N
- Nitrogen application
  - Side-dress: $12.00/acre per application
  - Sling/broadcast: $6.50/acre per application
  - Fertigation through pivot: $1.85/acre per application.
- Seed: $3.0250 to $3.3125 per thousand
- Irrigation: $11.00 per acre inch

- Insurance: depends on selection
- Fixed production costs: $600/acre

2022 Competition Results:

Project Timeline:

The competition started with a kickoff meeting on March 1st, 2022, at the NFREC-SV at Live Oka, FL, where the rules and regulations of the competition were described to the participating teams, industry partners, and other stakeholders. Field operation began with corn planting on March 25th, 2022. All the plots received a baseline of 13 gals/ac (~ 30 lb/ac of N) of startup fertilizer (23-9-0) at the time of planting. The start-up fertilizer was applied using a double-colter liquid applicator at about 2-inch deep and 2-inch sides of the planted row. Several seminars and a field tour were conducted throughout the growing season. The field tour provided an opportunity for growers to interact with each other as well as UF faculty and industry personnel. The corn was harvested on August 16th which was the final day for the participants to market their grain. Results and awards were presented at the ATEP awards banquet on October 25th, 2022 (Figure 4).

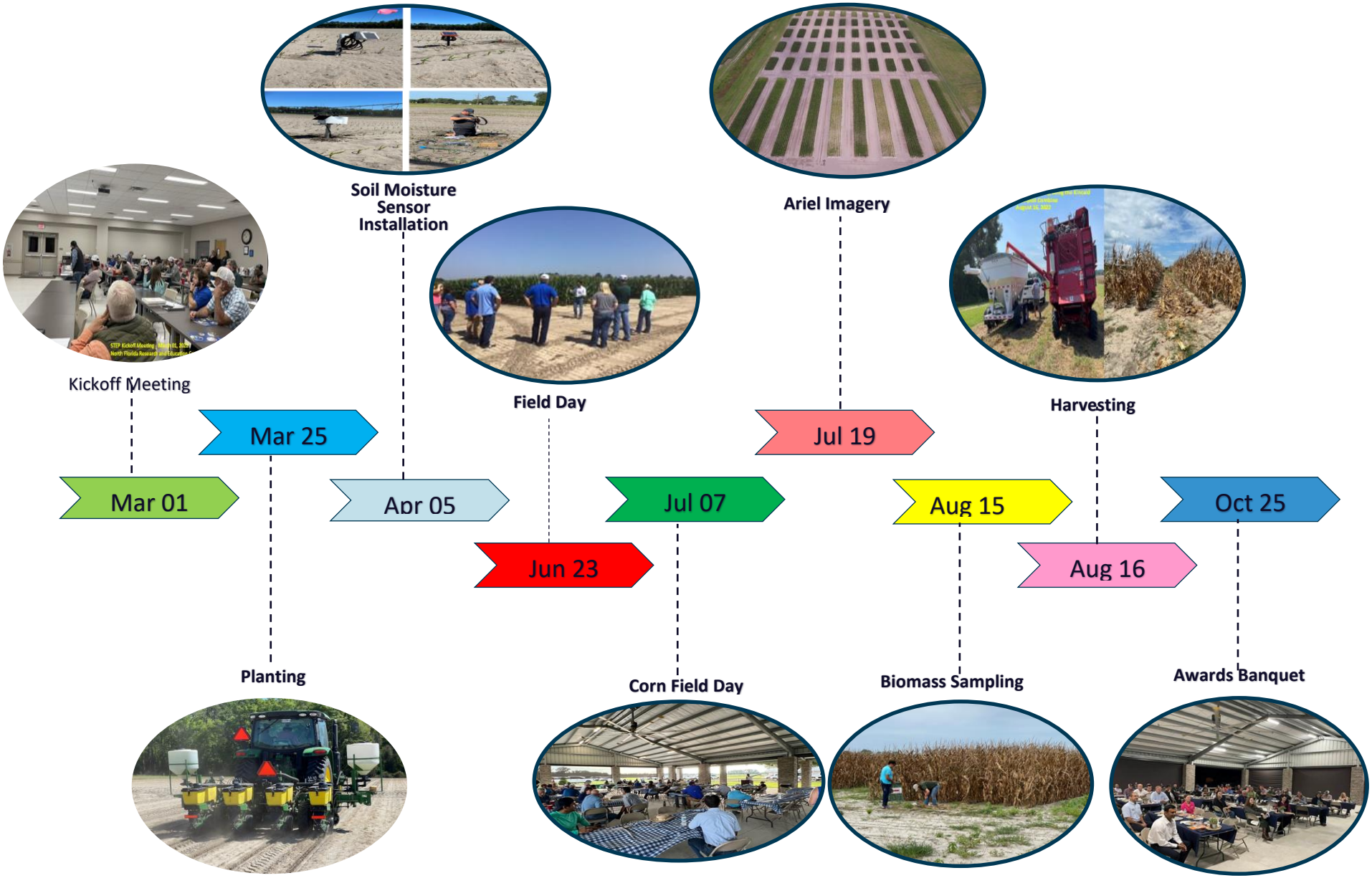


Figure 4. The Florida Stakeholder Engagement Program (STEP) project Timeline.

Weather conditions:

The study site received a total of 20.6 inches of rainfall from planting to physiological maturity, with most of the rainfall occur from mid-May to harvest (Florida Automated Weather Network, https://fawn.ifas.ufl.edu/). The highest precipitation event of 1.6 inches occurred on April 17th, 2022. Throughout the growing season, none of the precipitation event(s) qualified as a leaching rain event (Figure 5).

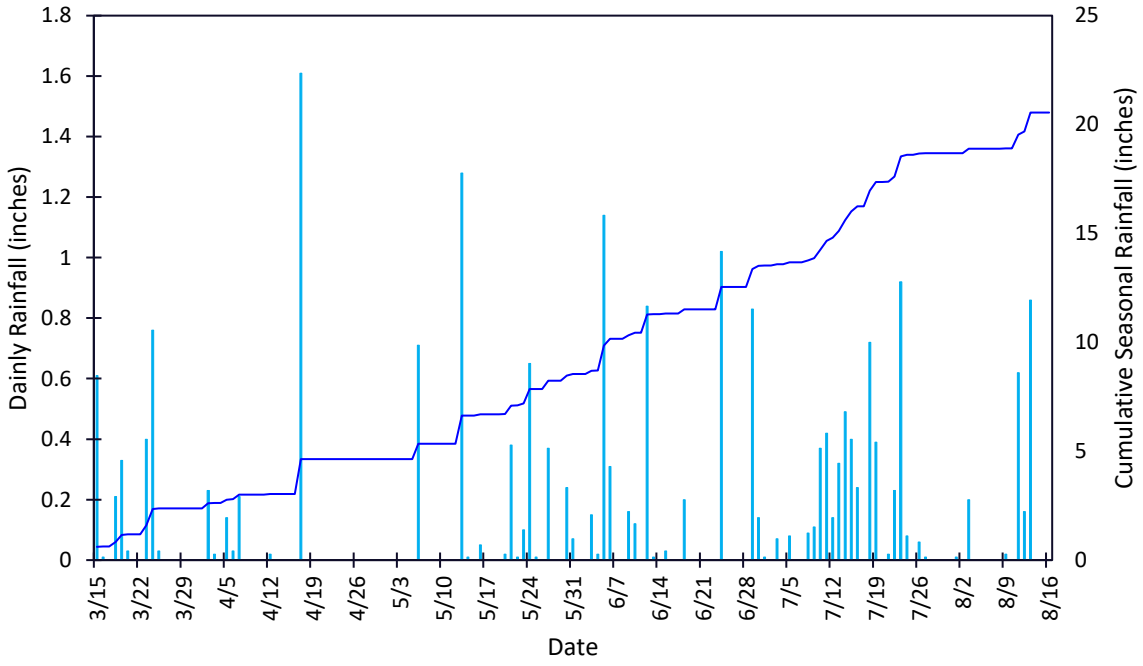


Figure 5. Daily and cumulative season rainfall from planting to harvesting at the NFREC-SV.

Farm Management Decisions and Yield Results:

1. *Hybrid Selection and Seeding Rate Decisions:*

   Over the years, many new corn hybrids are introduced to the growers by different companies which vary in traits (physiological, growth), yield potential, and cost. For the 2022 STEP competition, four default hybrids were selected for the competition from Pioneer, AgriGold, and Local Seed Co. Teams were allowed to work with multiple local seed companies for hybrid selection and to source their own seed. Two teams decided to go with their own hybrid. In total, six corn hybrids i.e., P2042YHR and P1870YHR from Pionner, A6659VT@ from AgriGold, LC1577VT2P from Local Seed Co., Armor Seed 1477, and D54VC14 were planted in the first year of the competition with seed cost ranged from $3.025 to $3.3125 per thousand seeds. The most common hybrid selection for the 2022 competition

was P2042YHR which is opted by five teams. All the remaining hybrids were selected by one team each (Figure 6).

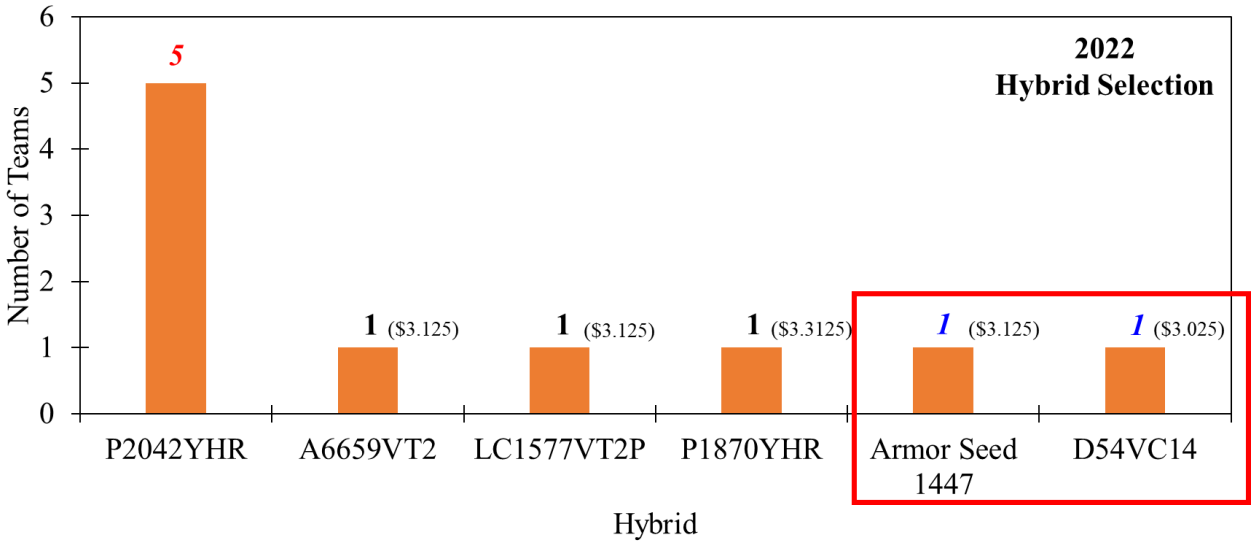


Figure 6. Hybrid selected in the 2022 STEP competition. The red box includes hybrids other than the competition's default hybrids.

In addition to hybrid selection, the seeding rate is also an important management decision as it affects the cost of production and can impact grain yield. For the 2022 competition, the plant population ranged from 28000 seeds/ac to 36000 seeds/ac, where five teams opted for 34000 seeds/ac and two teams opted for 30000 seeds/ac (Figure 7).

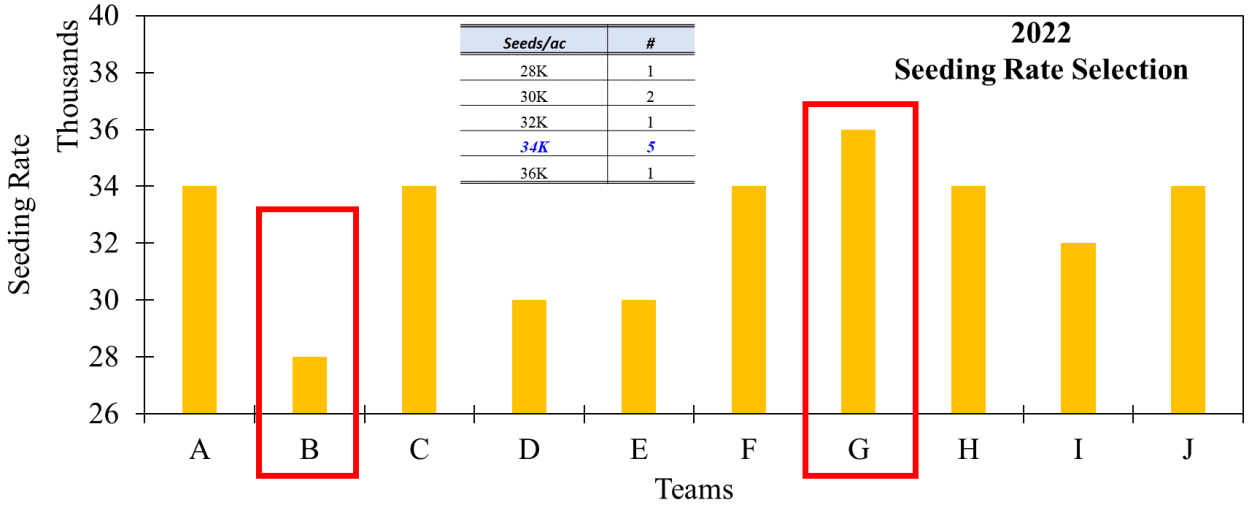


Figure 7. Seeding rate selected by different participating teams. Red box indicates the highest and lowest seeding rate selected by the teams.

2. *Nitrogen Management Decisions:*

The participant had the opportunity to apply granularly nitrogen (34-0-0), liquid nitrogen (UAN 28%), and controlled-release fertilizer (CRF blend 43-0-0) using three application methods (i) broadcast from planting to V10 growth stages, (ii) Banding/side-dressed from planting to V10, and (ii) fertigation from V10 to tasseling. All the plots received 13 gals/ac (~ 30lb/ac of N) of startup fertilizer (23-9-0) at the time of planting. None of the team opted for the CRF program. For the 2022 competition, the total nitrogen application ranged from 190 lbs of N/ac to 370 lbs of N/ac, with five teams opted to broadcast the fertilizer and five teams opted to side-dressed the fertilizer from planting to V10 with a total target application of 100 lbs of N/ac. The major difference in nitrogen application was observed in the fertigation application, where nitrogen fertilizer application ranged from 60 lbs of N/ac to 240 lbs of N/ac, which represent 32% to 65% of the total nitrogen application (Figure 8). Throughout the growing season, soil samples at 1 ft,, 2ft, ad 3ft depth and plant tissue samples were provided to the participating teams for decision-making. Plant and grain tissue samples were also collected at the physiological maturity to calculate the nitrogen intensification performance index.

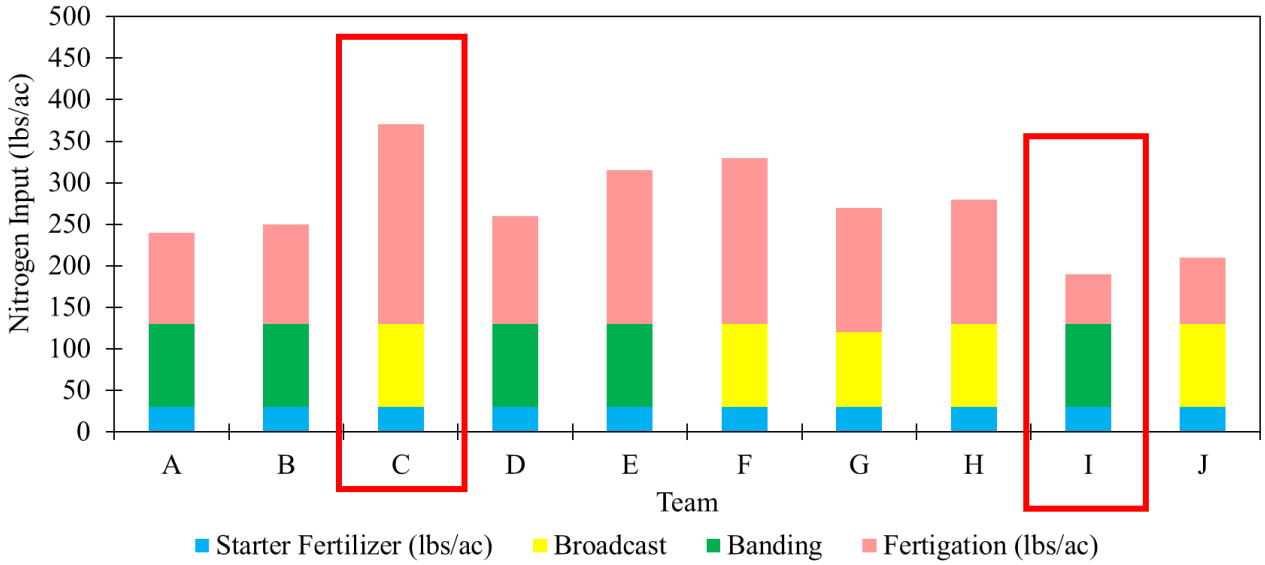


Figure 8. Nitrogen application method and amount (lbs of N/ac) for the participating teams. Red box indicates the highest and lowest fertilizer rate selected by the teams.

3. *Irrigation Management Decisions:*

Before the start of the competition, participating teams were asked to select the method of irrigation scheduling. All the teams opted to use the soil moisture-

based irrigation scheduling. Based on their preference, four local soil moisture sensor company options were provided to them (based on the local soil moisture sensors company support). Five teams opted for BMP logic Sentenk Drill and Drop sensor, three opted for AquaSpy, and the remaining two opted for Holder Ag Sentek Drill and Drop sensors.

Participating teams had the opportunity to apply 0 to 0.5 inches of water at an increment of 0.05 inches throughout the growing season. Total irrigation applied ranged from 5.2 inches (17 irrigation events) to 12.05 inches (29 irrigation events). All the participating teams applied a significant portion of their water during the month of May and June to avoid water stress during the critical growth stages of tasseling (VT). All the team restricted their irrigation in July and effectively used the precipitation during the month of July (Figure 9).

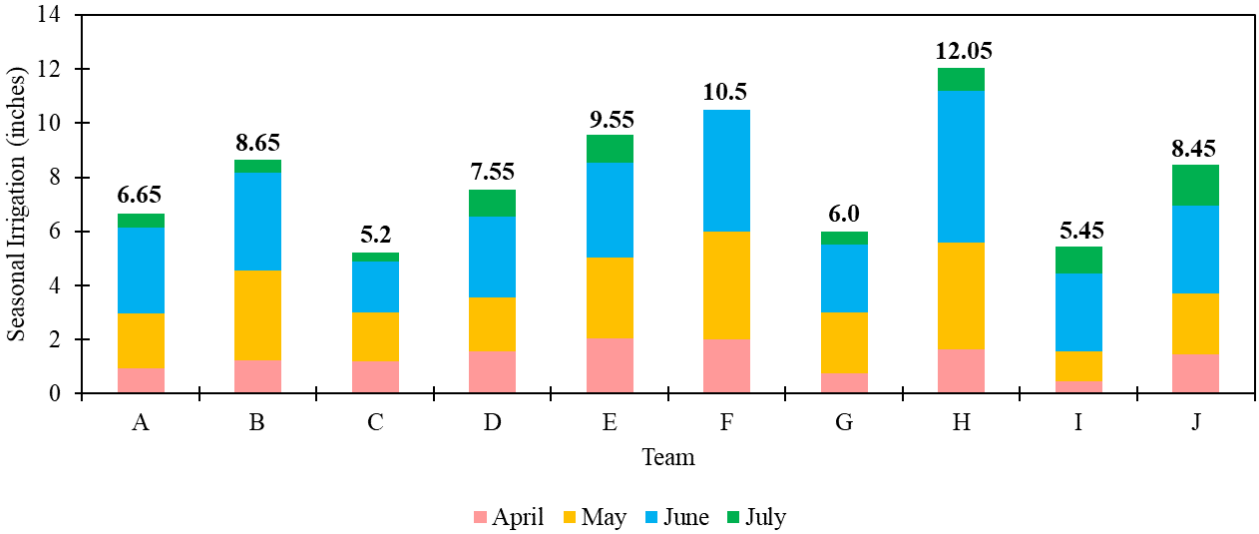


Figure 9. Monthly and cumulative season irrigation applied by the participating teams.

4. *Insurance Selection Decisions:*

Teams were required to select a crop insurance policy by March 15th. Two types of crop insurance were offered: Yield Protection and Revenue Protection.

Insurance premium quotes were provided by Jordan Agency/Acentria Insurance in Live Oak, FL. Premiums were based on 1,000 acres of corn with an actual production history (APH) of 192 bushels per acre. The projected corn price (set by USDA-RMA) was $5.87 per bushel.

All but one team chose Yield Protection insurance. Only three teams chose coverage levels above 50% (Table 1 and Figure 10). None of the teams' research plots incurred yield losses substantial enough to trigger insurance indemnity

payments. The price of corn also remained high enough to avoid any indemnity payments under Revenue Protection insurance.

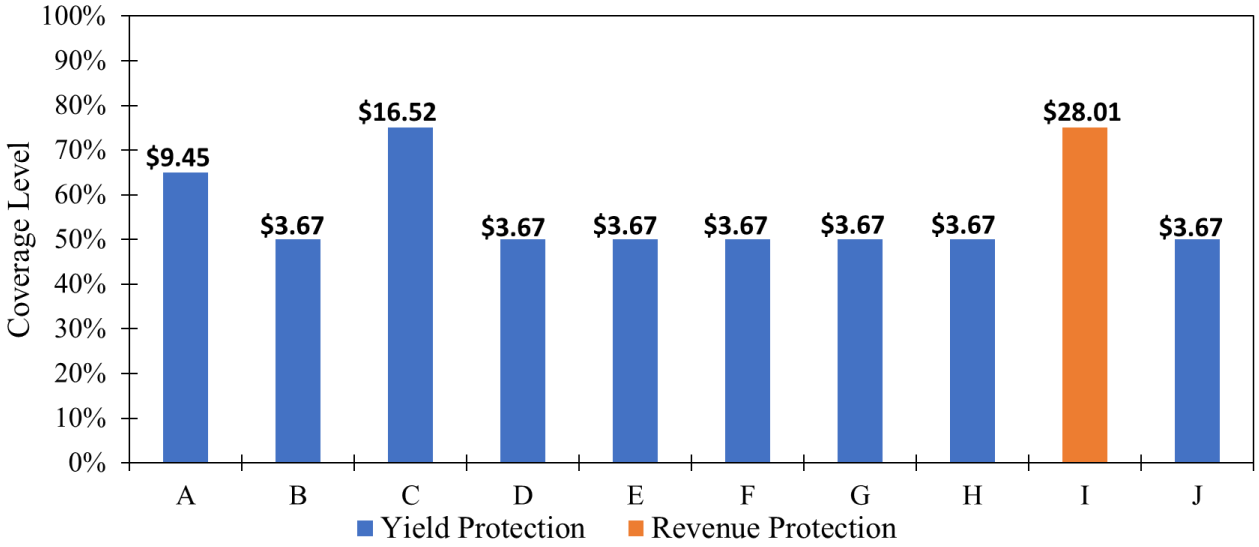


Figure 10. Insurance selections by team.

Table 1. Insurance selections by team.

Team	Insurance Type	Coverage Level	Premium per Acre
A	Yield Protection	65%	$9.4500
B	Yield Protection	50%	$3.6740
C	Yield Protection	75%	$16.5150
D	Yield Protection	50%	$3.6740
E	Yield Protection	50%	$3.6740
F	Yield Protection	50%	$3.6740
G	Yield Protection	50%	$3.6740
H	Yield Protection	50%	$3.6740
I	Revenue Protection	75%	$28.0090
J	Yield Protection	50%	$3.6740

5. Marketing Selection Decisions:

Each team was able to choose how to market their simulated corn harvest. The yield (bushels per acre) from each team's research plots was multiplied by 1,000 acres to calculate the simulated harvest amount that each team sold. The simulated corn harvest was assumed to be delivered to a local buying point during the week of harvest at 15.5% moisture. No storage, drying, or long-distance transport options were allowed.

The corn contract price on a given date is determined by the closing Chicago futures price (for September or December delivery) on that date plus the local basis in effect on that date. For example, the Chicago September futures closing price on April 5, 2022, was $7.1750 and the local basis was $0.80. Therefore, the local flat contract price on April 5 was $7.9750. The Chicago futures price changes daily and is posted on various publicly available sites. The local basis does not change frequently, and in fact only changed once during the 2022 corn growing season. We contacted a local buying point, Furst-McNess Company (formerly Central States Enterprises) in Lake City, each week to verify the local basis. The local basis amount was posted on the competition website weekly and remained in effect for calculating contract prices until it was updated the following week.

Contract prices between March 1st and July 29th, and the August 15th local spot price, are shown in Figure 11. The local contract price ranged from a low of $6.64 per bushel on July 22nd to a high of $8.46 per bushel on May 16th. The local spot price offered for corn harvested the week of August 15th was $7.28 per bushel.

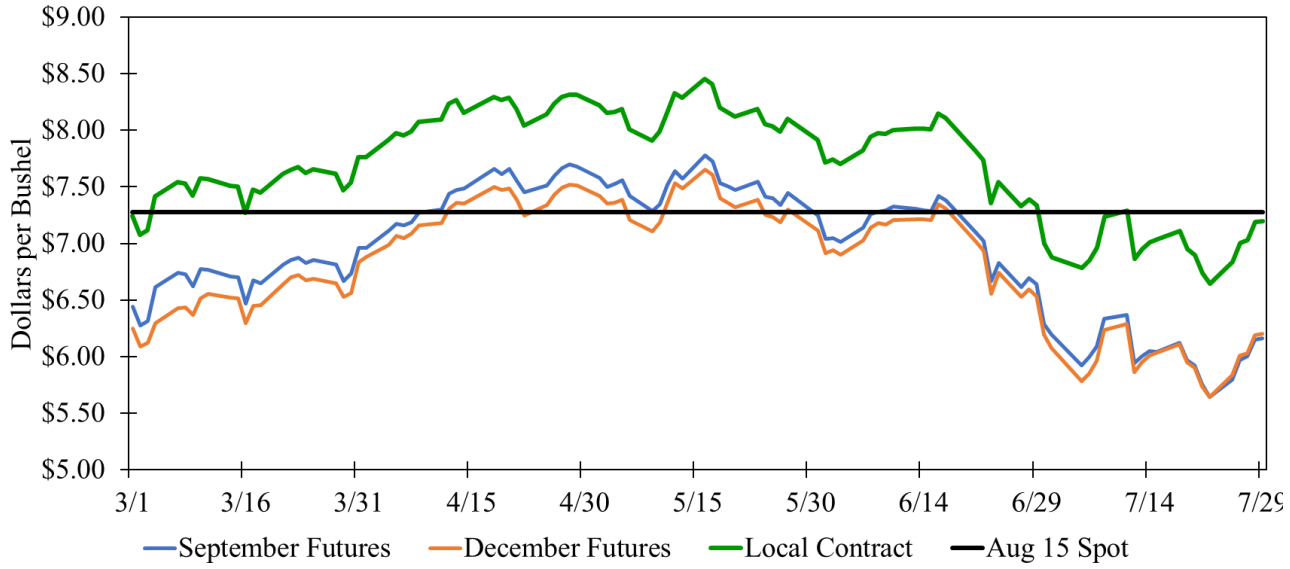


Figure 11. Corn prices during 2022 growing season.

For the competition marketing, teams could select contracts in 10,000-bushel increments on any date between the planting date and July 29th. Teams could choose a flat contract or a basis contract. The flat contract locks in the delivered price on the date the contract is selected. The basis contract locks in the local basis on the date the contract is initiated but allows the team to lock in the Chicago futures price on a later date. Any bushels left uncontracted from each team's simulated harvest were

"sold" at the local cash spot price in effect during the competition harvest week (August 15).

Across all teams, 760,000 bushels were contracted between March and July. The remaining 1,611,000 uncontracted bushels from each team's simulated harvest were assigned the August 15th local spot market price. Figure 12 shows the number of bushels contracted or sold by the month. April was the month with the highest number of bushels contracted. The vast majority of bushels were left uncontracted.

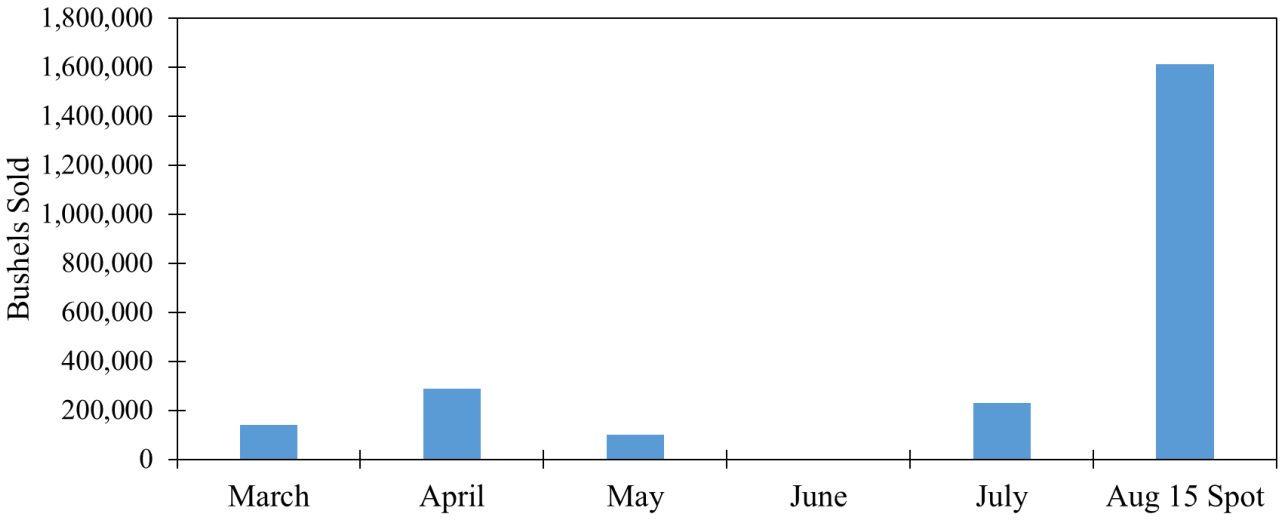


Figure 12. Bushels contracted or sold by month.

The weighted average delivered price was calculated for each team. The results are shown in Figure 13. Team E contracted 150,000 bushels and earned an average delivered price of $7.91 per bushel. The average delivered price for teams that did not contract any bushels was the spot market price of $7.28 per bushel.

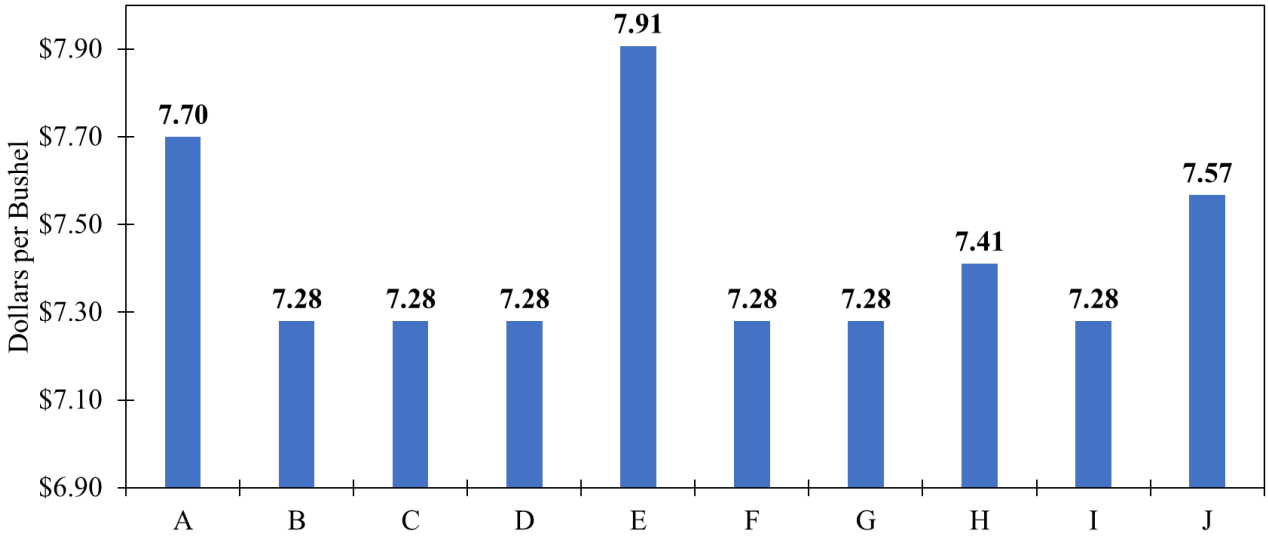


Figure 13. Average delivered price by teams.

6. Yield Results:

For the 2022 STEP competition, the corn yield ranged from 198 bu/ac to 279 bu/ac. The control plot that received no irrigation and no fertilizer yielded only 59 bu/ac. The highest yield corresponded to the corn hybrid Armor Seed 1477 at a rate of 34000 seeds per acre. (Figure 14).

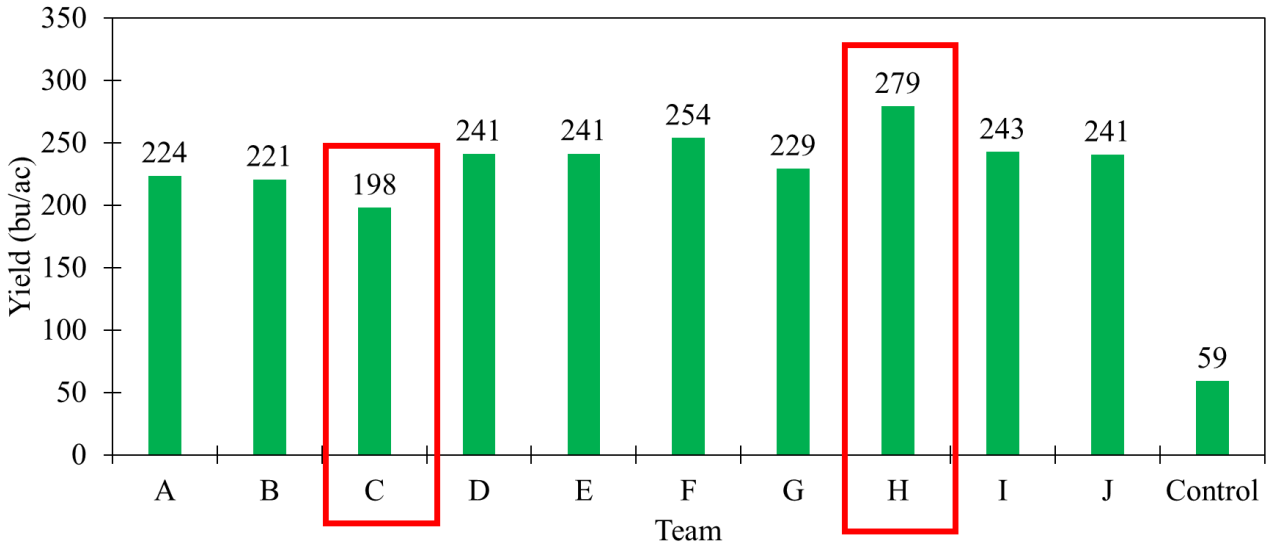


Figure 14. Median crop yield of individual teams and control plot. The red boxes indicate the highest and lowest yield.

To further understand the differences in yield, grain yield was compared to the hybrid selection, seeding rate, and seasonal cumulative irrigation and nitrogen amounts. Figure 15 represents the average grain yield from different hybrids selected by the participating teams. The highest and lowest grain yields of 279 bu/ac and 221 bu/ac were observed for Armor 1477 and Local Seed LC1577VT20 hybrid, respectively. The hybrid Pioneer P2042YHR which was selected by five teams resulted in an average yield of 229 bu/ac.

To further understand the differences, the grain yield was compared to the plant population (Figure 16). The red and blue dotted lines in Figure 16 represent the average yield and average seeding rate observed in the study. Five teams chose the same 34000 seeds/ac seeding rate comprising four hybrids. Significant differences in grain yield at the same seeding rate of 34000 seeds/ac signify the importance of hybrid selection. Selection of higher seeding rates did not result in higher yield. For example, the team with the highest seeding rate (36000 seeds/ac) had below average yield. In addition, two teams selecting the same P2042YHR hybrid at the same seeding rate of 34000 seeds/ac yielded differently, which signifies the importance of other management decisions including irrigation and nitrogen management.

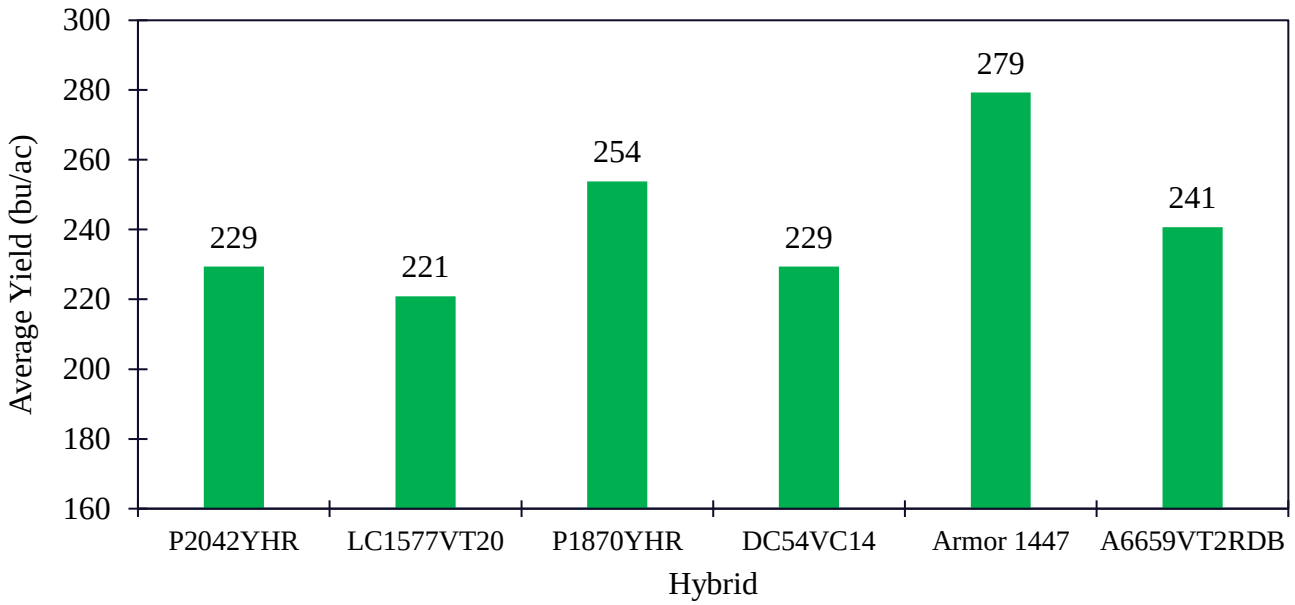


Figure 15. Grain yield response to hybrid.

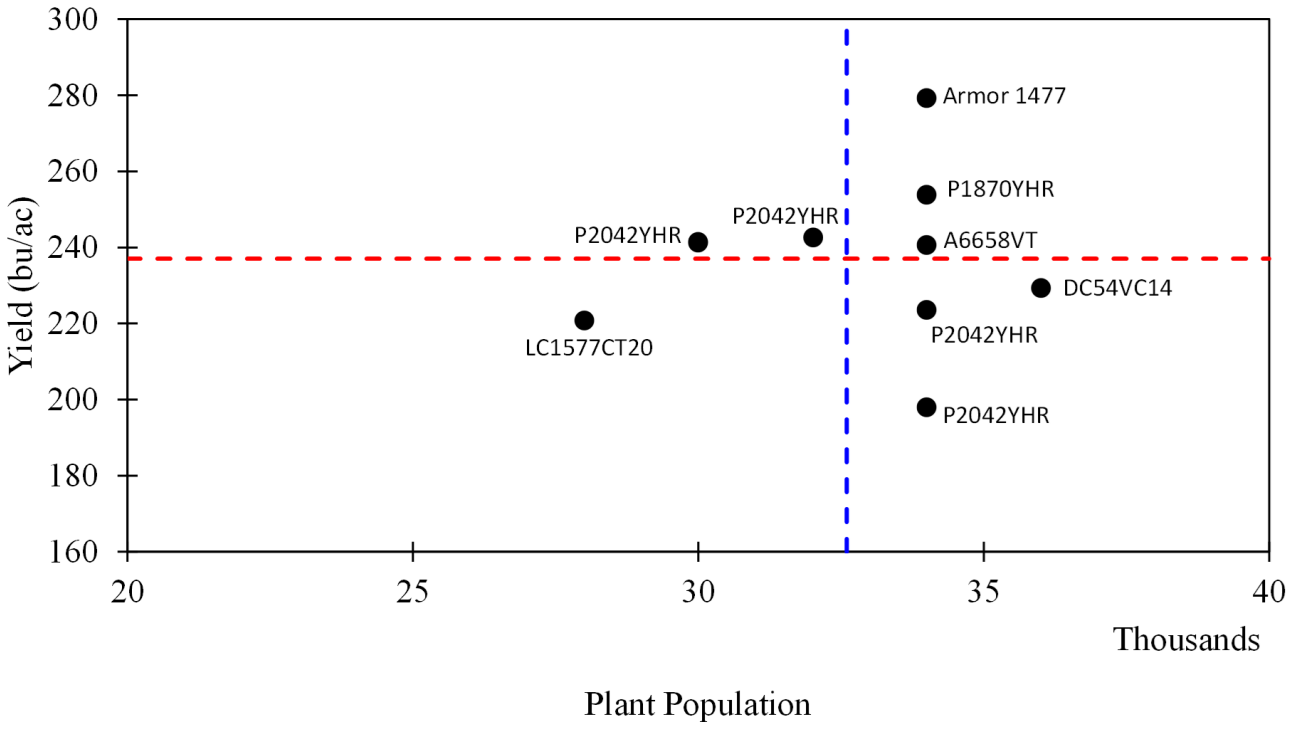


Figure 16. Corn yield at varying seeding rates.

Figure 17 represents the relationship between the observed grain yield and total growing season nitrogen application. The red and blue dotted lines in Figure 17 represent the average yield and average total nitrogen applied in the study. Yellow and

pink markers represent the nitrogen application and corresponding yield for highest input use efficiency and most profitable team, respectively. The team with highest yield applied 280 lbs/ac of nitrogen. The team with lowest nitrogen application (190 lbs/ac) had an above average yield of 243 bu/ac. The lowest yield (other than control plot) was observed at the highest nitrogen application rate of 370 lbs/ac.

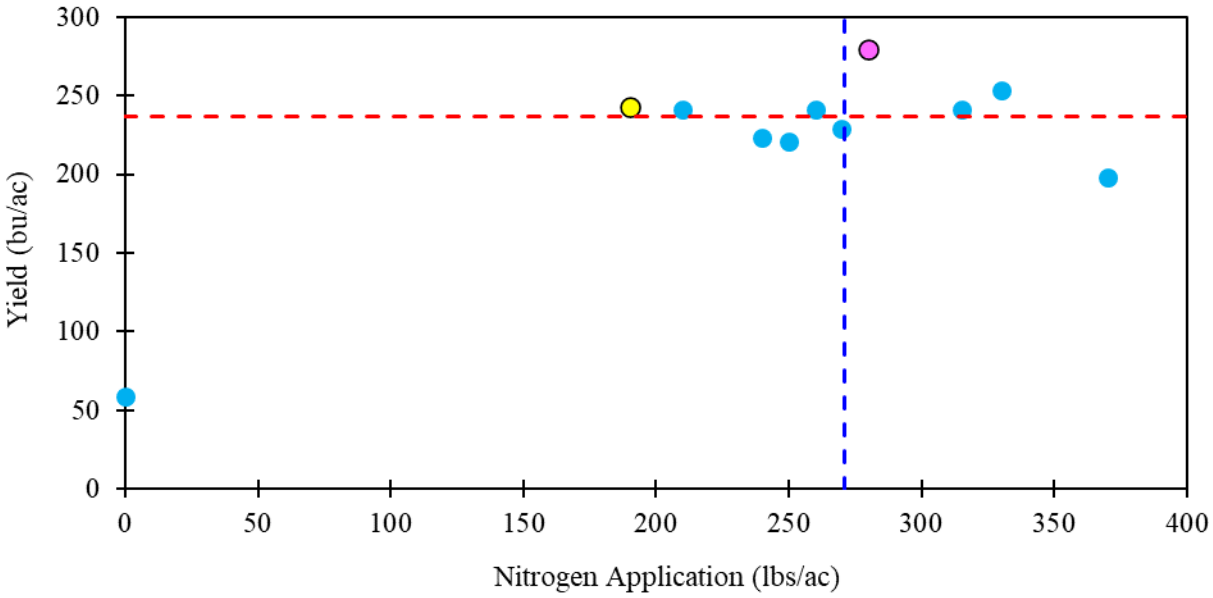


Figure 17. Corn yield (bu/ac) response to season total nitrogen application (lbs/ac). The most efficient and most profitable indicted by yellow and pink markers.

Grain yield had a positive association with amount of irrigation (Figure 18). The team that applied the most irrigation achieved the highest yield, and the team that applied the least irrigation had the lowest yield. However the team that applied the second lowest amount of irrigation had a yield slightly above average, suggesting that the relationship between yield and irrigation is affected by other management decisions and variables.

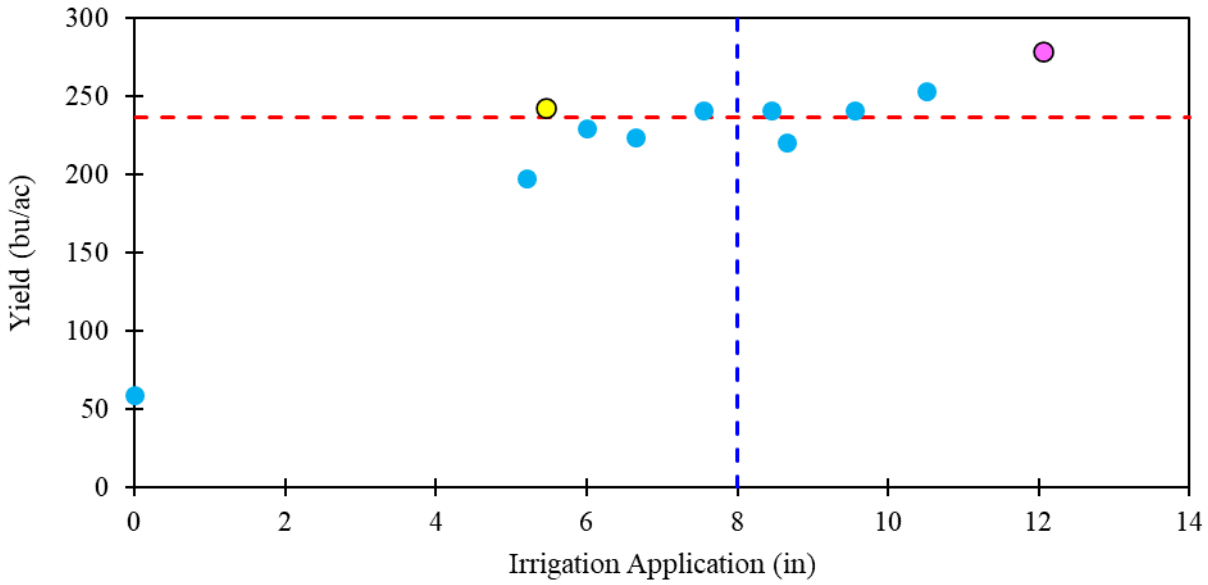


Figure 18. Corn yield (bu/ac) response to season total irrigation application (inches). The most efficient and most profitable indicted by yellow and pink markers.

2022 STEP Award Winners:

1. Most Profitable Award:

An award was given to the team with the most profitable corn crop. Gross profit was calculated by subtracting the total production cost per acre from corn sales revenue per acre. Gross profit does not account for the general and administrative costs of running a farm business. Revenue per acre was calculated by multiplying yield per acre by the average farm-gate price for each team. The average farm-gate price is the average delivered price minus a $0.30 per bushel hauling charge to deliver the corn to the local buying point.

Figure 19 shows the profit results by team. Team Jackson Farms (Team Members: Wyatt Jackson, Mallory Jackson, and Bill Jackson) had the highest gross profit at $794 per acre. They planted the Armor Seed 1477 at a rate of 34000 seeds per acre, applied 280 lbs of N/ac (30 lbs/ac as a starter fertilizer, 100 lbs/ac broadcasted from planting to V10, and 150 lbs of N/ac as fertigation), applied a total of 12.05 inches of irrigation, selected yield protection insurance coverage at 50% coverage and marketed their grain as flat contracts of 50000 and 180000 bushels of corn on April 18, and July 29 at a price of $8.2975 and $7.2, respectively and had the highest yield of 279 bu/ac. **Congratulations Team Jackson Farm! (Figure 20).**

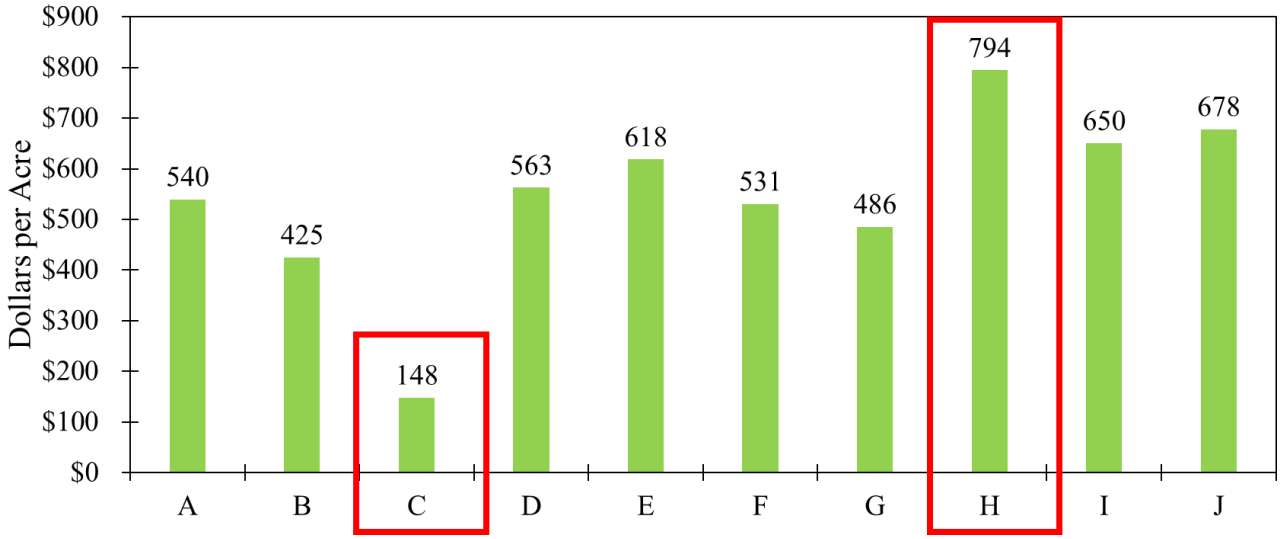


Figure 19. Profitability ($/acre) for individual teams. Red box indicates the highest and lowest profitability by the teams.

Figure 20. Team Jackson Farms – Winner 2022 STEP competition Most Profitable Award- receiving a check of $2000 from Dr. Saqib Mukhtar, Associate Dean and Program Leader Agriculture and Natural Resources UF-IFAS, and Mr. Stan Posey from Nutrien.

2. Highest Input-use Efficiency Award:

Input use efficiency was quantified using the Water and Nitrogen Intensification Performance Index (WNIPI), which was evaluated for each team relative to the control plot that received no irrigation or fertilizer inputs. The WNIPI values along with ranking, yield, irrigation, and nitrogen applied are presented in Table 2 and Figure 21. The WNIPI ranged from 0.15 to 0.36. The highest input-use efficiency award goes to Team Columbia (Team Member: Ronald Norris). Ronald Norris went with allow input production approach by applying total seasonal irrigation of 5.45 inches, applied 190 lbs /ac of nitrogen fertilizer (30 lbs/ac as starter fertilizer, banding 100 lbs/ac of nitrogen fertilizer from planting to V10, and 60 lbs/ac as fertigation) and planted corn hybrid Pioneer P2042YHR at 32000 seeds per acre. Their median yield was 243 bu/ac. Although Ronald had a lower yield, his efficiency was the greatest of the competing teams due to the increase in yield above the control farm, relative to the inputs applied. **Congratulations Team Columbia! (Figure 22)**

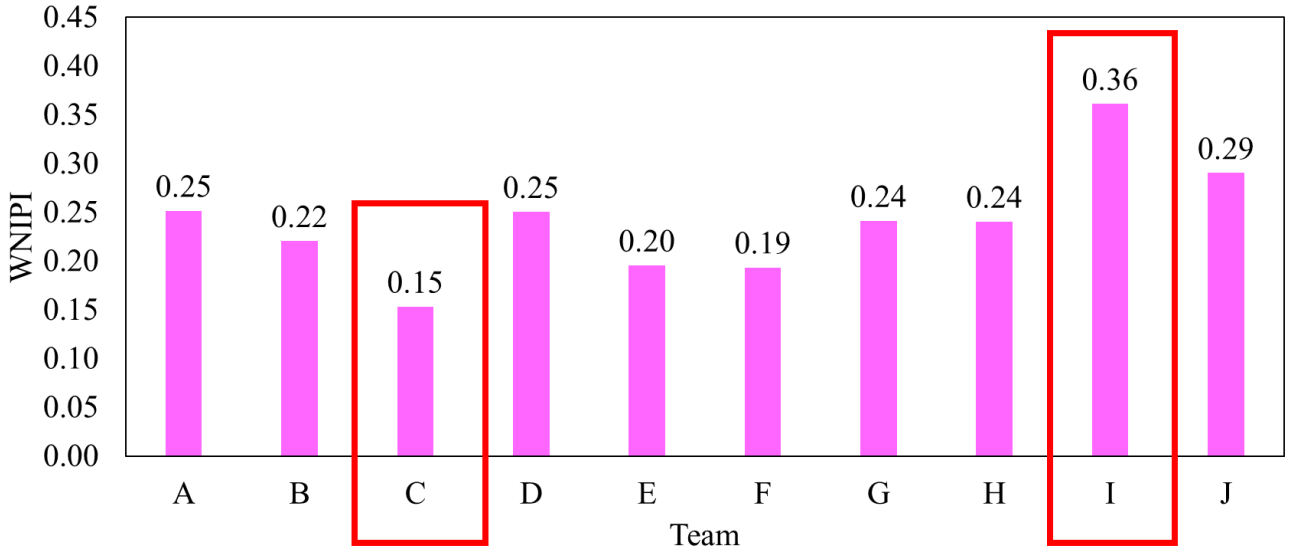


Figure 21. Water Nitrogen Intensification Performance Index (WNIPI) for different teams. Red box indicates the highest and lowest WNIPI values.

Table 2. Cumulative season irrigation, nitrogen application, yield, and Water Nitrogen Intensification Performance Index (WNIPI) for different teams.

Team	Irrigation (in)	Nitrogen Application	Yield	WNIPI
A	6.65	240	224	0.25
B	8.65	250	221	0.22
C	5.2	370	198	0.15
D	7.55	260	241	0.25

E	9.55	315	241	0.20
F	10.5	330	254	0.19
G	6	270	229	0.24
H	12.05	280	279	0.24
I	5.45	190	243	0.36
J	8.45	210	241	0.29

Figure 22. Team Columbia – Winner 2022 STEP competition Highest Input-use Efficiency Award-receiving a check of $2000 from Dr. Saqib Mukhtar, Associate Dean and Program Leader Agriculture and Natural Resources UF-IFAS, and Mr. Stan Posey from Nutrien.

3. Lowest Cost Per Bushel Award:

An award was given to the team with the lowest cost per bushel. Cost per bushel was calculated by dividing the total estimated production cost by the yield (number of bushels). Total estimated production cost included costs associated with each team's management decisions (STEP variable costs) plus an estimated $600 per acre representing production costs that were not affected by the management decisions. The STEP variable costs included costs of seed, nitrogen fertilizer and application, irrigation, and insurance. Total production cost does not include general and administrative costs associated with a farm business.

Figure 23 shows the cost per bushel results by team. The lowest cost per bushel award goes to Team Columbia which had the lowest cost per bushel at $4.19. **Congratulations Team Columbia! (Figure 24).**

Figure 23. Cost per bushel results by team.

Figure 24. Team Columbia – Winner 2022 STEP competition Lowest Cost Per Bushel Award- receiving a check of $2000 from Dr. Saqib Mukhtar, Associate Dean and Program Leader Agriculture and Natural Resources UF-IFAS, and Mr. Stan Posey from Nutrien.

4. Overall Runner-up Award:

Another noteworthy team that had second highest efficiency and gross profit per acre is Team Wilkerson (Team members: BJ Wilkerson and Kelsey Wilkerson). Their WNIPI and gross profit was 0.29 and $673, respectively. They planted the AgriGold A6659VT2RDB at a rate of 34000 seeds per acre, applied 210 lbs of N/ac (30 lbs/ac as starter fertilizer, 100 lbs/ac broadcasted from planting to V10, and 80 lbs of N/ac as fertigation), applied a total of 8.45 inches of irrigation, selected yield protection insurance coverage at 50% coverage and marketed their grain at an average price of $7.57 per bushel. Their median yield was 241 bu/ac. **Congratulations Team Wilkerson farms! (Figure 25).**

Figure 25. Team Wilkerson Farms – Winner 2022 STEP competition Runner-up Award- receiving a check of $1000 from Dr. Saqib Mukhtar, Associate Dean and Program Leader Agriculture and Natural Resources UF-IFAS, and Mr. Stan Posey from Nutrien.

Conclusion and Lesson Learned:

The first year of the STEP competition has been successful and provided great insight into various management strategies that can lead to profitable and efficient corn production. This report summarizes the strategies and management decisions made by

different teams and outcomes in relation to grain yield, profitability, and input use efficiency. The inaugural STEP corn competition was held at the UF-IFAS North Florida Research and Education Center – Suwannee Valley, Live Oak (NFREC-SV). Ten teams including the UF-IFAS team participated in the competition. Participants had control over six production parameters, including (i) crop hybrid type, (ii) seeding rate, (iii) irrigation management, (iv) nitrogen management, (v) insurance selection, and (vi) grain marketing. The teams competed for three awards: (i) Most profitable, (ii) Highest input use efficiency, and (iii) Lowest cost per bushel. There are considerable differences in growers' decisions ranging from the selection of hybrid, seeding population to irrigation and nitrogen management. A scientific evaluation of these management practices is especially valuable to growers and other stakeholders as it provides a thorough understanding of grower-based management practices as they compare against their peers as well as against university recommendations. Significant findings of the 2022 STEP competition include:

- In total, six corn hybrids i.e., P2042YHR and P1870YHR from Pioneer, A6659VT@ from AgriGold, LC1577VT2P from Local Seed Co., Armor Seed 1477, and D54VC14 were planted in the first year of the competition with seed cost ranged from $3.025 to $3.3125 per thousand seeds. The most common hybrid selection for the 2022 competition was P2042YHR which was chosen by five teams.
- The plant population ranged from 28000 seeds/ac to 36000 seeds/ac, where five teams opted for 34000 seeds/ac and two teams opted for 30000 seeds/ac.
- The total nitrogen application ranged from 190 lbs of N/ac to 370 lbs of N/acre.
- Total irrigation applied ranged from 5.2 inches (17 irrigation events) to 12.05 inches (29 irrigation events).
- All but one team chose Yield Protection insurance. Only three teams chose coverage levels above 50%.
- Across all teams, 760,000 bushels were contracted between March and July. The remaining 1,611,000 uncontracted bushels from each team's simulated harvest were assigned the August 15th local spot market price.
- For the 2022 STEP competition, the corn yield ranged from 198 bu/ac to 279 bu/ac.
- Team Jackson Farms (Team Members: Jackson Jackson, Mallory Jackson, and Bill Jackson) had the highest gross profit at $794 per acre.
- The highest input-use efficiency award goes to Team Columbia (Team Member: Ronald Norris) with WNIPI of 0.36.

- The lowest cost per bushel award also goes to Team Columbia which had the lowest cost per bushel at $4.19.
- Another noteworthy team that had the second highest efficiency and gross profit per acre is Team Wilkerson (Team members: BJ Wilkerson and Kelsey Wilkerson). Their WNIPI and gross profit was 0.29 and $673, respectively.

In addition to significant findings, the projects team was able to observe some key features, which could be implemented in future extension programs and STEP competition events.

- Most teams selected the lowest level of crop insurance coverage. Although that may be a rational strategy for the competition, it could reflect an underutilization of insurance for risk management on Suwannee Valley farms. The project leaders will consider providing educational programs on crop insurance.
- Most teams did not contract any corn and instead sold their entire harvest at the local spot market price. If these choices are reflective of actual grain marketing practices on Suwannee Valley farms, it appears that contracting is underutilized as a risk management tool by Suwannee Valley corn growers. The project leaders will consider providing education programs on grain marketing.
- Teams that showed the highest gross profit (and lowest cost per bushel) were not very similar in their management decisions. This observation suggests that there is no single "right" approach to profitable corn production. For example, it is possible to be profitable using less than the recommended amount of fertilizer, but farms can also be profitable using more than the recommended amount of fertilizer. Each farmer makes numerous management decisions each year, and complex interactions between those decisions and growing conditions determine outcomes. However, an analysis of relationships between variables suggests preliminary conclusions that the project will continue to test in subsequent years. The project leaders will also look for win-win scenarios that demonstrate how high profitability and high water and nutrient use efficiency can both be achieved by certain sets of practices.

Acknowledgement:

The successful completion of first year of Florida STEP corn competition is due to the commitment and support provided by our participating teams, industry partners, sponsors, funding agency, and many UF colleagues. Special thanks to the NFREC farm crew and UF-IFAS extension personnel for their support throughout the competition. They

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