

FLORIDA STAKEHOLDER ENGAGEMENT PROGRAM (STEP)

ANNUAL REPORT 2023 Corn Contest



UF | IFAS Extension
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Florida Stakeholder Engagement Program (STEP)

<https://step.ifas.ufl.edu/>

Agricultural and Biological Engineering Department
North Florida Research and Education Center-Suwannee Valley (NFREC-SV)
Institute of Food and Agricultural Sciences
University of Florida.

Mission Statement:

The University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) is dedicated to developing knowledge in agriculture, human and natural resources, and the life sciences. To that end, the Florida Stakeholder Engagement Program (STEP) engages farmers and other agricultural stakeholders in friendly crop management competitions focused on input use efficiency and profitability. The program creates a shared learning experience for growers, industry representatives, policymakers, researchers, and extension agents. The goal is to improve crop management and increase the adoption of Agricultural Best Management Practices (BMPs) to sustain agriculture and protect water quality.

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Program Overview:

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 Best Management Practices (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 (STEP) 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.

The 2nd annual sprinkler irrigated corn farm management contest was conducted under a Valmont Variable Rate Linear Move Lateral Irrigation System at the North Florida Research and Education Center-Suwanee Valley (NFREC-SV). The corn contest was made possible by the funding from Florida Department of Agricultural and Consumer Services (FDACS) and donations by industry partners. The 2023 corn STEP competition included fourteen grower teams, participating in collaboration with consultants and state agency personnel to test, observe, experiment, and implement new and

emerging water and fertilizer BMPs and technologies (Figure 1). 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 (Figure 2 and 3). Participants had control over six major production factors i.e., (i) corn hybrid selection, (ii) seeding rate, (iii) nitrogen management, (iv) irrigation management, (v) insurance selection, and (vi) grain marketing (Figure 4). A detailed description of each management decision is provided in the following section.

Hybrid Selection and Seeding Rate:

Each team was required to select any commercially available corn seed variety and seeding rate. Sale representatives from different seed companies including Pioneer, Integra, Dyna-Gro, Triangle Seed, Gateway Seed, Croplan, and Northup-King Seed provided a total of fourteen hybrids in 2023, which act as default hybrids for the contest. While each team was allowed to select any default hybrid, they were also allowed to work with different seed company representatives to select their own corn seed hybrid. If teams selected one of the default hybrids, the STEP project management team provided the seed. However, if a team selected their own hybrid, it was the responsibility of the team to procure the seed and deliver it to the competition site two weeks prior to planting. For seeding rate, six options ranged from 26,000 seed per acre to 36,000 seed per acre in increments of 2,000.



Figure 1. Team names and the location of the 2023 STEP competition participants.



Figure 2. Aerial Imagery of 2023 Florida Stakeholder Engagement Program (STEP) competition held at the North Florida Research and Education Center-Suwannee Valley (NFREC-SV).

Nitrogen Management:

All the plots received 13 gals/ac (30 lbs of N/ac) of startup fertilizer at the time of planting. The start-up was applied using a double-coultter liquid applicator at 2-inch depth and 2 inches to the side of the planted row. Before the start of the competition teams were asked to choose either in-season conventional fertilizer applications or controlled-release fertilizer (CRF) applied at planting. In the conventional fertilizer program, teams were allowed to pick any fertilizer rate and timing. Options for fertilizer material and application method included dry ammonium nitrate (34-0-0) either broadcast or banded, and UAN 28% (28-0-0-5) applied as liquid side dressing. Provisions were provided where teams can pick different application methods for different timings of fertilizer application. The banding nitrogen application was applied using the 1st Products rig. Liquid side-dressing was applied at the ground surface neighboring each row using the Miller High Boy 360 Y-drops (Figure 5). For the CRF program, teams were allowed choose 43-0-0 from Harrell's or 42-0-0 from Florikan at a rate ranging from 150 to 300 lbs/ac of N. All the CRF applications were applied at planting. Options were provided for additional application of 30 lbs N/ac in case of leaching rain event.

Irrigation Management:

The irrigation was applied using the two-span Valley lateral move zone control Variable Rate Irrigation (VRI) System (Valmont Industries, Inc.). The irrigation system was operated everyday throughout the growing season. Teams submitted their irrigation decisions one day prior to the day of irrigation using the STEP website. Irrigation

depth per event was restricted to a maximum of 0.5 inches. If the team failed to indicate their irrigation decision, irrigation was not applied. Teams had three options for irrigation scheduling (i) soil moisture-based irrigation scheduling, (ii) evapotranspiration-based irrigation scheduling, and (iii) 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: (i) Sentek Drill and Drop probe from Holder Ag, (ii) Sentek Drill and Drop probe from BMP logic, and (iii) Aqua-Spy Probe. Based on the sensor selection, free access to soil moisture data was provided to each team for irrigation scheduling. For evapotranspiration-based irrigation scheduling, free access to smart irrigation apps was provided to each team.

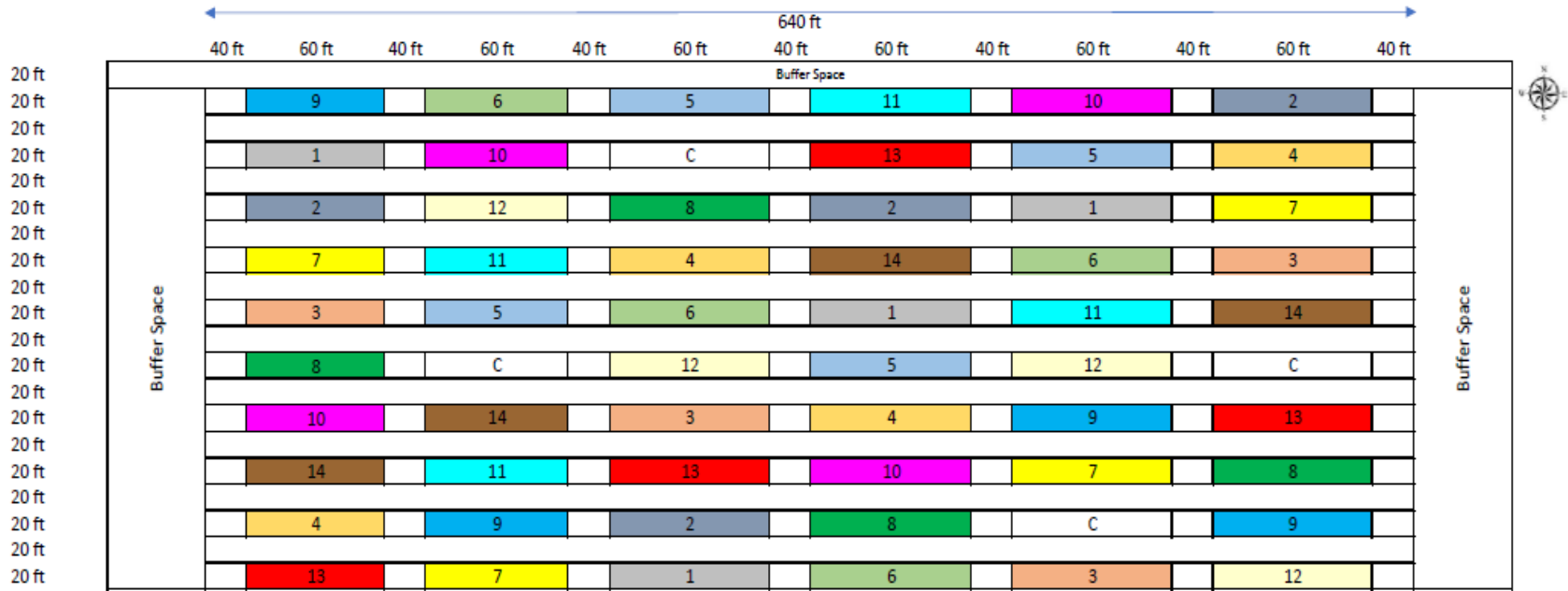


Figure 3. Plot map for the 2023 Florida Stakeholder Engagement Program (STEP) competition held at the North Florida Research and Education Center-Suwannee Valley (NFREC-SV).

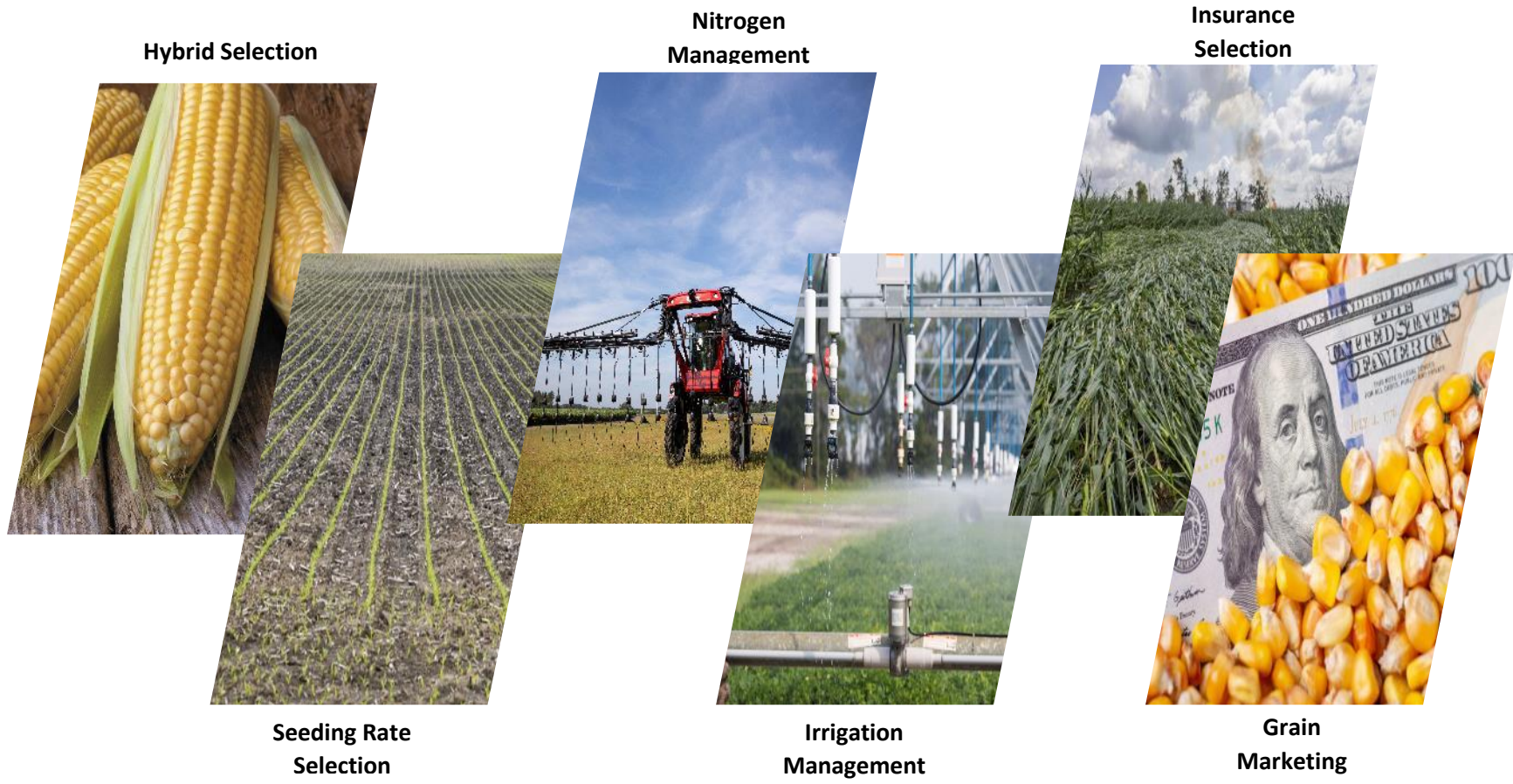


Figure 4. Management Decisions for 2023 STEP Competition.



Figure 5. Miller High Boy 360 Y-drops used for liquid side dressing.

Insurance selection:

Teams were asked to select a multi-peril crop insurance plan from two options: (i) Revenue protection, and (ii) Yield protection. 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. 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. Available coverage levels ranged from 50% to 85% at 5% increments. Premium rates for the two plans and different coverage levels were obtained from a local insurance company and provided to each team before the competition.

Table 1. Description of 2023 STEP corn contest default hybrids along with seed cost.

Variety	Cost (\$) per 80K bag	Cost (\$) per thousand seed
Pioneer P2042VYHR	367	4.5875
Pioneer P1847VYHR	386	4.825
Pioneer P1622VYHR	392	4.90

Pioneer P1289YHR	389	4.8625
Integra 6641	336	4.20
Integra 6342	365	4.5625
Dyna-Gro D58SS65	385	4.8125
Dyna Gro D57VC51	330	4.125
Cropland 5893TRE	375	4.6875
NK1748-3110	330	4.125
NK1677-3110	330	4.125

Grain Marketing:

Each team was responsible for marketing corn from a simulated (on paper) 1,000-acre harvest. This upscaling provided teams an opportunity to market grain in quantities consistent with real-world agricultural operations. 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 could 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 were 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.

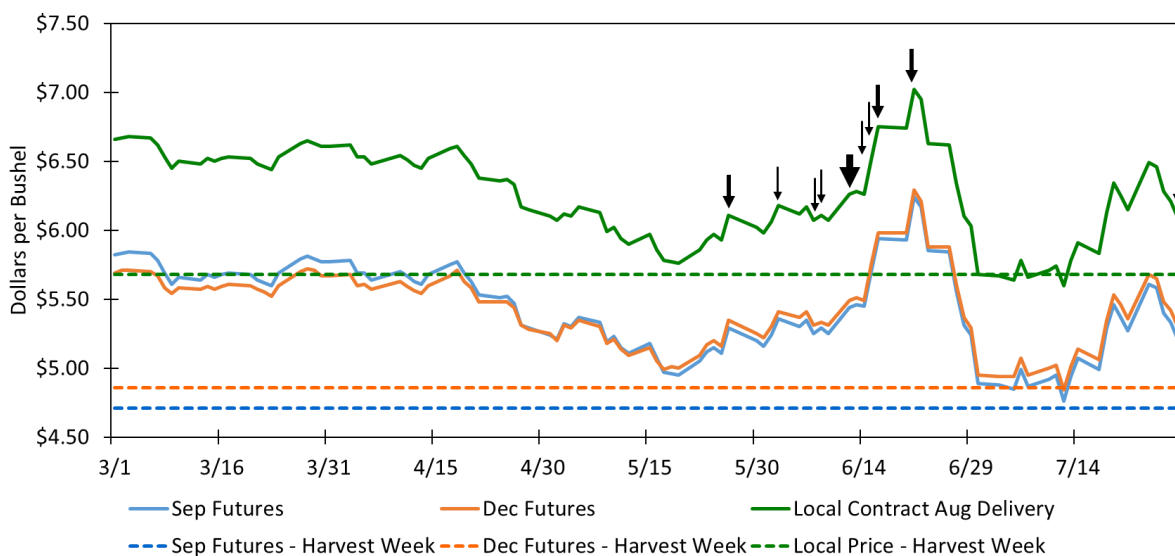


Figure 6. Corn price (\$/bu) for the 2023 corn growing season.

Other Management 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. The variable 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. Competition plots were open to participating teams to observe and to collect additional data throughout the growing season.

Data Collection:

One of the main goals of the Florida STEP is to test, observe, experiment, and implement new and emerging water and fertilizer conservation technologies and management techniques in a risk-free environment. In 2023, seventeen industry partners and technology providers joined the STEP corn contest. Teams received free access to ag technologies and services. For example, for irrigation management, one set of soil moisture sensors (as per the teams' choice) was installed in one replication. To support the nutrient management decisions, corn growth data (i.e., plant height, growth stages, etc.), soil samples, and leaf tissue samples were collected throughout the corn growing season and shared with the teams. Soil and tissue data were sent to Waters Lab for nutrient analysis. All the information and data were shared with the participating teams through the STEP website (<https://step.ifas.ufl.edu/>). In addition, drone

images were collected throughout the growing season. Drone images were processed using the SOLVI platform, and the information on the different vegetative indices and thermal imagery were shared with the teams using the SOLVI web platform. Detailed information on SOLVI is available at (<https://solvi.ag/>).

Awards and Award Calculations

In 2023, the teams competed for two awards (i) Most profitable and (ii) Highest input use efficiency. In each category, 1st, 2nd, and 3rd place teams were awarded \$2000, \$1000, and \$500, respectively. In addition, a plaque was presented to the first-place winner in each category.

Most Profitable: The “most profitable” award was based on 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.

The seed cost for different hybrids is presented in Table 2. Start-up fertilizer (23-9-0) remained part of the fixed cost calculation and remained the same for all the teams. In-season fertilizer cost was set to \$0.96 per lb of N (\$650/ton) for ammonium nitrate (34-0-0), \$0.80 per lb of N (\$450/ton) for UAN 28% with sulfur (28-0-0-5). Harrell’s CRF was \$1.86 per lb of N (\$1,600/ton), and Florikan CRF was \$1.23 per lb of N (\$1,080/ton). Application cost was set to \$15/acre per application for side-dress application of ammonium nitrate or CRF, \$7/acre per application of broadcast application of ammonium nitrate or CRF, and \$11.50/acres per application of liquid side-dress application of 28-0-0-5. Irrigation cost was set to \$12 per acre-inch of water application.

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; Y_n = grain yield of the zero-input treatment; ET = crop evapotranspiration of the farm under evaluation; ET_n = crop evapotranspiration of the zero-input treatment; G_n = 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. ET_n was calculated using the water balance approach.

2023 Competition Results:

Timeline:

The competition started with a kickoff meeting on March 2nd, 2023, at the NFREC-SV at Live Oak, FL, where the rules and regulations of the competition were described to the participating teams, industry partners, and other stakeholders. In addition, an in-service training was organized on the same day for extension agents and UF specialists to gain knowledge in the STEP corn contest. Field operations began with corn planting on March 22nd, 2023. 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. For example, a STEP corn field day was organized in collaboration with Suwannee River Partnership on June 9, followed by STEP plot demonstrations for IoT4Ag group on June 16th. The STEP corn contest data and information were also shared at the North Florida Research and Education Center – Suwannee Valley annual corn field day. The project findings were also shared at the Annual Florida Section American Society of Agricultural and Biological Engineers Annual Conference at Duck Keys, FL. The corn was harvested on August 16th. Results and awards were presented at the STEP awards banquet on November 2nd, 2023 (Figure 7).

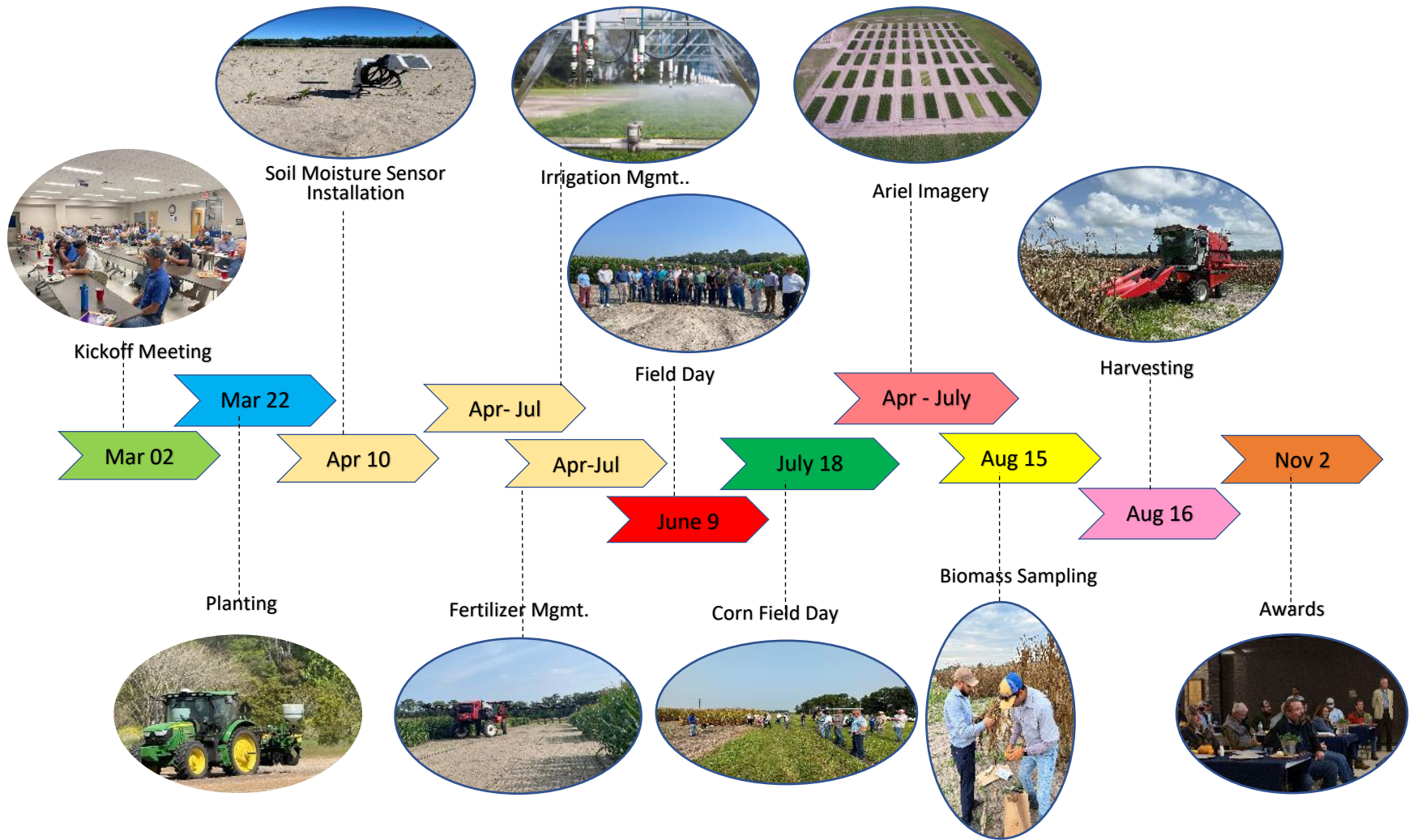


Figure 7. The Florida Stakeholder Engagement Program (STEP) project Timeline

Weather conditions:

The study site received a total of 25.9 inches of rainfall from planting to physiological maturity, with most of the rainfall occurring from mid-May to harvest (Florida Automated Weather Network, <https://fawn.ifas.ufl.edu/>).

The highest precipitation event of 3.7 inches occurred on June 21st, 2023. All the fertilizer applications were concluded before the June 21st precipitation event, so it is not considered as a leaching rain event (Figure 8).

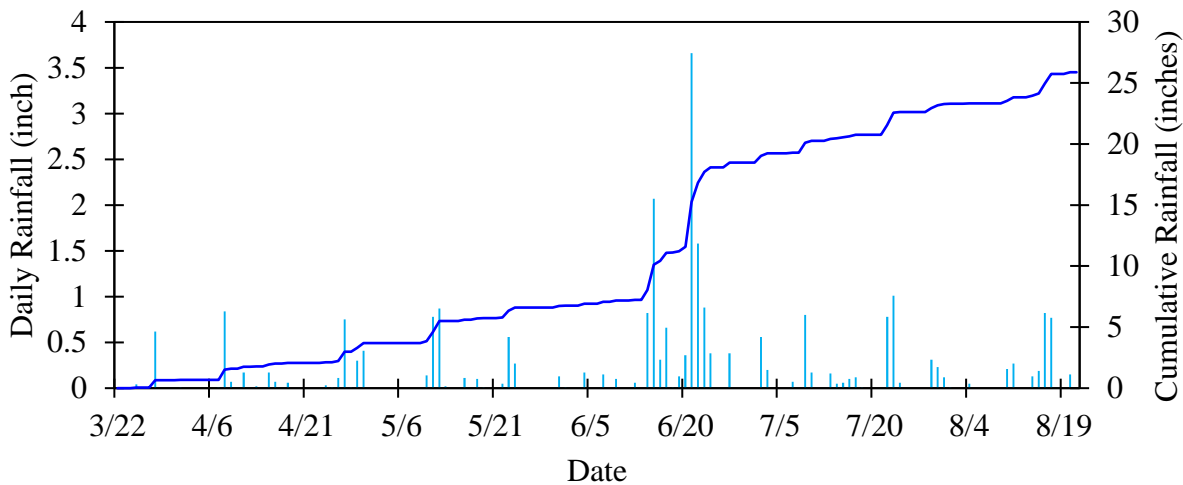


Figure 8. Daily and cumulative seasonal rainfall from planting to harvesting at the NFREC-SV, Live Oak, FL.

Farm Management Decisions and Yield

Results:

Hybrid Selection and Seeding Rate

Decisions:

Growers opted for different seed varieties by different companies which vary in traits (physiological, growth), yield potential, and cost. For the 2023 STEP competition, fourteen default hybrids from Pioneer, Integra, Dyna-Gro, Triangle Seed, Gateway Seed, Croplan, and Northup-King Seed were provided to the teams. Eight teams decided to

go with Pioneer hybrids i.e, P2042VYHR, P1622VYHR and P1847VYHR out of which P2042VYHR was the most common hybrid being selected by 5 teams, followed by P1847VYHR by 2 teams. Out of the default hybrids, DynoGro D57VC51 and Integra 6641 were selected by one team each. It was exciting to see the team's enthusiasm for this competition as four growers decided to work with multiple seed companies and brought their own hybrids including AGRATEC 85VT2P, Croplan 1447, Dekalb6208 and DKC68-69 (Figure 9).

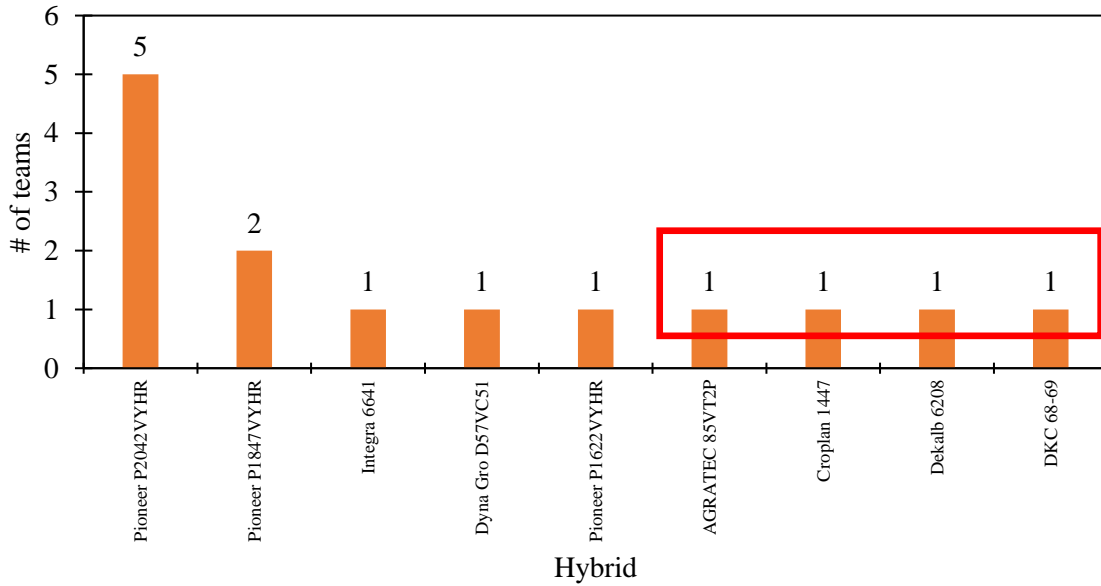


Figure 9. Hybrid selected in the 2023 STEP competition. The red box includes hybrids other than the competition’s default hybrids.

Seeding rate also played a significant role in management decisions as it affects the cost of production and can impact grain yield. For the 2023 competition, the plant population ranged from 28000 seeds/ac to 34000 seeds/ac, where ten teams opted for 34000

seeds/ac and two teams opted for 32000 seeds/ac. Seeding rate of 30000 and 28000 seeds/ac was selected by team B and team K respectively (Figure 10). In 2023 competition, the seed cost ranged from \$112.63 to \$164.05 per acre (Figure 11).

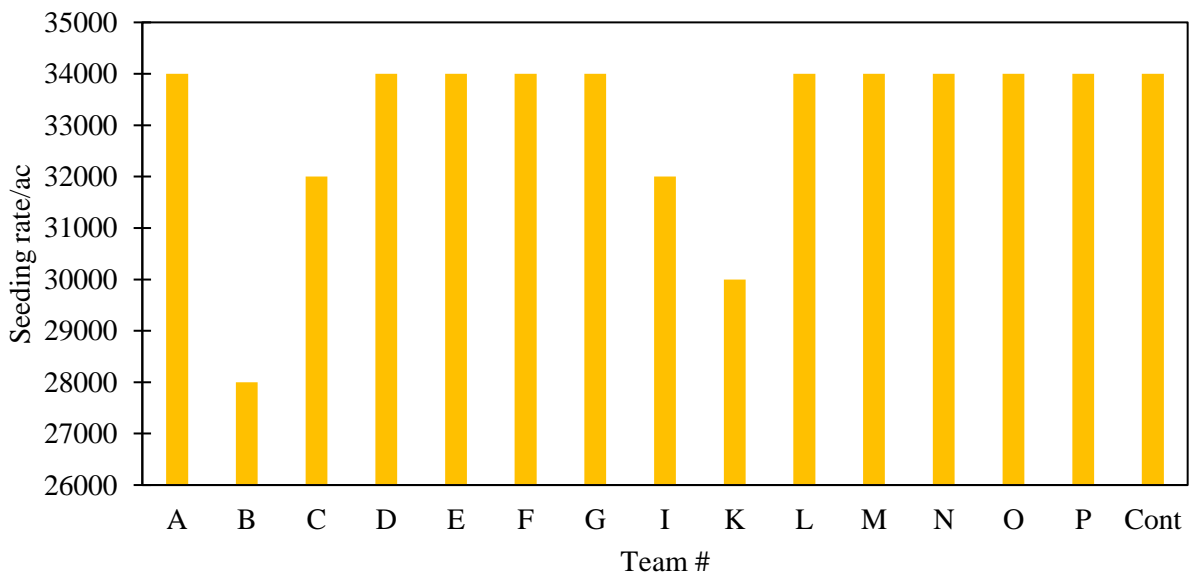


Figure 10. Seeding rate selected by different participating teams.

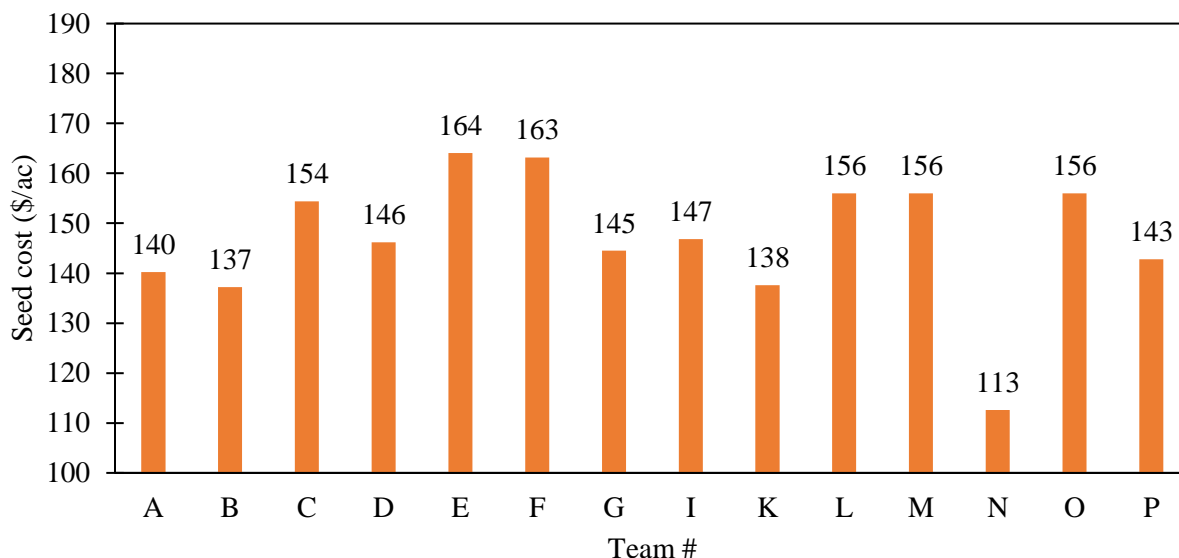


Figure 11. Total seed cost based on team’s hybrid selection and seeding rate.

Nitrogen Management

All the plots received 13 gals/ac (~ 30lb/ac of N) of startup fertilizer (23-9-0) at the time of planting. Participants had the opportunity to apply granularly nitrogen (34-0-0), liquid nitrogen UAN 28% (28-0-0-5), and controlled-release fertilizer (CRF blend 43-0-0) using three application methods: (i) broadcast, (ii) banding, and (iii) liquid side dressing using the Miller High-Boy 360 Y-drop. For the 2023 competition, the total nitrogen application ranged from 190 lbs of N/ac to 387 lbs of N/ac. The teams B and P opted for broadcasting fertilizer application at the beginning of the crop growing season along with liquid side dressing with a total target application. Team E and F opted to apply all the fertilizer as liquid side-dressing using the Miller High Boy 360 Y-drop. Remaining teams opted for the combination of banding (granular application of ammonium nitrate using the 1st Products rig) and liquid side dressing using the Miller High-Boy 360 Y-drop. Team K and L opted

for the control release fertilizer program, where all the fertilizer was applied at the time of planting by banding the fertilizer approximately 5-inches away from the planting row. The major difference in nitrogen application was observed in the liquid side-dressing 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 12). In 2023, based on the teams’ selection of fertilizer material and amount, and method of application, the total fertilizer cost ranged from \$482/ac (\$326 material cost plus \$157 application cost) for team A to \$209/ac (\$163 material cost plus \$46 application cost) for team E (Figure 13). Throughout the growing season, soil samples at 1 ft, 2ft, and 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.

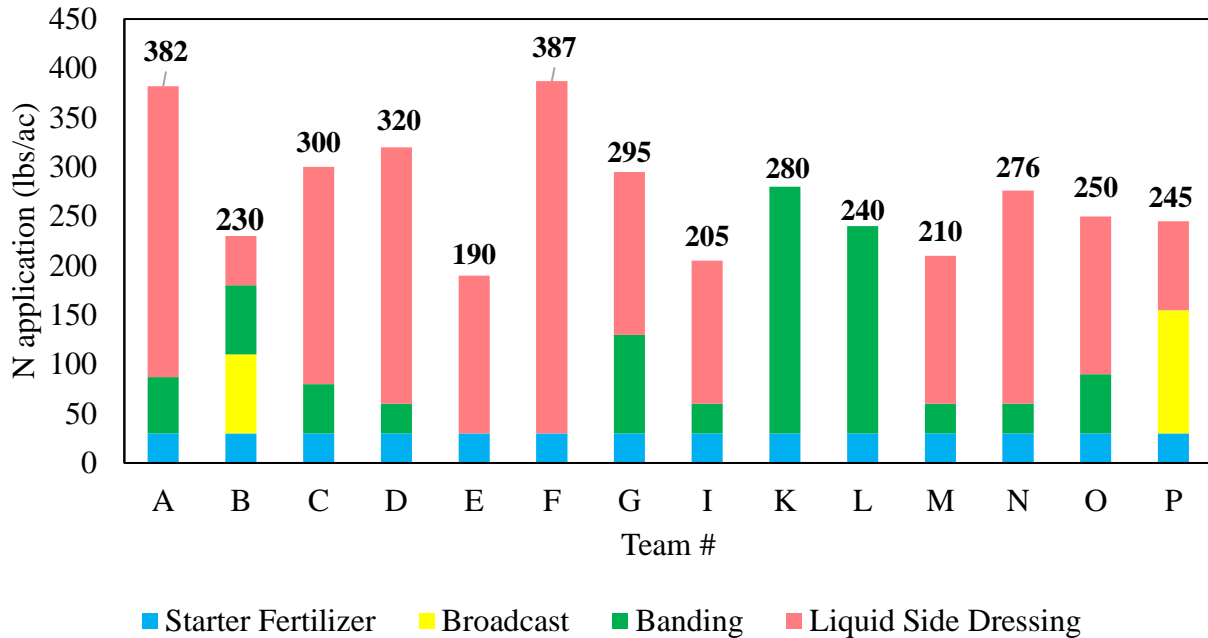


Figure 12. Nitrogen application method and amount (lbs of N/ac) for the participating teams.

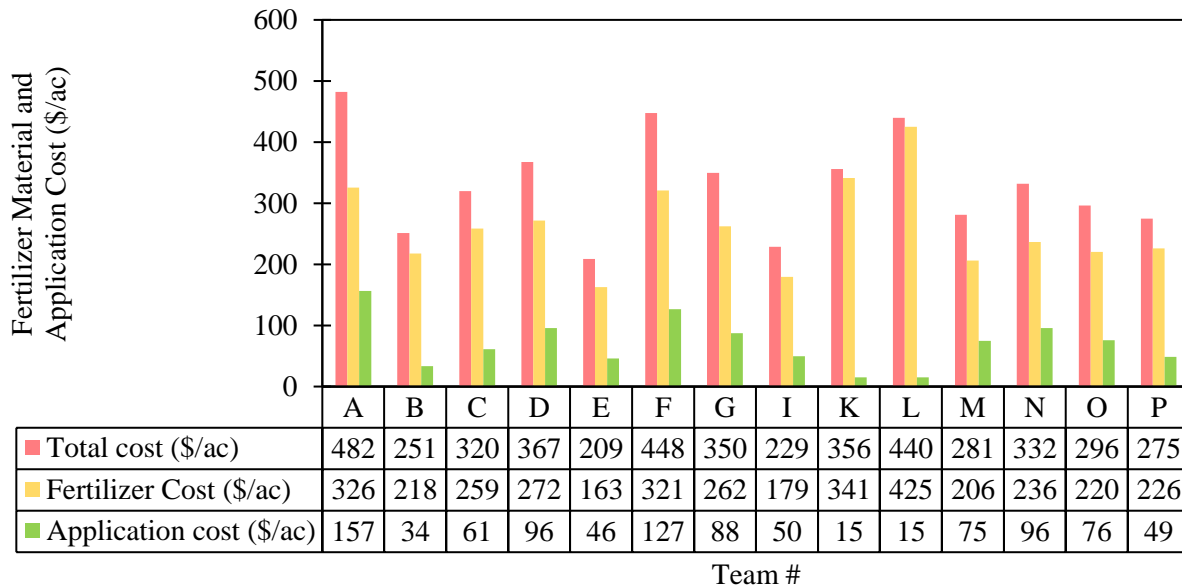


Figure 13. Fertilizer material and application cost (\$/ac) for the participating teams.

Irrigation Management:

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, three local soil moisture sensor company options were provided to them. In 2023, eight teams opted for BMP logic and four teams 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 1.6 inches (7 irrigation events) for team M to 20.9 inches (47 irrigation events) for team F. Only four teams applied irrigation immediately after sowing in the last week of March. 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). Most of the teams restricted their irrigation in July and effectively used the precipitation (Figure 14). In 2023, the total irrigation cost ranged from \$19/ac for team M to \$250/ac for team F (Figure 15).

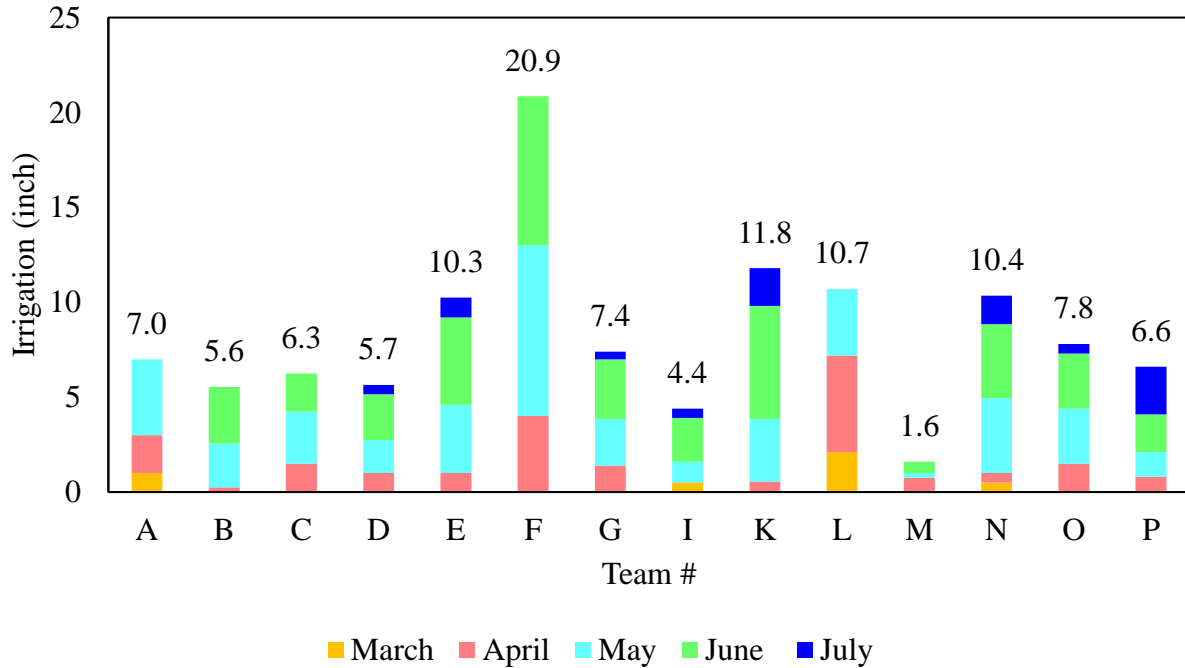


Figure 14. Monthly and cumulative season irrigation applied by the participating teams.

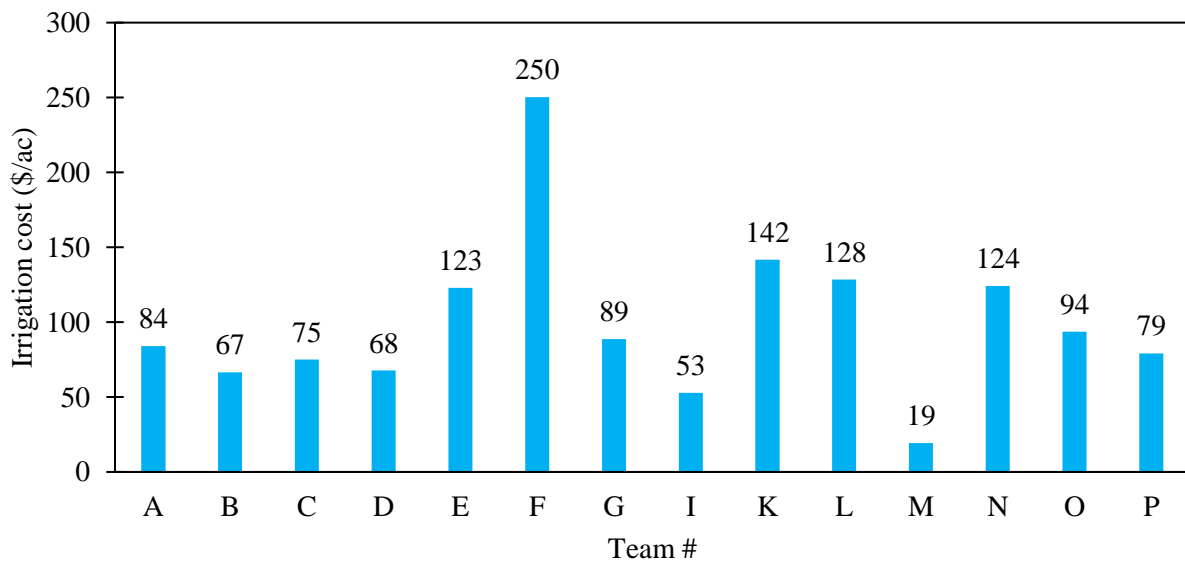


Figure 15. Total irrigation cost (\$/ac) for the participating teams.

Insurance Selection:

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 C&C Insurance of North Florida located in Mayo, 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 \$6.09 per bushel. Ten teams opted for Yield Protection with a coverage level of 50%, whereas four teams chose the Revenue Protection insurance plan with a coverage level of 50% or above (Table 3 and Figure 16). Team M chose Revenue Protection at the 75% coverage level and was the only team to receive an indemnity payment, based on their low yield and the drop in corn price at harvest time.

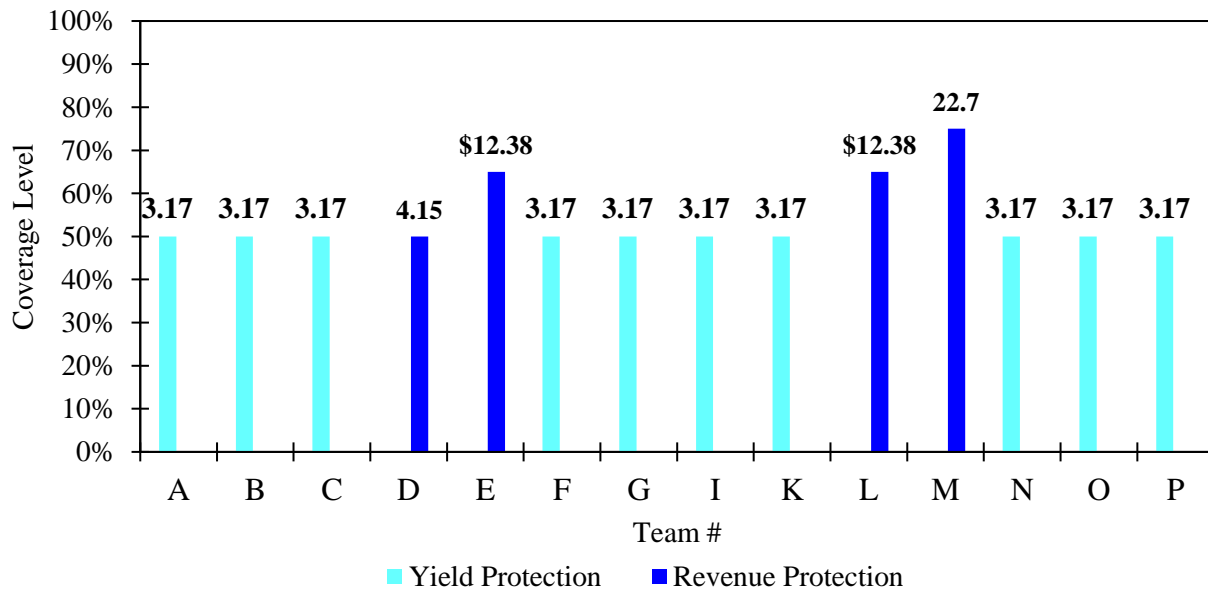


Figure 16. Insurance selections by team.

Table 3. Insurance coverage level and premium per acre selected by different participating teams.

Team	Insurance Type	Coverage Level	Premium per Acre
A	Yield Protection	50%	\$3.17
B	Yield Protection	50%	\$3.17
C	Yield Protection	50%	\$3.17
D	Revenue Protection	50%	\$4.15
E	Revenue Protection	65%	\$12.38
F	Yield Protection	50%	\$3.17
G	Yield Protection	50%	\$3.17
I	Yield Protection	50%	\$3.17
K	Yield Protection	50%	\$3.17
L	Revenue Protection	65%	\$12.38
M	Revenue Protection	75%	\$22.70
N	Yield Protection	50%	\$3.17
O	Yield Protection	50%	\$3.17
P	Yield Protection	50%	\$3.17

Grain Marketing:

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 September futures price on that date plus the local basis in effect on that date. For example, the Chicago September futures closing price on May 5, 2023, was \$5.37 and the local basis was \$0.80. Therefore, the local flat contract price on May 5 was \$6.17. The Chicago futures price changes daily and is posted on various publicly available sites. The local basis does not change as frequently and was updated weekly for the competition, based on quotes we obtained from three local buying points. During the 2023 competition the basis ranged from \$0.78 to \$0.88 above the September futures price. 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 6. The local contract price ranged from a low of \$5.6025 per bushel on July 12th to a high of \$7.015 per bushel on June 21st, 2023. The local spot price offered for corn harvested the week of August 15th was \$5.68 per bushel.

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.

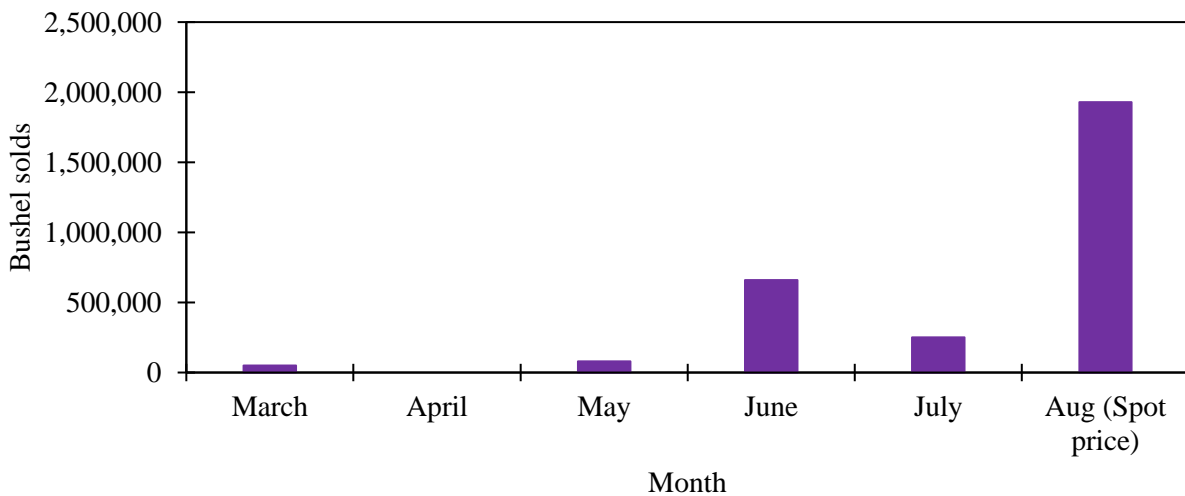


Figure 17. Bushels contracted and sold by month in 2023 STEP corn contest.

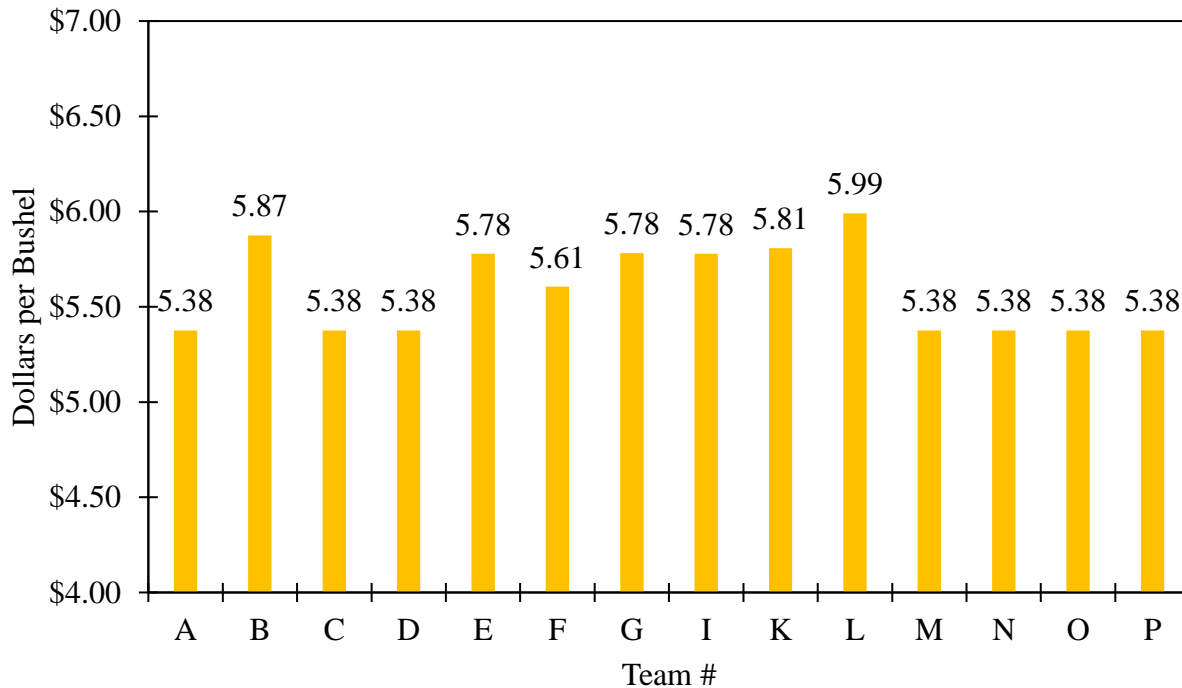


Figure 18. Average farm-gate price by team in 2023 STEP corn contest.

Across all teams, 1,040,000 bushels were contracted between March and July. The remaining 1,929,813 uncontracted bushels from each team’s simulated harvest were assigned the August 15th local spot market price. Figure 17 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.

The weighted average delivered price and farm-gate price (subtracting a hauling cost of \$0.30/bu) were calculated for each team. The results are shown in Figure 18. Team L

contracted 190,000 bushels and earned an average farm-gate price of \$5.99 per bushel. The average farm-gate price for teams that did not contract any bushels was the spot market price of \$5.38 per bushel (Figure 18).

Yield Results:

For the 2023 STEP competition, the corn yield per team ranged from 153 bu/ac to 282 bu/ac. The control plot that received no irrigation and no fertilizer yielded only 27 bu/ac. Team K achieved the highest yield using the corn hybrid Pioneer P2042VYHR at a rate of 30000 seeds per acre. (Figure 19).

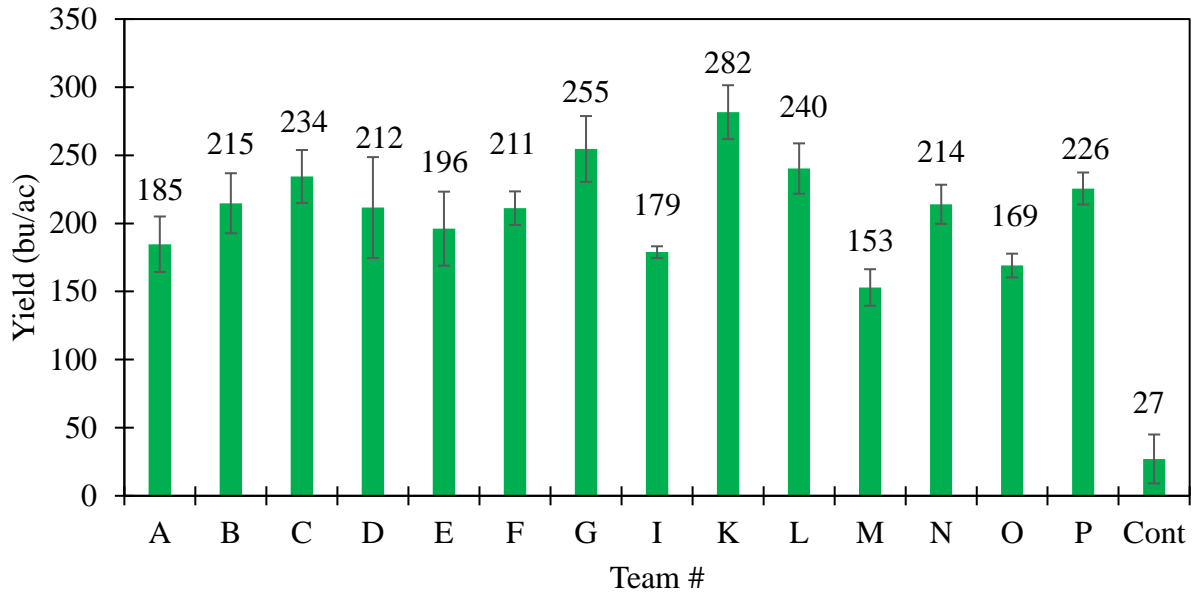


Figure 19. Average crop yield of individual teams and control plot in 2023 STEP corn contest.

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 20 represents the average grain yield from different hybrids selected by the participating teams. The highest and lowest average grain yields of 255 bu/ac and 185 bu/ac were observed for Croplan 1447 and Dyna Gro D57VC51 hybrid, respectively. The hybrid Pioneer P2042YHR which was selected by six teams resulted in an average yield of 205 bu/ac ($SD = 54$ bu/ac). The study also showed that higher yield not only

depends on high seeding rates but also on factors like hybrid selection, yield potential of that hybrid and management practice followed. For example, five teams chose the same hybrid (P2042YHR) out of which three teams got different yield results even though their seeding rate was the same i.e., 34000 seeds/acre (Figure 21). In addition, two teams selecting the same P2042YHR hybrid at the seeding rate less than 34000 seeds/ac yielded differently, which also signifies the importance of other management decisions including irrigation and nitrogen management.

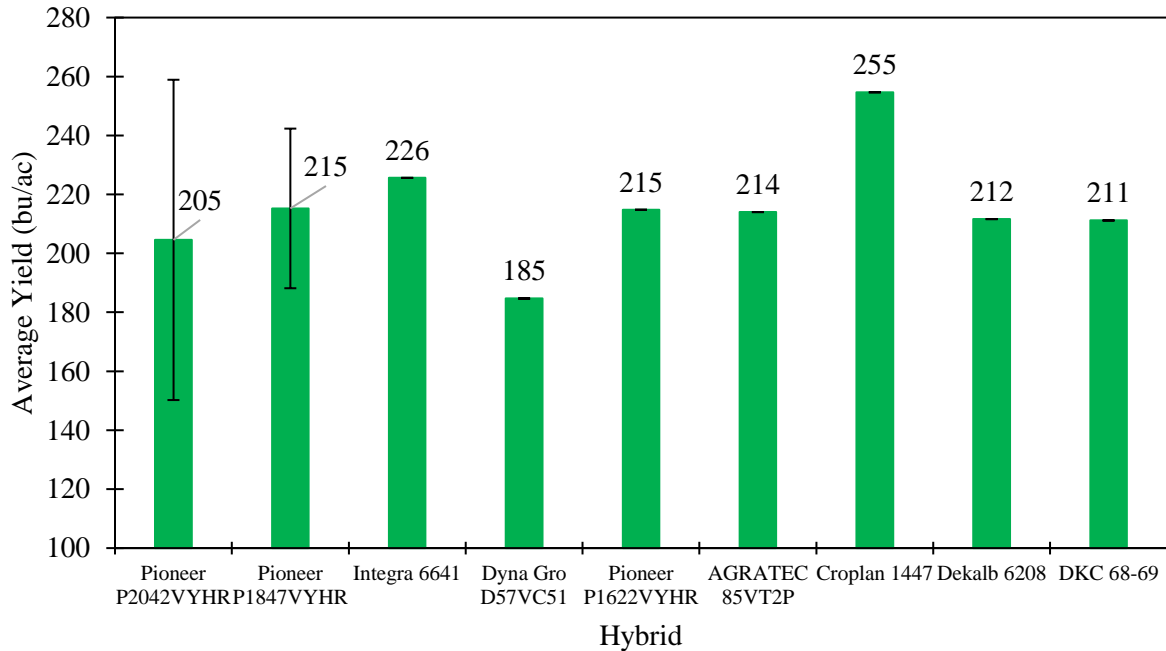


Figure 20. Grain yield response to hybrid in 2023 STEP corn contest.

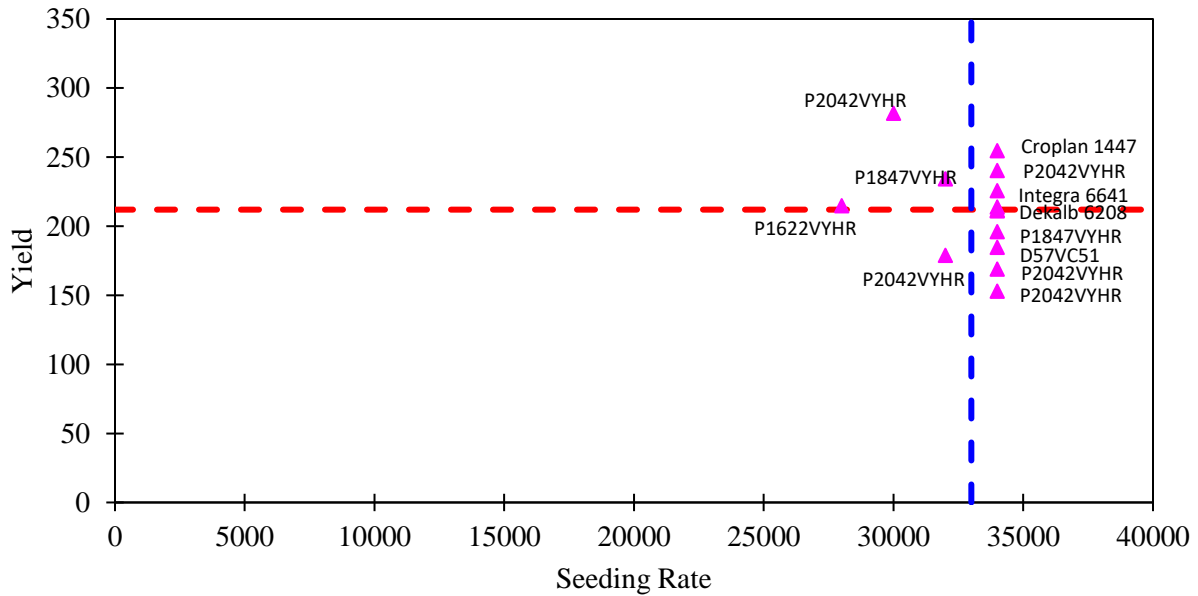


Figure 21. Corn yield at varying seeding rates. The red and blue dotted line represents the average yield and average seeding for the 2023 STEP corn contest.

Total nitrogen application also had a significant effect on the grain yield as shown in Figure 22. The red and blue dotted lines in Figure 20 represent the average yield and

average total nitrogen applied in the study. Blue and pink markers represent the nitrogen application and corresponding yield for highest input use efficiency and most

profitable team, respectively. The team with the highest yield applied 280 lbs/ac of nitrogen. The team with nitrogen application 230 lbs/ac or less exhibited below average yield results. The grain yield peaked at 280

lbs N/ac and after that grain yield has no response or slightly negative response to additional application of nitrogen application.

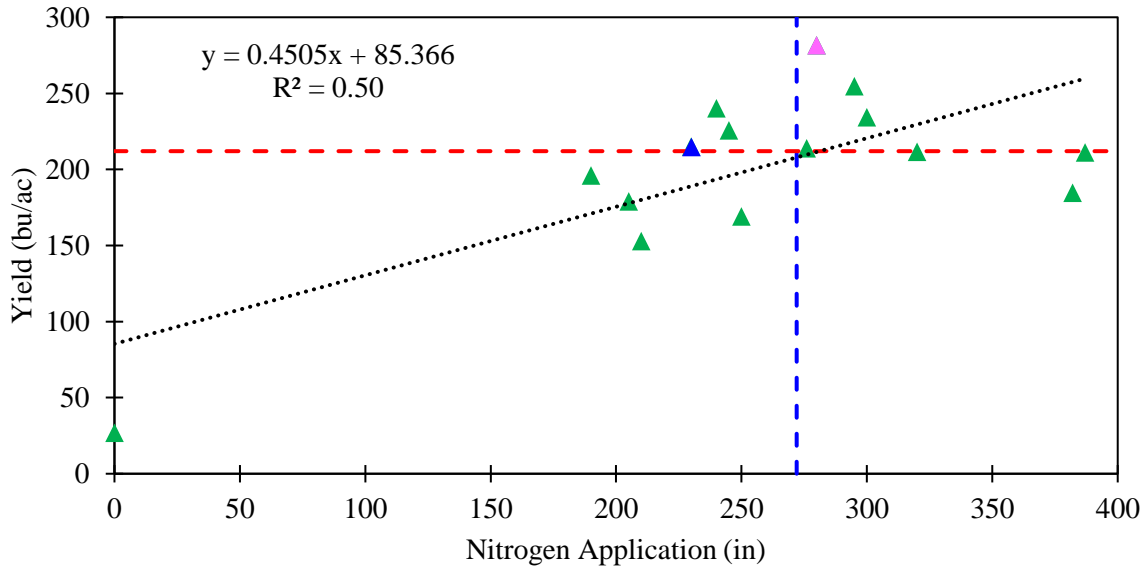


Figure 22. Corn yield (bu/ac) response to season total nitrogen application (lbs/ac). The most efficient and most profitable indicated by yellow and pink markers.

Grain yield had a positive association with amount of irrigation with seasonal irrigation explain 68% yield variability (Figure 18). The average yield exhibited an increase trend from irrigations applied between 5.6 inches to 11.8 inches respectively, and the team that applied the least irrigation had the lowest yield. However, the team with the blue marker applied the third lowest amount of

irrigation had a yield slightly above average and was also the most efficient, on the other hand the team represented with pink marker applied twice the irrigation as compared to the most efficient team, hence exhibiting maximum yield and profitability. This again puts forward the assertion that yield and irrigation is affected by other management decisions and variables.

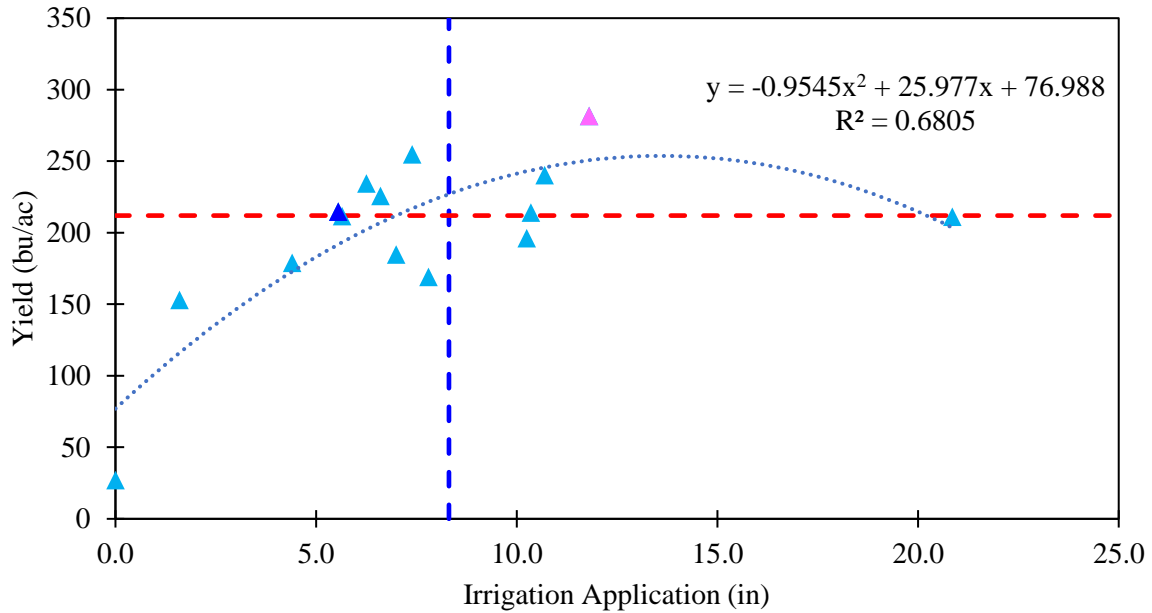


Figure 23. Corn yield (bu/ac) response to season total irrigation application (inches). The most efficient and most profitable indicated by yellow and pink markers.

2022 STEP Award Winners:

1. Most Profitable

For the most profitable award, gross profit was calculated by subtracting the total fixed production cost per acre and STEP variable 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 weighted average delivered price minus a \$0.30 per bushel hauling charge to deliver the corn to the local buying point.

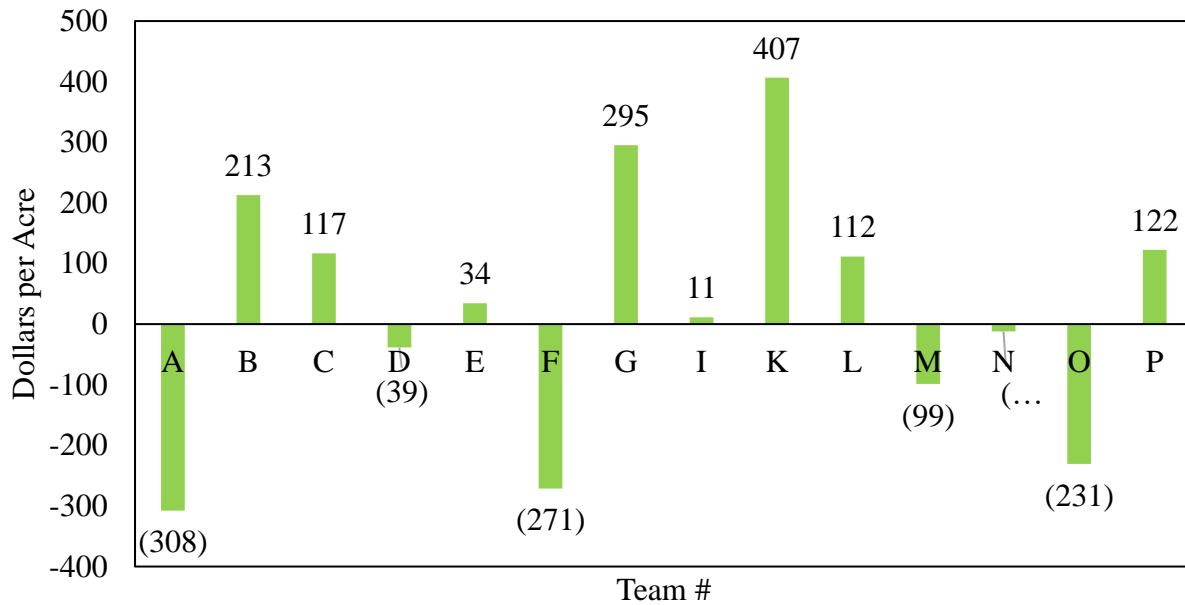


Figure 24. Profitability (\$/acre) for individual teams.

Figure 24 shows the profit results by team. In the 2023 corn contest six out of 14 teams have negative net revenue. Team Florikan had the highest gross profit at \$407 per acre. They planted the Pioneer 2042VYHR Seed at a rate of 30,000 seeds per acre. Team Florikan picked the controlled-release fertilizer program and applied a total of 280 lbs of N/ac (30 lbs/ac as a starter fertilizer and 250 lbs/ac of CRF (44-0-0) by banding at the time of planting. They applied a total of 11.8

inches of irrigation and selected yield protection insurance coverage at 50% coverage. For marketing they marketed their grain as flat contracts of 50,000, 100,000, and 50,000 bushels of corn at a price of \$6.105, \$6.26, and \$6.51, respectively. The remaining 81,710 bushels were sold at the spot price of \$5.68. Team Florikan had the highest yield of 280 bu/ac. Congratulations Team Florikan (Figure 25).



Figure 25. Team Florikan – Winner 2023 STEP competition Most Profitable Award category - receiving a check of \$2000 from Ms. Kathryn Holland, Environmental Administrator, Office of Agricultural Water Policy Florida Department of Agriculture and Consumer Services and Dr. Kati Migliaccio, Chair department of Agricultural and Biological Engineering.

Another noteworthy team that had second highest profitability with a gross profit of \$295 per acre is Team Jackson farm. They planted the Croplan 1447 Seed at a rate of 34,000 seeds per acre, applied 295 lbs of N/ac (30 lbs/ac as a starter fertilizer and 100 lbs/ac by banding from planting to V10, and 165

lbs/ac liquid side dressing), applied a total of 7.4 inches of irrigation in 19 events, selected yield protection insurance coverage at 50% coverage and marketed their grain as flat contracts of 250,000 bushels of corn at a price of \$6.09, respectively and yielded of 255 bu/ac. Congratulations team Jackson Farm (Figure 26).



Figure 26. Team Jackson second position holder in STEP competition Most Profitable Award category - receiving a check of \$1000 from Ms. Kathryn Holland, Environmental Administrator, Office of Agricultural Water Policy Florida Department of Agriculture and Consumer Services and Dr. Kati Migliaccio, Chair department of Agricultural and Biological Engineering.

At third place was Deas farm with a gross profit of \$215 per acre. Team Deas planted Pioneer P1622VYHR hybrids with a seeding rate of 28,000 seeds per acre respectively, 230 lbs of N/ac (broadcasting 80 lbs/ac, 70 lbs/ac banding, 50 lbs/ac liquid side dressing respectively). Applied 5.55 inches of irrigation in 13 events and had a yield of 215 bu/acre. They selected yield protection insurance coverage at 50% coverage and marketed their grain as flat contracts of 80,000 bushels of corn at a price of \$7.015

and sold the remaining bushels at the spot price of \$5.68.

1. Highest Input-use Efficiency:

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 4 and Figure 25. The WNIPI ranged from 0.10 to 0.28 (Figure 27).

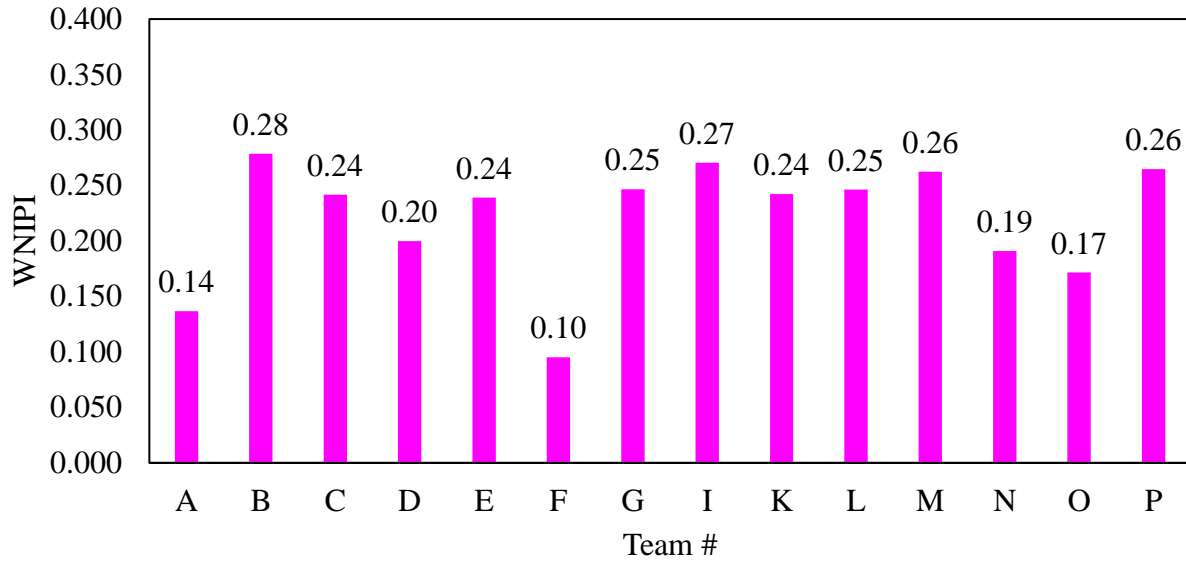


Figure 27. Water Nitrogen Intensification Performance Index (WNIPI) for different teams

Table 4. Cumulative season irrigation, nitrogen application, yield, and Water Nitrogen Intensification Performance Index (WNIPI) for different teams.

Team	Irrigation (in)	Nitrogen Application	Yield	WNIPI
A	7	382	185	0.14
B	5.55	230	215	0.28
C	6.25	300	234	0.24
D	5.65	320	212	0.20
E	10.25	190	196	0.24
F	20.85	387	211	0.10
G	7.4	295	255	0.25
I	4.4	205	179	0.27
K	11.8	280	282	0.24
L	10.7	240	240	0.25
M	1.6	210	153	0.26
N	10.35	276	214	0.19
O	7.8	250	169	0.17
P	6.6	245	226	0.26

The highest input-use efficiency award goes to Team Deas Farm. Team Deas applied a total seasonal irrigation of 5.55 inches in total 13 events, applied 230 lbs /ac of nitrogen fertilizer (30 lbs/ac as starter fertilizer, broadcasting 80 lbs/ac of nitrogen fertilizer, and 70 lbs/ac banding from planting to V10, and 50 lbs/ac as fertigation). They planted corn hybrid Pioneer P1622VYHR at the lowest seed rate of 28000 seeds per acre. Although Deas had an average yield, his efficiency was the greatest of the competing teams due to his low nitrogen and water use. Congratulations Team Deas!

Team Columbia closely followed and bagged the second place in the category with a WNIPI of 0.27. Team Columbia applied total seasonal irrigation of 4.4 inches in 10 events,

applied 205 lbs/ac of nitrogen fertilizer (30 lbs/ac as starter fertilizer, banding 30 lbs/acre and liquid side dressing 145 lbs/acre), and planted corn hybrid Pioneer 2042VYHR with a seed rate of 32000 seeds per acre. Their yield was 179 bu/ac. Congratulations Team Columbia (Figure 28).

Third prize in this category went to Team Rootin Tutens with a WNIPI score of 0.265. Team Rootin Tutens applied total seasonal irrigation of 6.6 inches in 14 events, applied 245 lbs/ac. of nitrogen fertilizer (30 lbs/ac as starter fertilizer, broadcasting 125 lbs/ac and liquid side dressing of 90 lbs/ac), and planted corn hybrid Integra 6641 with a seed rate of 34,000 seeds per acre. The average yield obtained was 226 bu/ac. Congratulations Team Rootin Tutens. (Figure 29).



Figure 28. Team Columbia – Second place in STEP competition Highest Input-use Efficiency Award category- receiving a check of \$1000 from Mr. Stan Posey from Nutrien and Dr. Michale Dukes, Associate Dean for Extension IFAS.



Figure 29. Team Rootin Tutens – Third place in STEP competition Highest Input-use Efficiency Award category- receiving a check of \$500 from Mr. Stan Posey from Nutrien and Dr. Michale Dukes, Associate Dean for Extension IFAS.

Conclusion:

The 2023 STEP competition was completed successfully 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 2023 STEP corn competition was held at the UF-IFAS North Florida Research and Education Center – Suwannee Valley, Live Oak (NFREC-SV). Fourteen 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 two awards: (i) Most

profitable, and (ii) Highest input use efficiency. 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 2023 STEP competition include:

- In 2023, 14 different corn hybrids were offered to the growers out of which 9 hybrids i.e., P2042YHR and P1870YHR from Pioneer, 85VT2P@ from Agratech, Dyna Gro D57VC51, Croplan 1447, Dekalab, Integra 6641

and local variety DKC 68-69 were planted with seed cost ranged from \$112.63 to \$164.05 per acre. The most common hybrid selection for the 2023 competition was Pioneer P2042YHR which was chosen by five teams.

- Plant populations chosen ranged from 28000 seeds/ac to 34000 seeds/ac, where ten teams opted for 34000 seeds/ac and two teams opted for 32000 seeds/ac.
- The total nitrogen application ranged from 190 lbs of N/ac to 387 lbs of N/acre.
- Total irrigation applied ranged from 1.6 inches (7 irrigation events) to 20.9 inches (47 irrigation events).
- The majority of teams opted for Yield Protection insurance with coverage level 50 %. Only four teams chose the Revenue Protection plan with a coverage level of 50% and above.
- Across all teams, 1,040,000 bushels were contracted between March and July. The remaining 1,929,813 uncontracted bushels from each team's simulated harvest were assigned the August 15th local spot market price.
- For the 2023 STEP competition, the corn yield ranged from 153 bu/ac to 282 bu/ac.
- Team Florikans (Team Members: Billy Browning and Jay Skillman) had the highest gross profit at \$407 per acre.

- Team Jackson (Team Members: Wyatt Jackson) had the second highest gross profit at \$295 per acre.
- Team Deas farm (Team Member: Zach Deas) had the third highest gross profit at \$215 per acre.
- The highest input-use efficiency award goes to Team Deas farm (Team Member: Zac Deas and Baley Hines) with WNIPI of 0.28.
- Team Columbia (Team member: Jay Capasso) had the second highest input use efficiency with WNIPI of 0.27
- Team Rootin Tutens (Team member: Travis Tuten) had the third highest input use efficiency with WNIPI of 0.265.

Acknowledgement:

The successful completion of the second 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. The project is supported by the Florida Department of Agriculture and Consumer Science (FDACS) Office of Agricultural Water Policy under award number AWD12685. Special thanks to our exclusive sponsor "Nutrien" for award sponsorship. In addition, we would like to thank University of Nebraska, Lincoln Testing Ag Performance Solution (UNL-TAPS) team leader Dr. Daran Rudnick for sharing his competition insights at the beginning of the project.

Thank you for your support!



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