Grower Competition for Efficient and Profitable Crop Production

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Motivation

Major Questions
• How do we increase adoption of best management practices and technology?
• Are we the best “Teachers” of the information?
• Are we addressing the questions asked by producers?
• How do we connect with many (not a few) producers?

Hypothesis
Producers would be more apt to adopting technology and best management practices if they:

1. Were first able to try them without exposing their whole operation to unknown results.
2. Could evaluate their management practices/techniques against their peers.
Program Objectives

1. To facilitate growers discovery and adoption of new and emerging knowledge relative to agriculture production and management
2. Create a safe environment for the testing, observation, experimentation, and implementation of new and emerging technologies, management, and production techniques
3. Create an atmosphere of excitement, competition, and learning
4. Create a forum for collaboration and communication among all stakeholders related to agricultural production (i.e., UNL, producers, tech companies, agriculture service providers, government agencies) to face current and future challenges
5. Maintain discovery and information integrity and faithfully share, report, and distribute all outcomes, methods, and strategies to all active or latent stakeholders, making the program an engine of change and innovation
Conceptual Underpinnings

There are three conceptual components for the TAPS program, which focus on creating self-motivation, self-reliance in learning, and adaptive management capability of associates (participants).
Program Overview

• The TAPS program hosts “Farm Management Competitions”

• Each “Farm” on paper includes 3,000 harvested acres for the purposes of making decisions, but were imposed on 3 randomized plots (~0.4 acres) held under a variable rate irrigation (VRI) pivot at WCREC in North Platte, NE.

• Management decisions:
  • Insurance Selection
  • Nitrogen Management
  • Hybrid Selection
  • Seeding Rate
  • Irrigation Management
  • Marketing Grain

Real-time decisions are logged on TAPS.unl.edu
Awards

1. Most Economically Profitable
   • Amount = $2,000

2. Highest Input Use Efficiency:
   • Water-Nitrogen Intensification Performance Index (WNICI, Lo et al., 2019)
   • Amount = $1,000
   
   \[
   WNICI = \frac{\left( \frac{Y_{Farm}}{Y_{Control}} - 1 \right)}{\left(1 + \frac{I_{Farm}}{ET_{Control}}\right) \times \left(1 + \frac{N_{Farm}}{ANU_{Control}}\right)}
   \]

3. Greatest Grain Yield
   • Amount = $500 \times (Percent of Most Profitable Farm)
   • Example: Farm 1 has highest yield, but only profited 78% of the most profitable farm.
     • $500 \times 0.78 = $390
2017 Participants

- Roric Paulman Sutherland, NE
- Bob Wiseman Hershey, NE
- UNL Team North Platte, NE
- Jon Walz Stapleton, NE
- Tim Schmeekle Gothenburg, NE
- Brian Armstrong Brule, NE
- Ted Tietjen, Shawn Turner, Jim Kemling, Troy Kemling, Bruce Young, & Ron Hagan Grant, NE
- NCTA Students Curtis, NE
- Mike Baker Trenton, NE
- Marlin Murdoch, Jordan Bergquist, & Clayton Geisinger Oxford, NE
- Chadd Jacobson Holdrege, NE
2019 Participants

Nebraska:

Sprinkler Irrigated Corn
- 24 Teams
- ~ 99 Participants

Sprinkler Irrigated Sorghum
- 10 Teams
- ~ 18 Participants

SDI Corn
- 16 Teams
- ~ 36 Participants

Oklahoma:

Sprinkler Irrigated Corn
- 9 Teams
- ~ 7 Participants
2019 Site Descriptions
Thank you 2019 Partners & Sponsors

Agricultural Industries
- The Climate Corporation
- AquaSpy
- CropMetrics
- Bunge
- Arable
- Lindsay Corporation
- AirScout
- Ward Laboratories, Inc.
- TerrAvion
- FarmersEdge
- Phytech

Commodity Boards & Regulatory Agencies
- Nebraska Corn Board
- Nebraska Grain Sorghum Board
- Upper Republican NRD
- Middle Republican
- Lower Big Blue Natural Resources District
- NRCS

Seed Companies
- Pioneer
- Fontanelle Hybrids
- Stine
- Big Cob Hybrids
- Syngenta
- Channel
- Dyna-Gro
- Arrow Seed

Financial Institutions
- NebraskaLand National Bank
- First State Bank
- Equitable Bank
- Sandhills State Bank
- Farm Credit Services of America
- Great Western Bank

Non-Profit Entities
- Nebraska Extension
- Ogallala Water.org
- The Nature Conservancy
Decisions
Timeline: Management Decisions

- Insurance selection: March 30th
- Pre-plant nitrogen amount (lbs/acre): April 10th
- Hybrid selection and seed delivery: April 10th
- Seeding rate: April 10th
- Side-dress nitrogen amount (lbs/acre): According to crop progress
- Fertigation options available
  - Corn: V9, V12, VT/R1, & R2
  - Sorghum: Stage 2, 3, 4, and 5
- Irrigation Management
- Marketing of Grain
  - March 19th to Nov. 15th
Ex. Irrigation Scheduling

• Irrigation System Operated:
  • Monday
  • Thursday

• Irrigation Depths:
  • 0 to 1.0 inches per event

• Cost:
  • Fixed cost per acre-inch

• Decisions:
  • The participants have until 10 AM on the irrigation days to note whether they would like to irrigate using the competition website (www.TAPS.unl.edu).
  • If participants fail to indicate their intent to irrigate by 10 AM, no irrigation water will be applied on that irrigation day.
  • Irrigation scheduling can be made approximately 2 weeks in advance using the competition website.
Available Technology
What information was collected?

Data has been generated on:

- Soil, plant, and atmospheric conditions
Visual, Thermal, and Reflectance Imagery

- Imagery Dates
  - May 4th
  - June 1st
  - June 22nd
  - July 4th
  - July 11th
  - July 21st
  - July 31st
  - August 9th
  - August 15th
  - August 22nd
Imagery by Terravion
Imagery and Plant Health

Aug 20, 2018
- Image Date
- Rain: 11.2" (Season: Low)
- GDUs: 2,227

Aug 9, 2018
- Image Date
- Rain: 9.9" (Season: Low)
- GDUs: 2,005

Aug 4, 2018
- Image Date
- Rain: 9.8" (Season: Low)
- GDUs: 1,896

Jul 25, 2018
- Image Date
- Rain: 8.9" (Season: Low)
- GDUs: 1,694

Jul 21, 2018
- Image Date
- Rain: 8.5" (Season: Low)
- GDUs: 1,598

Precipitation Report
for June 17, 2019

Precipitation was detected on 4 of your fields on June 17, 2019.
For more up-to-date estimates, please check your rainfall in the Climate FieldView app. If our estimates look off, please let us know using the “feedback” link for the field.

- 2019 Corn Pivot
  - Lincoln, NE: 7.04 ac
  - 0.6" (Feedback)

- 2019 Corn Subsurface Drip
  - Lincoln, NE: 5.49 ac
  - 0.6" (Feedback)

- 2019 Sorghum
  - Lincoln, NE: 1.68 ac
  - 0.6" (Feedback)

- TAPS
  - Lincoln, NE: 9.51 ac
  - 0.6" (Feedback)
Satellite Imagery, Weather, & Crop Management

UNL TAPS – 2019 – Farmers Edge Scouting – 7.13.19

[Map and weather data]

Low:
- TUE 08-22: 57.2°F
- WED 08-23: 60.8°F
- THU 08-24: 68.8°F
- FRI 08-25: 68.8°F
- SAT 08-26: 59.0°F
- SUN 08-27: 57.2°F
- MON 08-28: 55.4°F
- TUE 08-29: 57.2°F
- WED 08-30: 55.4°F
- THU 08-31: 55.4°F

High:
- TUE 08-22: 88.8°F
- WED 08-23: 87.8°F
- THU 08-24: 86.0°F
- FRI 08-25: 82.4°F
- SAT 08-26: 86.0°F
- SUN 08-27: 84.2°F
- MON 08-28: 84.2°F
- TUE 08-29: 82.4°F
- WED 08-30: 78.8°F
- THU 08-31: 80.6°F

Day
- POP:
  - TUE 08-22: 0%
  - WED 08-23: 20%
  - THU 08-24: 50%
  - FRI 08-25: 80%
  - SAT 08-26: 20%
  - SUN 08-27: 10%
  - MON 08-28: 10%
  - TUE 08-29: 0%
  - WED 08-30: 0%
  - THU 08-31: 0%

- Amount:
  - TUE 08-22: 0.00 in
  - WED 08-23: 0.00 in
  - THU 08-24: 0.12 in
  - FRI 08-25: 0.11 in
  - SAT 08-26: 0.00 in
  - SUN 08-27: 0.00 in
  - MON 08-28: 0.00 in
  - TUE 08-29: 0.00 in
  - WED 08-30: 0.00 in
  - THU 08-31: 0.00 in

Night
- POP:
  - TUE 08-22: 0%
  - WED 08-23: 10%
  - THU 08-24: 50%
  - FRI 08-25: 80%
  - SAT 08-26: 20%
  - SUN 08-27: 10%
  - MON 08-28: 10%
  - TUE 08-29: 0%
  - WED 08-30: 0%
  - THU 08-31: 0%

- Amount:
  - TUE 08-22: 0.00 in
  - WED 08-23: 0.03 in
  - THU 08-24: 0.25 in
  - FRI 08-25: 0.15 in
  - SAT 08-26: 0.00 in
  - SUN 08-27: 0.00 in
  - MON 08-28: 0.00 in
  - TUE 08-29: 0.00 in
  - WED 08-30: 0.00 in
  - THU 08-31: 0.00 in
### 15 DAY FORECAST

<table>
<thead>
<tr>
<th>Day</th>
<th>Weather Conditions</th>
<th>Hi/Lo (°F)</th>
<th>Feels Like (°F)</th>
<th>Wind (mph)</th>
<th>Dew Point (°F)</th>
<th>Humidity (%)</th>
<th>Precip Chance (%)</th>
<th>Precip (in)</th>
<th>Precip Snow (in)</th>
<th>GDD (°F)</th>
<th>Evap (in)</th>
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<tbody>
<tr>
<td>07/26  Thu</td>
<td>T-Storms Likely</td>
<td>84/62</td>
<td>84/62</td>
<td>4 SE</td>
<td>56</td>
<td>49</td>
<td>56</td>
<td>0.07</td>
<td>-</td>
<td>23.0</td>
<td>0.23</td>
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<tr>
<td>07/27  Fri</td>
<td>All Day T-Storms Likely</td>
<td>78/60</td>
<td>78/60</td>
<td>7 SE</td>
<td>61</td>
<td>72</td>
<td>80</td>
<td>1.02</td>
<td>-</td>
<td>19.0</td>
<td>0.16</td>
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<tr>
<td>07/28  Sat</td>
<td>All Day T-Storms Likely</td>
<td>75/61</td>
<td>75/61</td>
<td>6 NE</td>
<td>62</td>
<td>77</td>
<td>80</td>
<td>0.21</td>
<td>-</td>
<td>18.0</td>
<td>0.14</td>
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<tr>
<td>07/29  Sun</td>
<td>AM T-Storms Likely</td>
<td>85/66</td>
<td>85/66</td>
<td>5 N</td>
<td>59</td>
<td>50</td>
<td>80</td>
<td>0.10</td>
<td>-</td>
<td>25.5</td>
<td>0.20</td>
</tr>
<tr>
<td>07/30  Mon</td>
<td>Sunny</td>
<td>88/62</td>
<td>88/62</td>
<td>5 NW</td>
<td>56</td>
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<td>-</td>
<td>24.0</td>
<td>0.26</td>
</tr>
<tr>
<td>07/31  Tue</td>
<td>Sunny</td>
<td>93/65</td>
<td>93/65</td>
<td>4 S</td>
<td>58</td>
<td>43</td>
<td>-</td>
<td>0.00</td>
<td>-</td>
<td>25.5</td>
<td>0.27</td>
</tr>
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</table>
Soil Water Status

Weekly Summary: “1.5" of water available in the root zone before the crop will experience any need for additional moisture. And, this week I don’t expect we will be withdrawing normal ET for the soil. Since we currently are taking around .18" each day out we should have enough water to get it through until next week. Also, note that we have some pretty good chances of rain too so want to capitalize on that if possible.”
Weather and Plant Sensing
Soil Water Status

AquaSpy®
Plant Sensing for Water Stress
2017 and 2018
Precipitation

May 1 to Sept. 29
2017: 18.2 inches
2018: 14.9 inches
1986-2015: 12.5 inches

Cumulative Rainfall (inches)

2017
2018
1986-2015
2017 Management Decisions

- **Hybrids**: 9 types
- **Hybrid Cost**: $2.75 to $3.76 per 1,000 seeds (median: $2.95 per 1,000)
- **Planting Population**: 28,000 to 34,500 seeds/acre (median: 33,250)
- **Irrigation**: 2.50 to 10.75 inches (median: 6.93 inches)
- **Total Nitrogen**: 145 to 240 lbs/acre (median: 180 lbs/ac)
  - Pre-Plant: 0 to 140 lbs/acre (median: 80 lbs/ac)
  - Sidedress: 0 to 125 lbs/acre (median: 48 lbs/ac)
  - Fertigation: 30 to 120 lbs/acre (median: 80 lbs/ac)
- **Insurance**: $0 to $106.50 per acre ($19.96/acre)
- **Marketing**: $3.03 to $3.59 per bushel (median: $3.18 per bushel)
- **Total Production Cost**: $702 to $859 per acre (median: $779 per acre)
Farm Profitability

~20-25% price difference in 2017 due to timing of grain marketing

--- Grain Yield (bu/acre) ---

<table>
<thead>
<tr>
<th>Profit per Acre</th>
<th>Grain Yield (bu/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$145.19</td>
<td>257</td>
</tr>
<tr>
<td>$135.00</td>
<td>250</td>
</tr>
<tr>
<td>$111.55</td>
<td>261</td>
</tr>
<tr>
<td>$101.83</td>
<td>245</td>
</tr>
<tr>
<td>$45.99</td>
<td>238</td>
</tr>
<tr>
<td>$38.65</td>
<td>261</td>
</tr>
<tr>
<td>$34.41</td>
<td>177</td>
</tr>
<tr>
<td>$22.94</td>
<td>244</td>
</tr>
<tr>
<td>$246</td>
<td>8</td>
</tr>
<tr>
<td>$247</td>
<td>15</td>
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<td>$246</td>
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<tr>
<td>$210</td>
<td>14</td>
</tr>
<tr>
<td>$239</td>
<td>4</td>
</tr>
<tr>
<td>$26.69</td>
<td>-29.90</td>
</tr>
<tr>
<td>$42.53</td>
<td>-$25.10</td>
</tr>
<tr>
<td>$56.52</td>
<td>-$57.52</td>
</tr>
<tr>
<td>$126.30</td>
<td>-$147.24</td>
</tr>
</tbody>
</table>

[Image of a bar chart showing profitability and grain yield]
Most Profitable Farm

Farm # 13
Roric Paulman of Sutherland, NE
Cash Award: $2,000

Hybrid: Pioneer P1197AM
Seeding Rate: 32,000 plants/acre
Irrigation: 8.85 inches
Nitrogen: 165 lbs/acre
Yield: 257.3 bushels/acre
Profit: $145.19 per acre
2018 Corn Competition
2018 Management Decisions

- **Hybrids**: 12 types
- **Hybrid Cost**: $2.38 to $4.17 per 1,000 seeds (median: $2.98 per 1,000)
- **Planting Population**: 26,000 to 34,000 seeds/acre (median: 33,000)
- **Irrigation**: 1.05 to 11.70 inches (median: 6.55 inches)
- **Total Nitrogen**: 130 to 225 lbs/acre (median: 190 lbs/ac)
  - Pre-Plant: 0 to 100 lbs/acre (median: 60 lbs/ac)
  - Sidedress: 0 to 100 lbs/acre (median: 40 lbs/ac)
  - Fertigation: 30 to 120 lbs/acre (median: 90 lbs/ac)
- **Insurance**: $4.86 to $48.54 per acre ($14.94/acre)
- **Marketing**: $3.27 to $3.61 per bushel (median: $3.38 per bushel)

- **Total Production Cost**: $585 to $721 per acre (median: $689 per acre)
Grain Yield

Grain Yield (bu/acre)
Highest Input Use Efficiency

- **Graph 1:** Input Efficiency vs. Grain Yield (bu/ac)
- **Graph 2:** Input Efficiency vs. Irrigation (inches)
- **Graph 3:** Input Efficiency vs. Nitrogen (lbs/ac)
Most Profitable

Profit per acre

Corn Farm #’s

- $278.32
- $276.32
- $260.55
- $232.21
- $226.66
- $216.75
- $215.06
- $206.87
- $204.58
- $200.62
- $194.52
- $186.00
- $185.28
- $179.32
- $176.13
- $160.70
- $158.60
- $149.48
- $138.45
- $133.22
2018 Award Winners

Farm # 7: Highest Yield
- Hybrid: Pioneer 1197
- Seeding Rate: 34,000 plants/acre
- Irrigation: 9.60 inches
- Nitrogen: 200 lbs/acre
- Yield: 288.5 bushels/acre
- Profit: $276/acre

Farm # 15: Highest Efficiency
- Hybrid: DynaGro 52VC91
- Seeding Rate: 34,000 plants/acre
- Irrigation: 4.70 inches
- Nitrogen: 195 lbs/acre
- Yield: 278.9 bushels/acre
- Profit: $261/acre

Farm # 13: Most Profitable
- Hybrid: Dekalb 60-69
- Seeding Rate: 34,000 plants/acre
- Irrigation: 6.20 inches
- Nitrogen: 140 lbs/acre
- Yield: 257.7 bushels/acre
- Profit: $278/acre
Understanding the Results
Ear Analysis
Cost versus Profit

Market Value ($3.03/ bu) on Nov. 22nd at Ag Valley Coop

Most Profitable Farm

Sold at market close

\[ y = -1.1967x + 3.8757 \]
\[ R^2 = 0.77 \]
Yield Response to Irrigation

**Single Hybrid**

\[ y = -2.6369x^2 + 30.286x + 177.31 \]

\[ R^2 = 0.8012 \]

**Pooled**

\[ y = -1.2752x^2 + 17.583x + 188.47 \]

\[ R^2 = 0.39 \]
Input Efficiency versus Profit

2017 and 2018

Size Indicates Yield

Profit (\$/acre)

\[ y = 1627.9x - 153.45 \]

\[ R^2 = 0.81 \]
Input Recommendations

Seasonal Evaluation

Temporal Evaluation

Lo et al. (2019)
Preliminary Assessment
2018 Post Competition Survey

How did you hear about TAPS

- Don’t Remember: 39%
- University Employee: 33%
- Friend: 18%
- Media: 6%
- Other: 3%

Expectations of TAPS

- Exceeded: 58%
- Met: 19%
- Didn’t Have Expectations: 14%
- Undecided: 6%
- Fell Short: 3%

Single Primary Factor in Decision to Participate in TAPS

- 34% - To learn from others
- 31% - To test new technology, ways or strategies
- 14% - To help someone who asked me to participate
- 6% - Curiosity
- 6% - To be part of a peer to peer network
- 3% - To have some fun growing crops
- 3% - To be part of a competitive team
- 3% - To benchmark your abilities relative to peers
Reasons for Competing

“Interested in seeing how everyone has different philosophies in growing crops. I thought it would be interesting in how I could compete with having a slightly different background compared to many in the competition.” ~Brian Frank~

“A different perspective.” ~Lorn Dizmang~

“TAPS has afforded me an opportunity to be a “farmer” in every sense of the word except for actually writing out the checks.” ~Cole Simmons~

“Seeing if reducing fertilizer and irrigation water reduces yield. How far can we reduce these inputs and yield the same.” ~Curtis Scheele~

“I love it because it is an experiment where there are so many choices and nobody is going to end up doing it the same way.” ~Mark Reiman~

“Meet people, see how different ideas effect yields and profits as well as contributing some ideas and experience.” ~Donald Bloss~
Which single part of TAPS have you found personally to be the most educational?

- The conversation about decisions with others (team members or mentor etc.): 43%
- Use of Unfamiliar Technology: 17%
- Competition Results: 11%
- Meetings: 3%
- Peer-to-Peer Engagement: 14%
- Time Spent Making Decisions: 11%
2018 Banquet Survey

- As a result of TAPS, responding attendees indicated they are more likely to make changes in their own operation in the following areas:
  ~ 40% - Grain Marketing
  ~ 31% - Water Management
  ~ 32% - Investment in Technology
  ~ 25% - Nitrogen Management

- 96% agreed that TAPS was a good representation of the farm business and can benefit growers

- Results showed that peer to peer interaction was very advantageous

- Survey indicated that marketing was the area that people felt deficient in and would like more education

\[ n = 55 \]
2018 Post Competition Survey

Since competing in TAPS you are more likely to…

a) Recognize that maximizing profit takes both business and agronomic skill - 4.21
b) Use soil water status as a means of scheduling irrigation - 3.94
c) Split apply nitrogen fertilizer - 3.94
d) Have more confidence in irrigation scheduling technologies - 3.91
e) Change how you manage and schedule nitrogen on your own farm - 3.82
f) Use weather data to schedule irrigation - 3.69
g) Change how you manage and schedule irrigation on your own farm - 3.62
h) Trust irrigation scheduling tools - 3.57

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree
Interesting
Informative
Enjoyable
Fun
Awesome
Innovative
Humbling
Engaging
Encouraging
Excellent
Outstanding
Good
Unexpected
Beneficial
Surprising
Shocking
Reality
Hair-pulling
Amazing
Phenomenal
Enlightening
Educational
Informational
Priceless
UNLTAPS
TESTING AG PERFORMANCE SOLUTIONS
Outreach Efforts

- Digital Newsletter ([https://taps.unl.edu/newsletter](https://taps.unl.edu/newsletter))
  - Method of sharing news, upcoming events, etc. with contestants & supporters
- Tips from TAPS
  - Written articles analyzing 2018 data of each decision
- Field Tours/Workshops/Banquet
- Summer Intern visit from Tufts University student
  - Focus on producer interviews & video production
  - In coordination with *Ogallala Water Coordinated Agriculture Project*
- Case Studies
  - Focus on each management decision
- Participant Interviews
- Articles (e.g., Nebraska Farmer)
Thank You!

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