

INNOVATION GRANT PROGRESS REPORT

PROJECT TITLE: Minimizing Corn Plant Variability Using a Planter Weight Distribution System

REPORTING PERIOD: December 15, 2021 and January 31, 2021 (FINAL)

FARMER INNOVATOR: Mark Enninga

COLLABORATING ORGANIZATIONS/PERSONS:

- Spencer Enninga – Shareholder, Enninga Farms Inc
- Dr. Elizabeth Ann Enninga, Scientist at Mayo Clinic, Rochester, MN
- Bob Recker – Founder, Cedar Valley Innovation LLC (CVI)
- Cheryl Heard – USDA NRCS Team Lead District Conservationist (Murray, Nobles, Rock, and Pipestone Counties)

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1.) PROJECT ACTIVITIES COMPLETED DURING THE REPORTING PERIOD. (*Describe project progress specific to goals, objectives, and deliverables identified in your project proposal.*)

We hypothesized that using a planter wing weight distribution system would result in more consistent emergence and less plant variability leading to higher yields. We aimed to test this hypothesis on approximately 30 acres of fall strip-tilled land located in Nobles County, Minnesota.

We evaluated individual corn plant emergence and plot yield where the weight distribution system was inactive (control) and where the weight distribution system was active (treatment). Completion of this study would answer the following questions: 1.) Is a planter weight distribution system a good investment for grain farmers? 2.) What other factors are driving plant variability?

March 28, 2021 through April 6, 2021: We installed an aftermarket, welded on Planter Wing Weight Distribution System on a John Deere DB44 (24 Row 22”) Planter ([Figure 1](#)). Cost for kit was \$5,000 and installation/welding cost was approximately \$1,000.

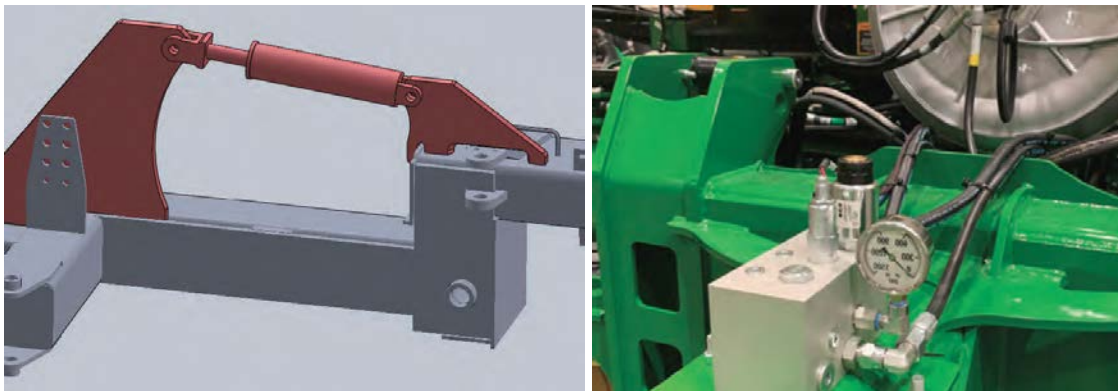


Figure 1: Planter Wing Weight Distribution System. Left – illustration showing system mounting brackets and hydraulic cylinder. Right – system hydraulic manifold.

April 24, 2021: 6 replicated alternating pairs of the treatment (planter weight distribution system activated) and control (planter weight distribution system inactive) were planted with Champion 53A20 VT2 Pro RIB corn at 34,000 seeds/acre (Figure 2). The two central fill hoppers were filled $\frac{3}{4}$ full. Field operations were recorded using Climate FieldView. Down force and applied down force per row maps were generated during planting. Plant population and hybrid remained the same between the control and treatment. Soil conditions were very dry. Seed was placed 2" deep. Planter is equipped with Precision Planting VSet, VDrive, and DeltaForce technology.



Figure 2: Planting corn in the trial plot. Circle shows the weight distribution system installed on the planter.

May 9, 2021: Placed two-time lapse cameras in plot - no significant results to share

Emergence Flag Test: Individual corn plants in $\frac{1}{1000}$ th of an acre (23' 9") for both control and treatment groups were flagged with a Precision Planting Flag Kit every 24 hours; green (day 1), blue (day 2), yellow (day 3), or red flag (day 4+) as they spiked out of the ground (Figure 3). Emergence was variable. Contributing factors may be due to variable moisture in seed trench and poor hybrid cold germ.



Figure 3: Aerial view of corn emergence flag test.

September 21, 2021: 4 rows were selected to be hand harvested and individual plant yield was determined. Collaborator, Bob Recker, led data collection and analysis. See full report in appendix.

October 19, 2021: Plot was harvested with a 12-row corn head. Data was collected using a grain cart scale and Precision Planting Yield Sense Monitor.

Results #3 – Plot Harvest Analysis

Executive Summary:

Plot harvest yields indicated corn planted with the weight distribution system active **did not significantly improve yields** compared to corn planted with the weight distribution system inactive ($p=0.19$; [Table 2](#)). The mean difference in yield using the weight distribution system was only 1.75 bu/acre more compared to the control group ([Figure 4](#)).

Possible reasons to explain the outcome of this trial:

1. Very dry conditions during planting resulted in less compaction from water saturated soils.
2. Field was strip-tilled and had better soil structure to support the planter weight as the planter was tracking on untilled soil.
3. Plant fertility was banded & indexed to each row with strip-till and Y-drop split nitrogen application, which may have encouraged corn plants to build healthy root systems, thereby masking the impact of the weight distribution system.
4. Precision Planting DeltaForce (row-by-row automatic downforce control system) capabilities may help manage the heavy planter center section against damaging excessive gauge wheel weight.

Table 2: Full plot harvest yield results. Comparisons of mean corn yield in treatment ($n=6$) and control ($n=6$) pairs using a student t-test. Significance was defined as a $p\text{-value} < 0.05$.

t-Test: Paired Two Sample for Means		
	Control (Weight Distribution System Inactive)	Treatment (Weight Distribution System Active)
Mean	247.08	248.83
Variance	9.04	17.97
Observations	6	6
Pearson Correlation	0.74	
Hypothesized Mean Difference	0	
df	5	
t Stat	-1.51	
P(T<=t) one-tail	0.09590	
t Critical one-tail	2.02	
P(T<=t) two tail	0.19180	
t Critical two-tail	2.57	

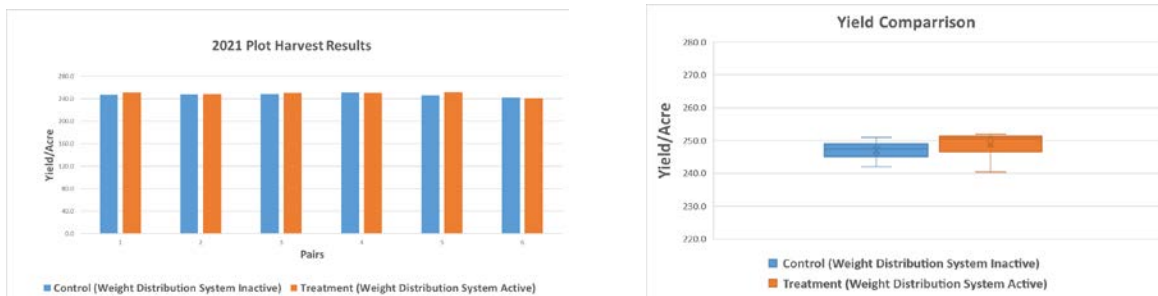


Figure 4: Plot harvest yields by pair. Left - Bar graph showing the corn yield in the treatment and control pairs. Right – Overall mean and variation comparisons of the control (247.08 ± 9.04 bu/acre) and treatment (248.83 ± 17.97 bu/acre) groups. Comparisons were not significant ($p=0.19$)

Conclusions:

This year, with these conditions at this plot, a planter weight distribution system did not provide a positive return on investment and result in significantly higher yields. This system still has promise to exhibit its capabilities in normal to higher-than-normal rainfall planting seasons.

Additionally, variability in corn plant emergence with this plot was more inconsistent than desired. There are other row-by-row processes like seed trench closing, residue cleaning and cold germ seed testing, that could be further micro-managed for improved corn emergence.

3.) CHALLENGES ENCOUNTERED. *(Describe any challenges that you encountered related to project progress specific to goals, objectives, and deliverables identified in the project proposal.)*

- Soil conditions were very dry at planting followed by cold weather. The hybrid in this plot had more inconsistencies in its emergence compared to another hybrid planted in the same field on the same day.
- Soil moisture remained less than adequate as of June 30, 2021. The growing season finished out with adequate moisture during grain fill.
- Emergence flag testing across 2 planter widths at 24 rows has a significant labor requirement. Concentrating flag testing efforts on 2 center rows and 2 wing rows per planter may give further insight and improved focus into seed germination, seed trench closing, and seed placement analysis.

4.) EDUCATION AND OUTREACH ACTIVITIES. *(Describe any opportunities to engage with farmers, influencers or the media about your project.)*

- Radio interview with Mark Dorenkamp, Farm Broadcaster at Brownfield Ag NewsRadio – March 2021
- [MN Corn Blog Post](#), November 18, 2021
- MN Ag Expo poster, January 20, 2022 (expected)

5.) HOW CAN WE HELP? *(Please let us know how we can improve the experience or assist in your project if possible.)*

- Nothing at this time.
- Thank you to the MN Corn Growers and all the project collaborators who helped make this study a success.



Left – Bob Recker, Cedar Valley Innovations LLC
Right – Mark Enninga, Farmer Innovator

Appendix



Corn Emergence Sequence

Individual Plant Yield Study



Data: 21 Sep 2021
Revised: 24 Dec 2021
Mark Enninga Farm
Fulda, MN



CVI

Bob Recker
116 W Schrock Rd
Waterloo, IA 50701 USA
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Cedar Valley Innovation LLC

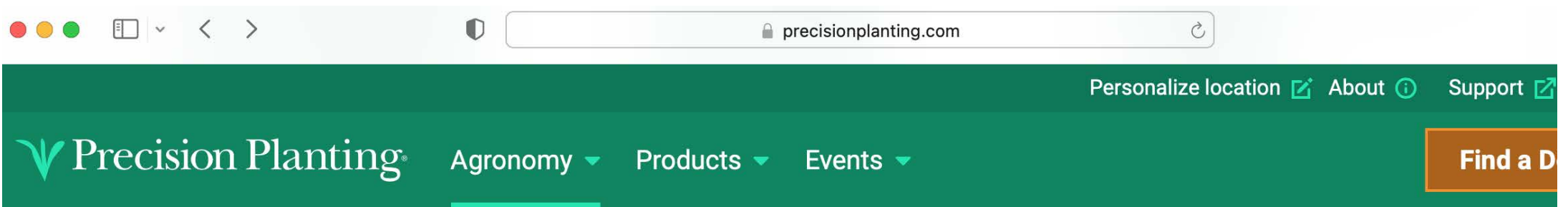
What's in Your Field?

e-mail: cedarvalleyinnovation@gmail.com
cedarvalleyinnovation.com

Agenda

1. Executive Summary
2. Relative Emergence Analysis
3. Discussion
4. Next Steps-2022 Season

Background Process



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[The Secret to Why Most Planters Still Don't Achieve the Best Stands](#)

Reduce complexity, improve planter performance, and maximize profitability



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[\[how to\] Emergence Flagging Kit](#)

Now that you have your Emergence Flagging Kit it's time to start flagging your emergence on the first day a plant comes up.



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[\[free\] Emergence Flagging Kit](#)

Inconsistent crop emergence decreases yield potential. See for yourself using an Emergence Flagging Kit.

Emergence Study Data-Shortly after emergence

		Emergence Testing																																						
		22" Row, 1/1000th of an acre = 23'9"																																						
		Control (Inactive Wing Weight Transfer)																																						
Planting Direction = East	Planter Row Unit #	3	5	7	9	12	14	16	18	20	22	24											Average Emergence Occurance % per day																	
	Green Flag = Day 1	5	16%	4	12%	8	24%	2	7%	23	68%	12	37.5%	30	83%	26	76%	26	76%	12	36%	13	38%											43%						
	Blue Flag = Day 2	10	32%	11	33%	17	52%	8	27%	10	29%	13	40.6%	3	8%	7	21%	5	15%	20	61%	12	35%											32%	75%	Day 1 & 2				
	Yellow Flag = Day 3	6	19%	10	30%	5	15%	4	13%	0	0%	2	6.3%	2	6%	0	0%	1	3%	1	3%	3	9%											10%	10%	Day 3				
	Red Flag = Day 4+	10	32%	8	24%	3	9%	16	53%	1	3%	5	15.6%	1	3%	1	3%	2	6%	0	0%	6	18%											15%	15%	Day 4+				
	Total	31	100%	33	100%	33	100%	30	100%	34	100%	32	100%	36	100%	34	100%	34	100%	33	100%	34	100%											33						
	Hand Tested = *	*											*	*																										
	Bob Priority/Sequence	4											1	2																										
	Bob Original Label	1											7	9																										
		Treatment (Active Wing Weight Transfer)																																						
Planting Direction = West	Planter Row Unit #	23	21	19	17	16	15	13	11	9	7	5	3	1											Average Emergence Occurance % per day															
	Green Flag = Day 1	14	39%	19	56%	22	63%	19	59%	4	14%	15	44%	29	83%	4	14%	14	48%	16	48%	10	32%	11	35%	22	73%											47%		
	Blue Flag = Day 2	11	33%	6	18%	4	11%	9	28%	9	31%	7	21%	5	14%	11	38%	7	24%	13	39%	12	39%	8	26%	5	17%											26%	73%	Day 1 & 2
	Yellow Flag = Day 3	5	15%	3	9%	2	6%	2	6%	5	17%	5	15%	1	3%	5	17%	5	17%	1	3%	3	10%	1	3%	2	7%											10%	10%	Day 3
	Red Flag = Day 4+	4	12%	6	18%	7	20%	2	6%	11	38%	7	21%	0	0%	9	31%	3	10%	3	9%	6	19%	11	35%	1	3%											17%	17%	Day 4+
	Total	34	100%	34	100%	35	100%	32	100%	29	100%	34	100%	35	100%	29	100%	29	100%	33	100%	31	100%	31	100%	30	100%											32		
	Hand Tested = *											*																												
	Bob Priority/Sequence											3																												
	Bob Original Label											13																												
	Hybrid:Champion 53A20 VT2P											Traits: VT2 Pro RIB																												
	Planted Population:	34000																																						
	Planting Date:	4/26/2021																																						
	RM:	103																																						
	Low Side Wall Tires Driven on Rows:	10, 11, 15, 16																																						

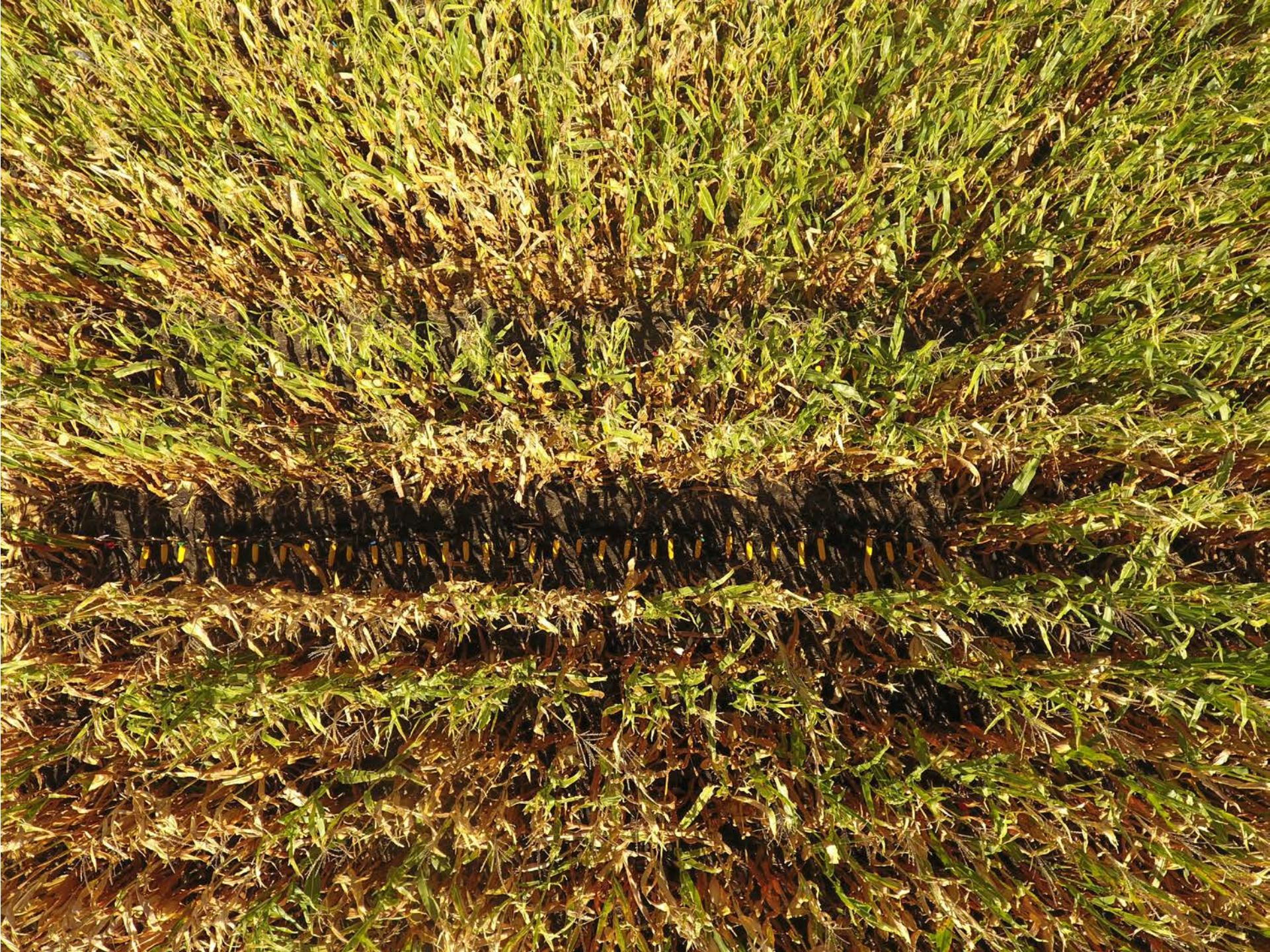
This Report: End of Season Yield by Plant



Row 7,
Row Unit 9



Row 9,
Row Unit 12



Row 13,
Row Unit 13



Row 1,
Row Unit 3



Executive Summary

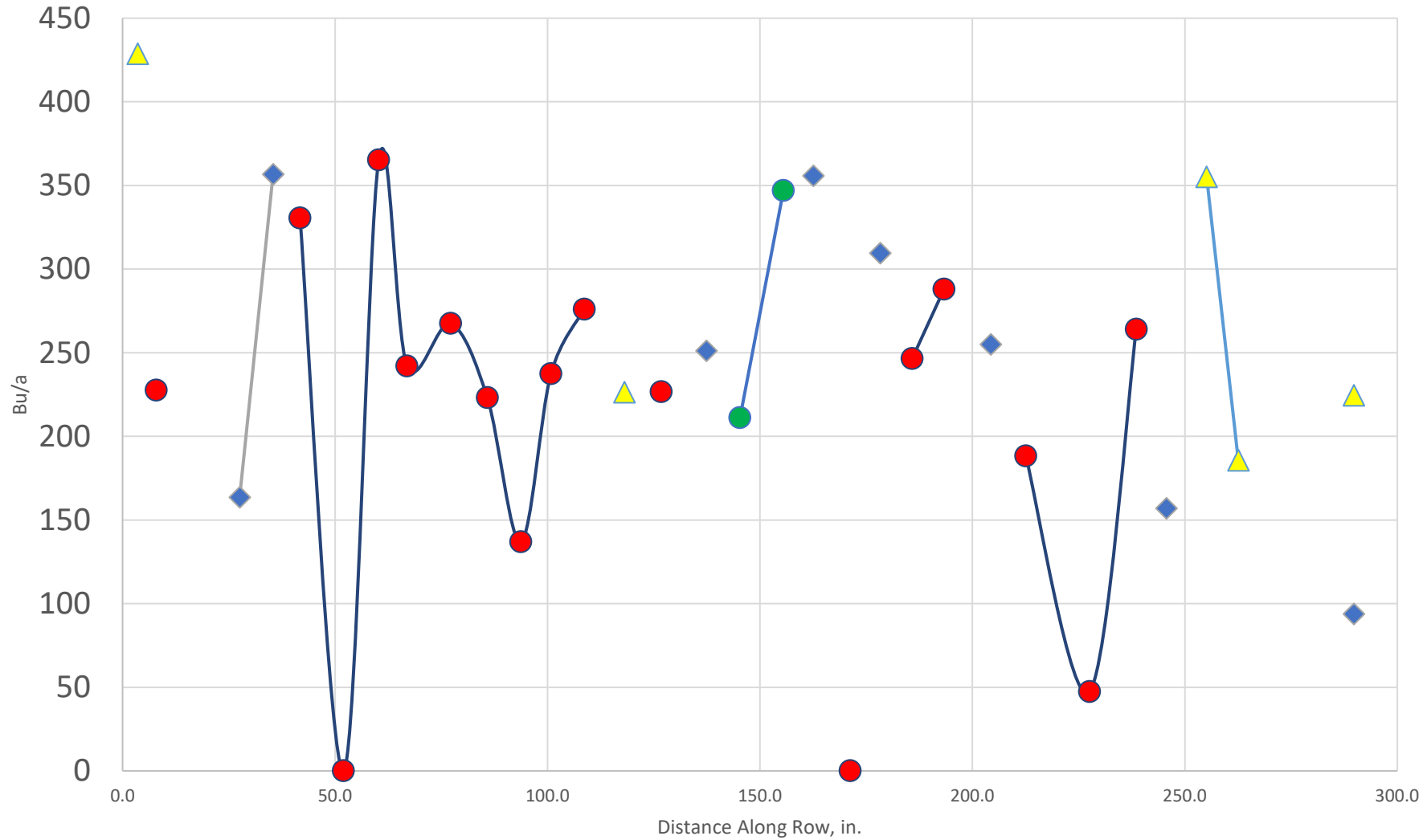
1. Large Differences between Plot Rows
Could be caused by Planter or Other By-Row Process
2. Barren Plants were a significant impact on yield
3. Planter Skips and/or Non-emerging plants are reducing yield
4. Early Emergence gives a small yield increase

Emergence Analysis

- Consider Impact of relative time to emergence of individual and adjacent plants

Single Plant Yield by Relative Emergence

Row 7



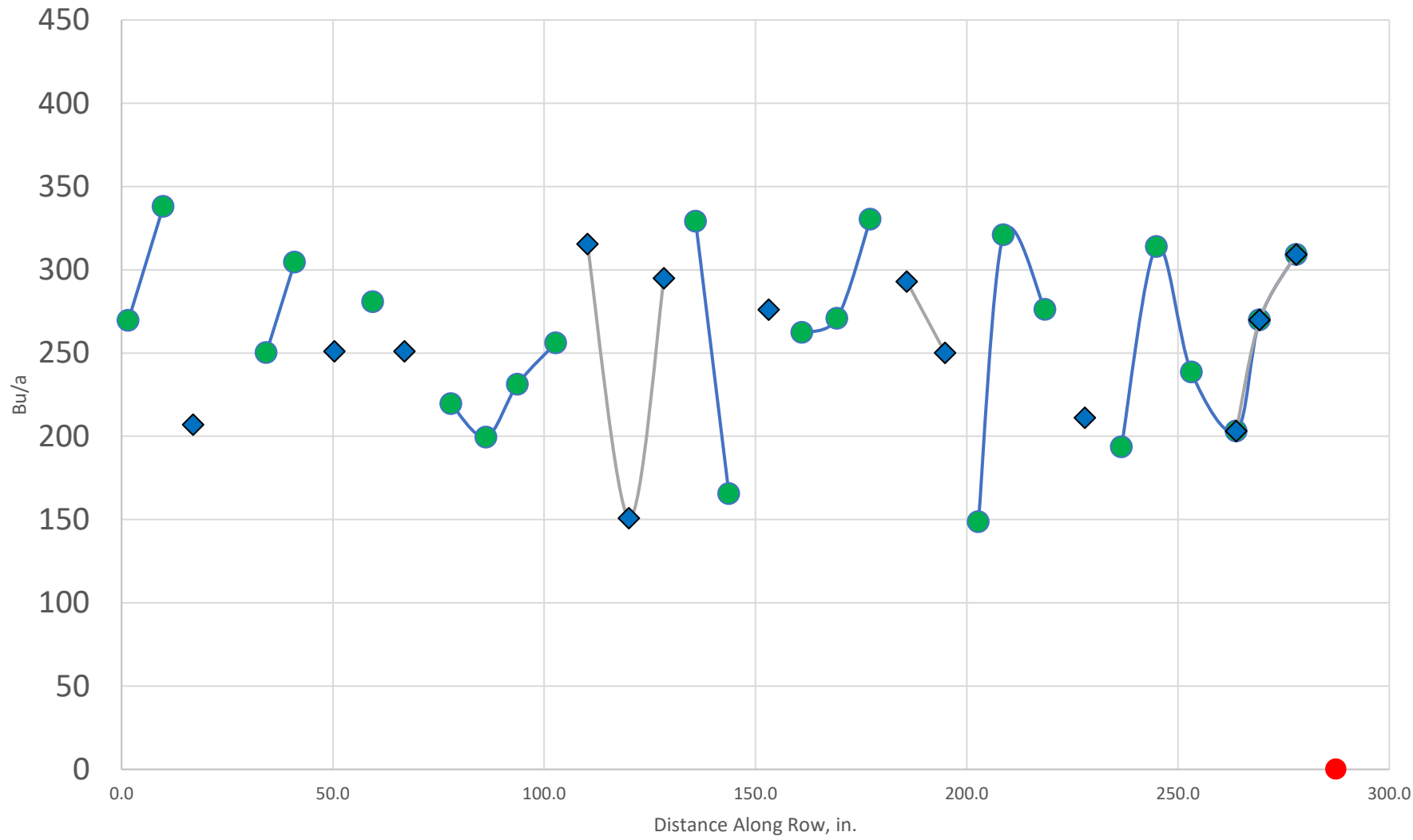
Row 07
32 Plants
30 Ears
223 Bu/a
Plot 101021
21 Sep 2021

7% on Day 1
27% on Day 2
13% on Day 3
53% on Day 4+

● Day 1 ◆ Day 2 ▲ Day 3 ● Day 4

Single Plant Yield by Relative Emergence

Row 9



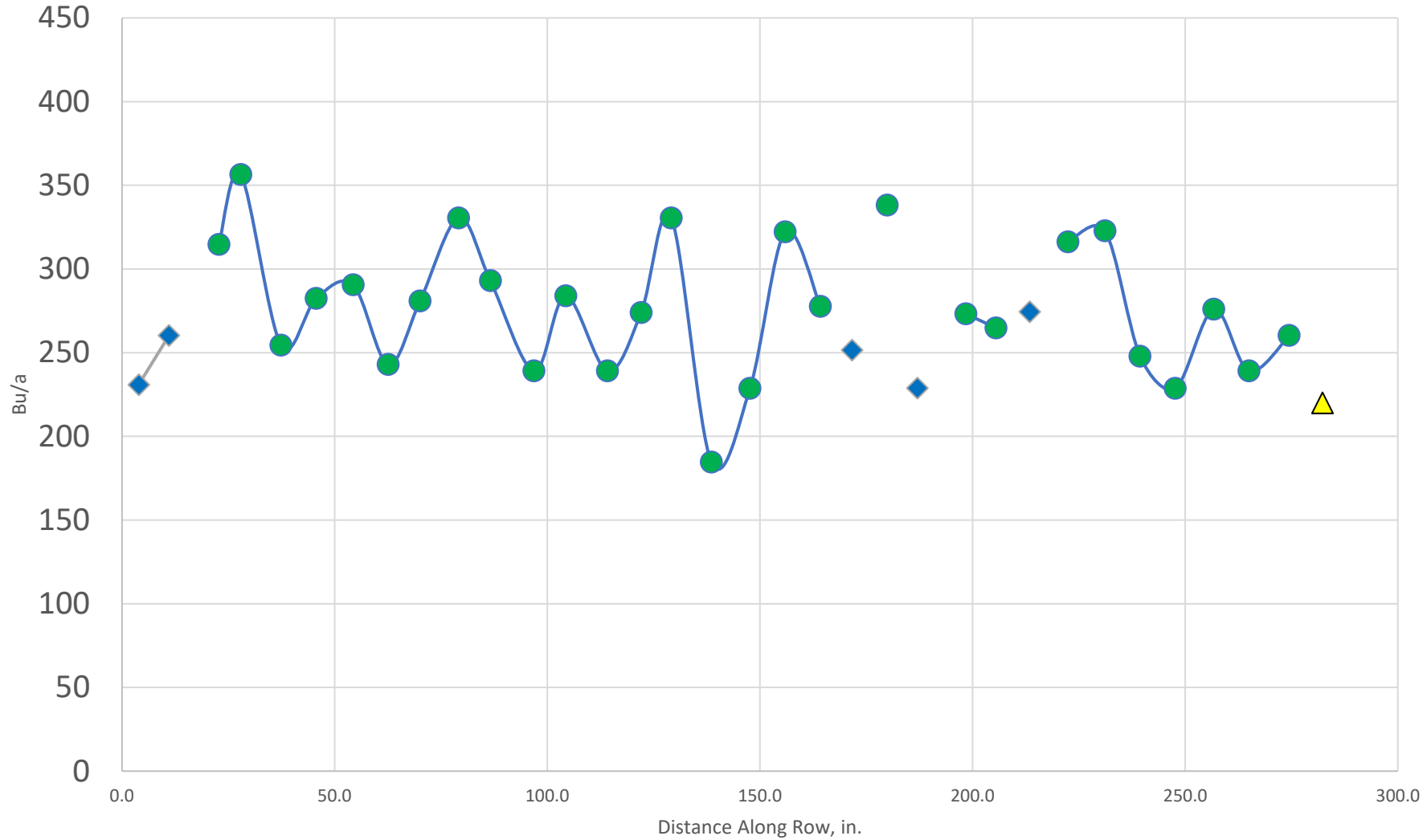
Row 09
34 Plants
33 Ears
248 Bu/a
Plot 101021
21 Sep 2021

68% on Day 1
29% on Day 2
0% on Day 3
3% on Day 4+

● Day 1 ◆ Day 2 ● Day 3 ● Day 4

Single Plant Yield by Relative Emergence

Row 13



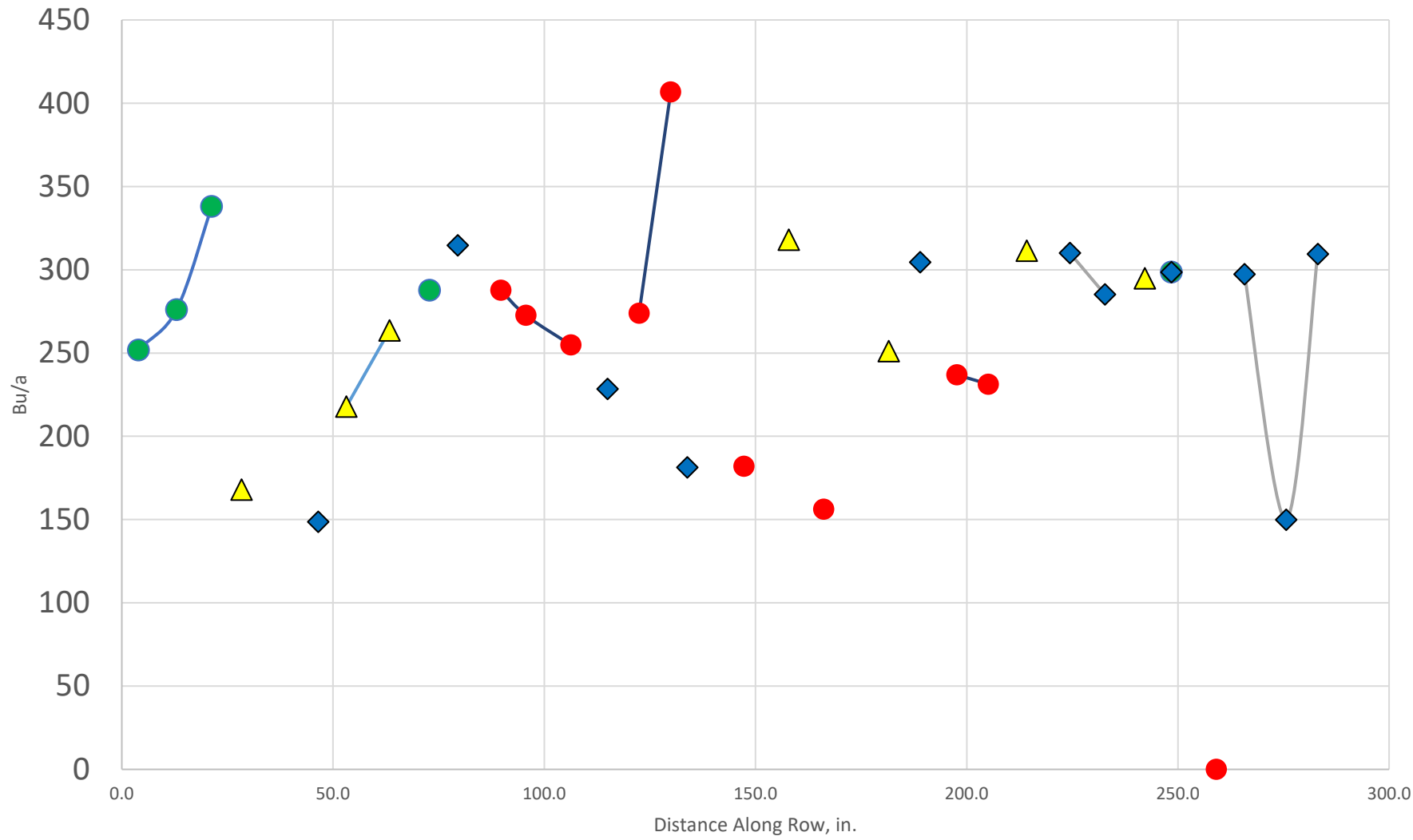
Row 13
35 Plants
35 Ears
272 Bu/a
Plot 101021
21 Sep 2021

83% on Day 1
8% on Day 2
6% on Day 3
3% on Day 4+

● Day 1 ◆ Day 2 ● Day 3 ● Day 4

Single Plant Yield by Relative Emergence

Row 01



Row 01
32 Plants
31 Ears
247 Bu/a
Plot 101021
21 Sep 2021

16% on Day 1
32% on Day 2
19% on Day 3
32% on Day 4+

● Day 1 ◆ Day 2 ▲ Day 3 ● Day 4

Average Ear Weight vs Emergence Day

Summary of Weight vs Emergence							
Bob	Planter	Day 1	Day 2	Day 3	Day 4	Average	% of O.A. Avg
Row 7	Row Unit 9	0.72	0.68	0.73	0.62	0.69	105%
Row 9	Row Unit 12	0.63	0.66			0.65	99%
Row 13	Row Unit 13	0.68	0.62	0.52		0.61	93%
Row 1	Row Unit 3	0.71	0.65	0.74	0.63	0.68	104%
Average		0.69	0.65	0.66	0.62	0.66	100%
% of O.A Avg		105%	99%	101%	95%		

Summary:

- The average of the hand-picked and weighed ears was the same as the plot level yield monitor: 248 bu/a
- This process showed a large variation (49 bu/a!) in rows across a single planter width:
 - Row Unit 3: 247 bu/a
 - Row Unit 9 223 bu/a
 - Row Unit 12 248 bu/a
 - Row Unit 13 272 bu/a

Next Steps: 2022 Season

- Repeat process?
- Dig for missing or non-emerged plants planter after Day 4 flags are in
- Added Insights in adjacent rows-Dig up late emerged plants vs early emerged plants
- Closer Look at Planter Residue Managers
- Closer Look at Closing Wheels