

MODIFYING STARTER FERTILIZER PLACEMENT TO INCREASE EFFECTIVENESS



JOSH MCGRATH, PH.D.
LEAD, TECHNOLOGY DEVELOPMENT

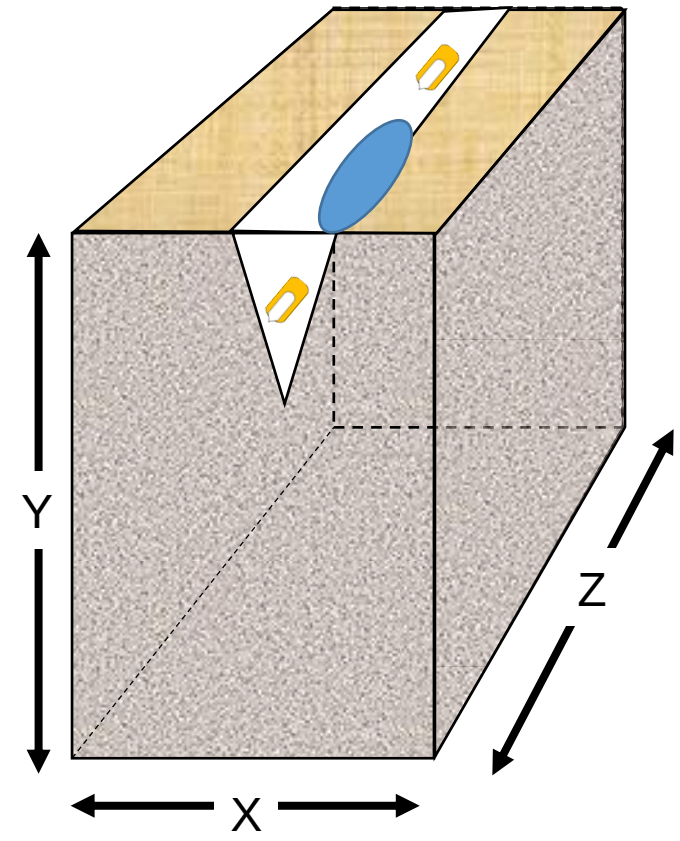
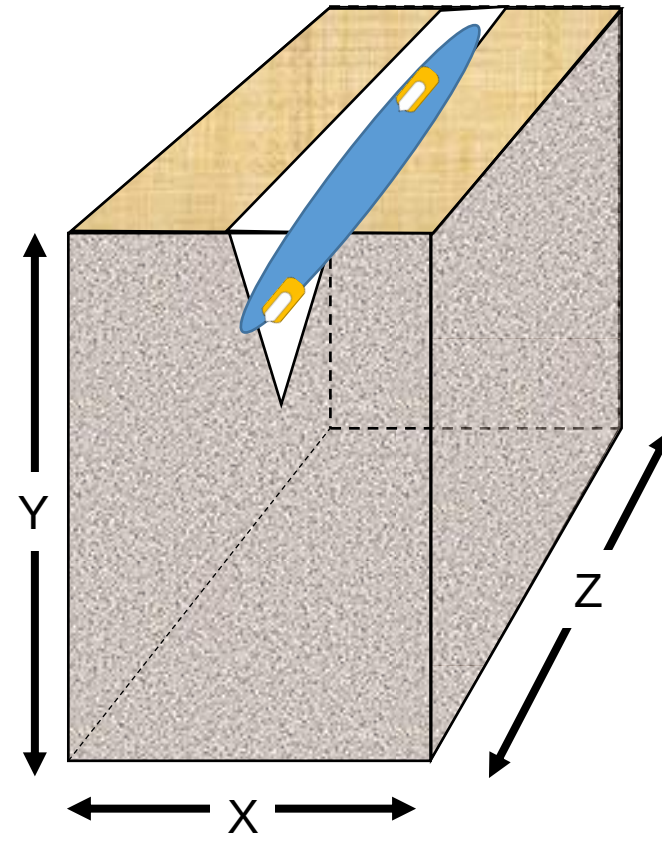
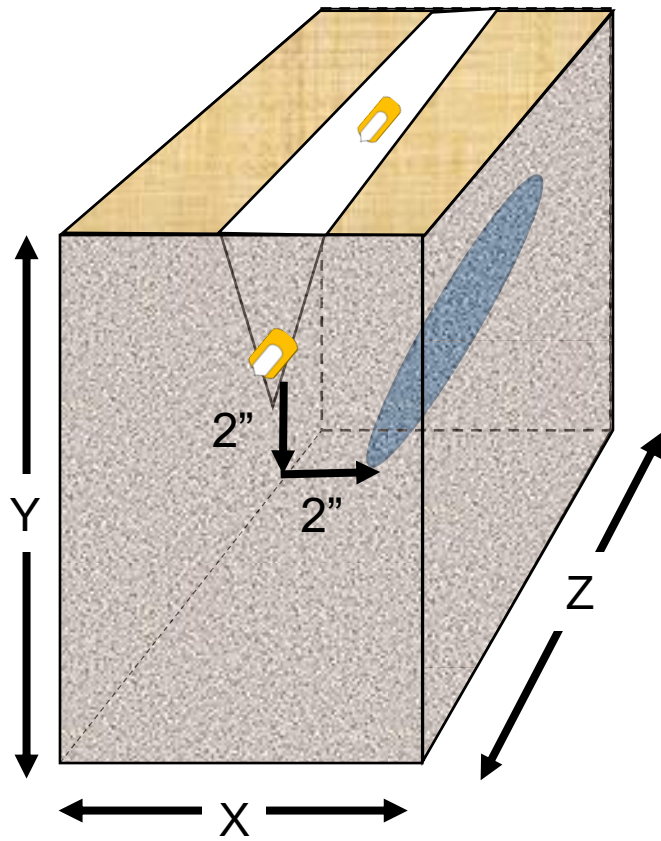
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Modifying Starter Fertilizer Placement to Increase Effectiveness

Josh McGrath

February 21, 2022

Placement options



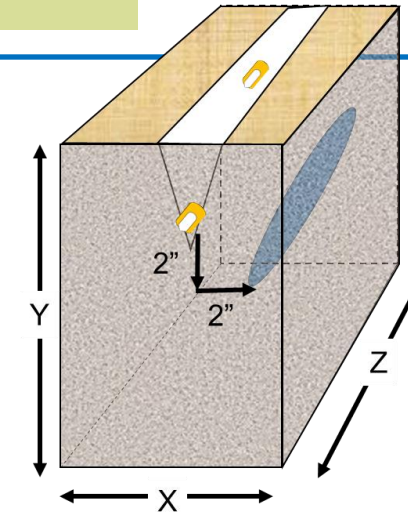
CapstanAG SelectShot for pulsed fertilizer



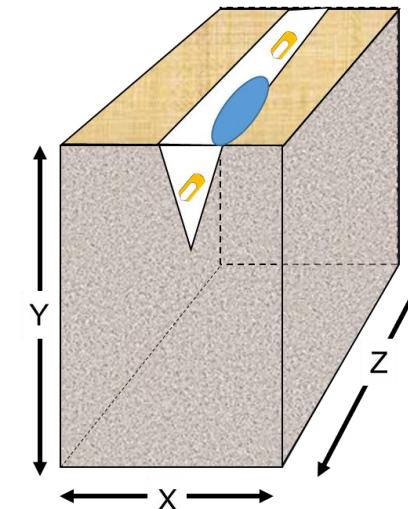
Diffusion

$$\frac{dC}{dt} = D_e * A * \frac{dC}{dx}$$

- **dC/dt** is the change in concentration over change in time (rate)
- **A** is the area of nutrient absorbing root surface or cross-sectional area through which the ions diffuse
- **D_e** is the effective diffusion coefficient
- **dC/dx** is the change in solution concentration (dC) with increasing distance (dx) from the root surface



Distance = 7.1 cm



Distance = variable

C = 1.2 - 6.4x offset

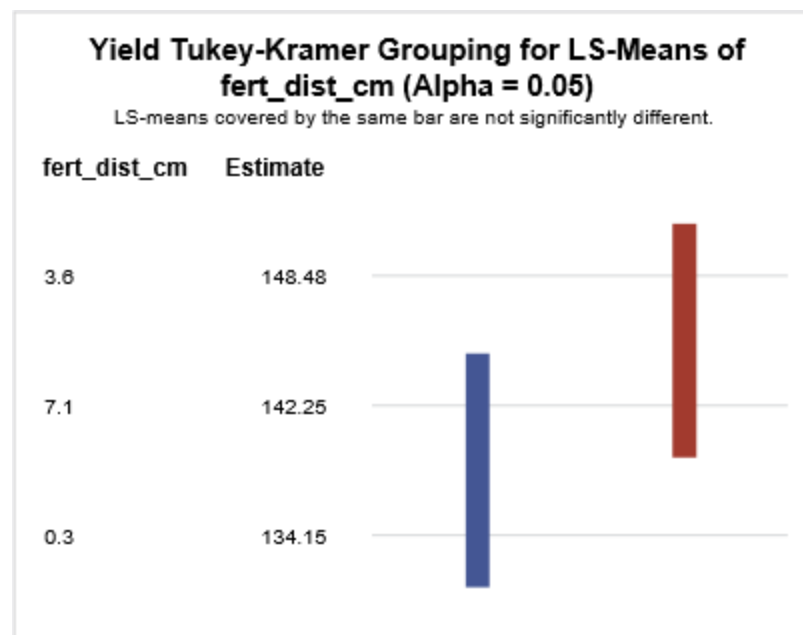
2020 Rates X (pulsed, seed row, 2x2)

Product	Rate	P ₂ O ₅	Pulse Volume	Pulse Rate	Continuous Rate	Apparent SI		Seed - fertilizer separation separation (in)	Pulse length
						Pulsed	Continuous		
	----gpa-----	-----lb/a-----	----ml/seed----	-----mg/cm-----		-----SI*mg/cm-----		-----in-----	
6-24-6	7.4	19.8	1.08	0.32	0.07	3.83	0.84	3.1	1.8
6-24-6	16.6	44.6	2.42	0.35	0.16	4.15	1.88	2.1	3.7
6-24-6	25.8	69.3	3.76	0.35	0.25	4.15	2.94	1.1	5.7
Poly	5.0	19.8	0.73	0.32	0.05	6.42	1.00	3.3	1.2
Poly	11.3	44.6	1.65	0.35	0.11	6.98	2.26	2.7	2.6
Poly	17.5	69.3	2.55	0.36	0.17	7.26	3.48	2.0	3.9
UAN32	14.1	0.0	2.05	0.33	0.13	23.53	9.53	2.4	3.2

2021 Rates X (2x2, pulsed, seed-row)

Product	Rate	P ₂ O ₅	Pulse Volume	Pulse Rate	Continuous Rate	Apparent SI		Seed - fertilizer separation	Pulse length
						Pulsed	Continuous		
	-gpa-	-lb/a-	-ml/seed-	----mg/cm----		-----SI*mg/cm-----		-----cm-----	
6-24-6	7.4	19.8	1.1	0.32	0.07	3.8	0.8	8.1	4.6
6-24-6	29.5	79.2	4.5	0.35	0.28	4.2	3.4	1.9	17.1
Poly	5.0	19.8	0.8	0.32	0.05	6.4	1.0	8.8	3.3
Poly	20.0	79.2	3.0	0.36	0.20	7.3	4.0	4.6	11.7
UAN32	14.1	0.0	2.1	0.3	0.1	23.5	9.5	6.3	8.4

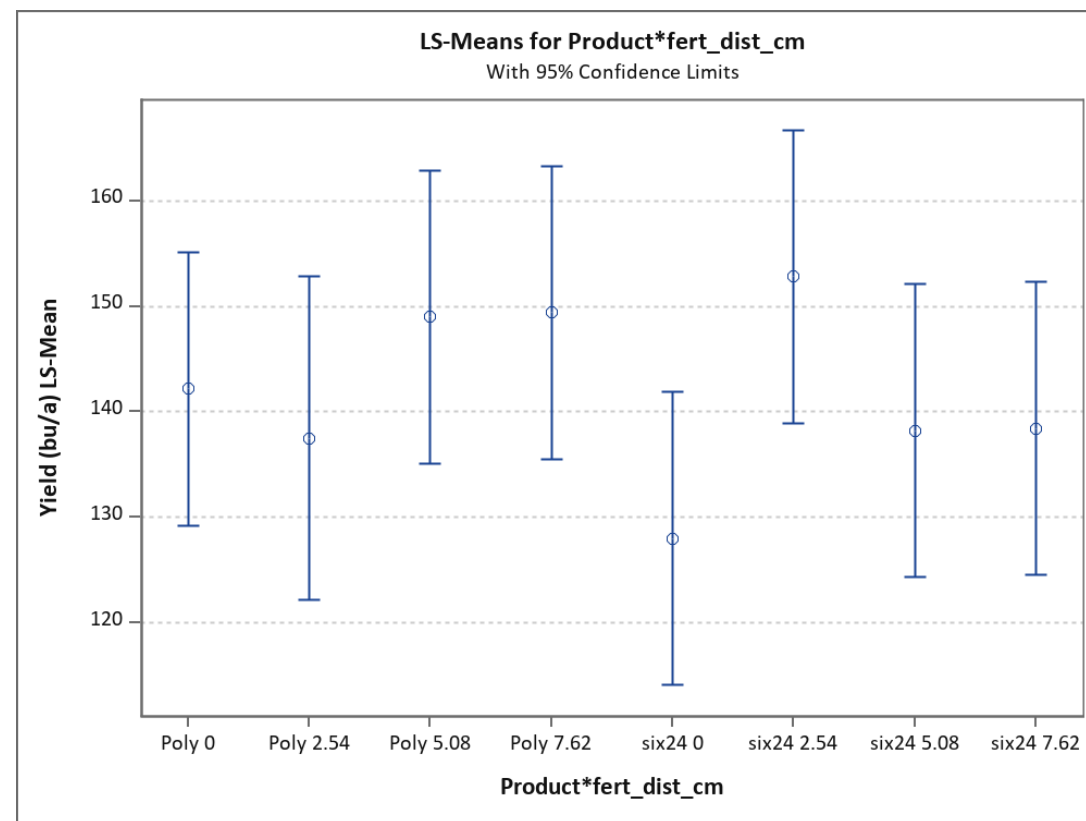
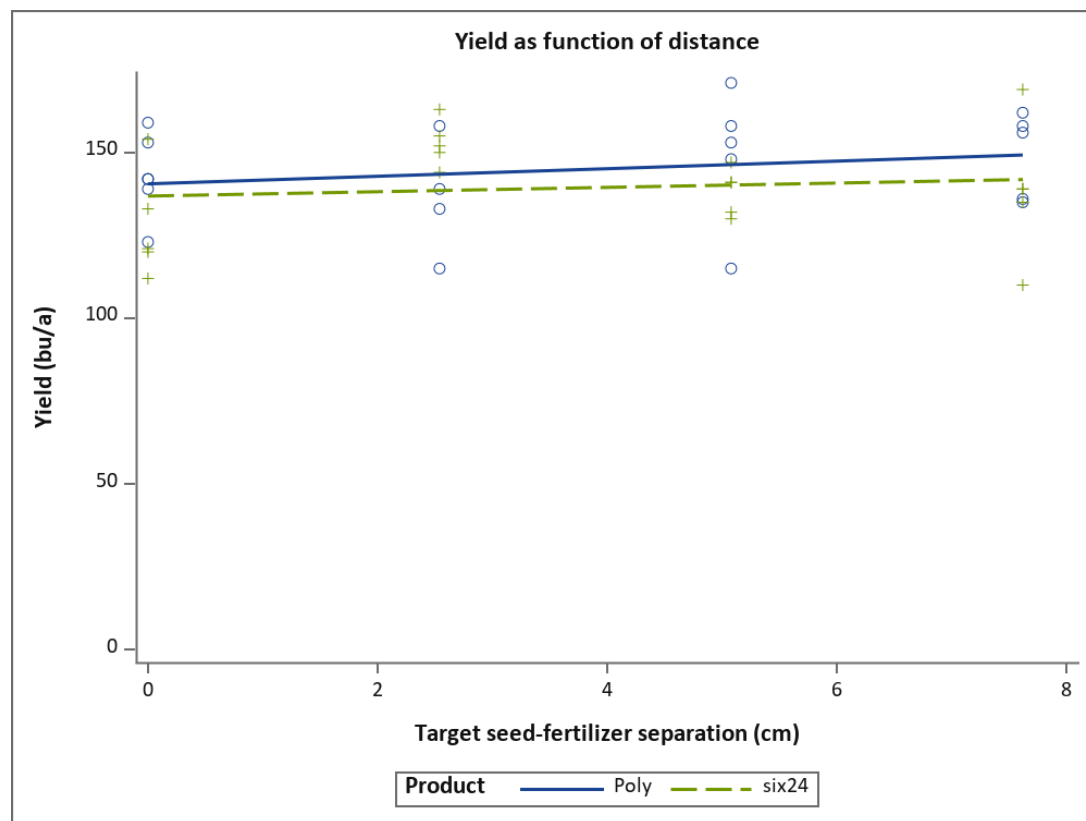
2020 Distance from seed did matter



Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Product	1	172	1.41	0.2372
Distance (cm)	2	172	8.78	0.0002
Product*Distance	2	172	1.18	0.3092

Fertilizer Separation Least Squares Means								
Seed-Pulse Separation (cm)	Estimate	Standard Error	DF	t Value	Pr > t	Alpha	Lower	Upper
0.3	134.15	2.9844	172	44.95	<.0001	0.05	128.26	140.04
3.6	148.48	2.9844	172	49.75	<.0001	0.05	142.59	154.37
7.1	142.25	2.9844	172	47.67	<.0001	0.05	136.36	148.14

Trend with distance – not significant in 2021



2020 & 2021

- We had problems with QS site
- NDVI and population supported hypothesis that distance from seed matters
- 2x2 is still the champ, but there's potential with pulsed if we can dial in proper distance to concentration balance



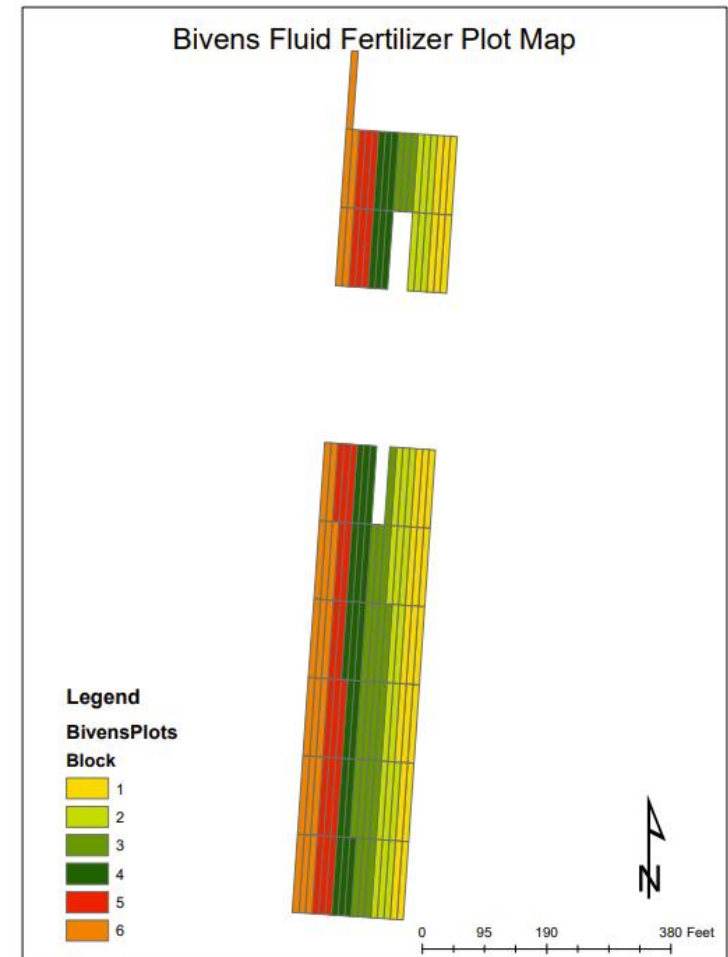
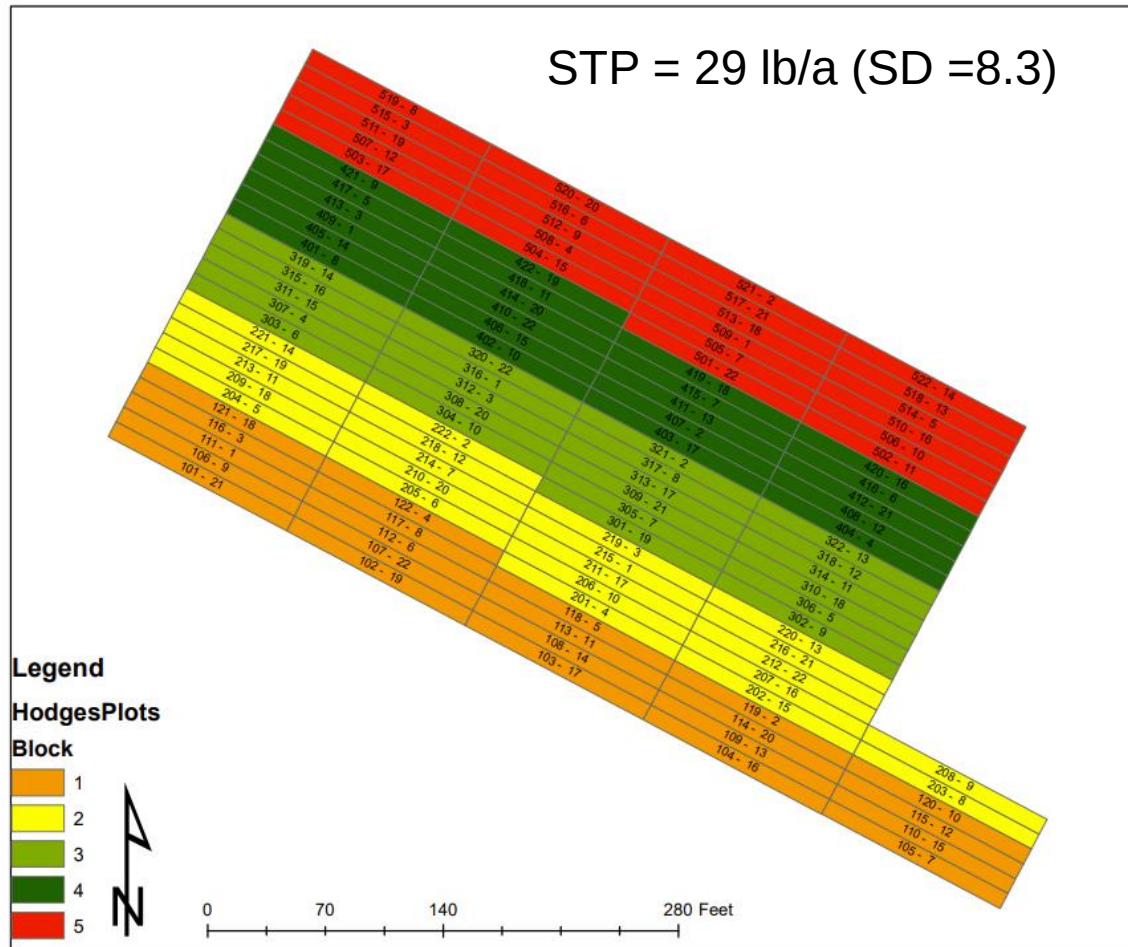
2022 Methods

- 6 reps
- 25k seeds/acre
- 1.5 mph
- Plots measured 10' x 120'
 - 10' trimmed from each end at harvest
 - Harvest center two rows
- Starter N balanced across all plots to 50 lb/a using 2x2
 - Side-dressed 150 lb/a N at v4
- Stand count at v4

25,000 seeds/acre = 21.2 cm between seeds



Two sites in cooperation with farmers (~3 acres)



STP = 19 lb/a (SD =9.6)

Treatments 2x2x5 Factorial

- Two products: Poly (10-34-0; SI=20) and ortho (8-24-0; SI=11.9)
- Two P rates: 20 & 60 lb/acre P_2O_5
- Placement – 5 treatments
 - 2x2
 - In-furrow continuous
 - In-furrow pulsed 0.1, 1.5, and 2.78 inches from seed
- 32% UAN no P control 2x2 and pulsed

									Apparent SI		
Product	Rate	P ₂ O ₅	Seed - fertilizer separation	Pulse length	Seed-Tail separation	Pulse Volume	Pulse Rate	Continuous Rate	Pulsed	Continuous	Pulsed/ Continuous
	-gpa-	-lb/a-		-----cm-----		-ml/seed-	----mg/cm----		-----SI*mg/cm-----		
8-24-0	7.7	19.8	0.1	2.9	18.3	1.2	0.5	0.1	6.1	0.8	7.3
8-24-0	7.7	19.8	3.5	2.9	14.8	1.2	0.5	0.1	6.1	0.8	7.3
8-24-0	7.7	19.8	7.1	2.9	11.3	1.2	0.5	0.1	6.1	0.8	7.3
8-24-0	23.2	59.4	0.1	8.1	13.0	3.5	0.5	0.2	6.5	2.5	2.6
8-24-0	23.2	59.4	3.5	8.1	9.6	3.5	0.5	0.2	6.5	2.5	2.6
8-24-0	23.2	59.4	7.1	8.1	6.1	3.5	0.5	0.2	6.5	2.5	2.6
10-34-0	5.0	19.8	0.1	2.0	19.2	0.8	0.5	0.1	10.6	1.0	10.6
10-34-0	5.0	19.8	3.5	2.0	15.7	0.8	0.5	0.1	10.6	1.0	10.6
10-34-0	5.0	19.8	7.1	2.0	12.2	0.8	0.5	0.1	10.6	1.0	10.6
10-34-0	15.0	59.4	0.1	5.3	15.8	2.3	0.6	0.1	12.0	3.0	4.0
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UAN32	14.1	0.0	7.1	5.0	7.1	2.1	0.6	0.1	39.6	9.5	4.2
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8-24-0	23.2	59.4	0.1	8.1	13.0	3.5	0.5	0.2	6.5	2.5	2.6
8-24-0	23.2	59.4	3.5	8.1	9.6	3.5	0.5	0.2	6.5	2.5	2.6
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10-34-0	5.0	19.8	0.1	2.0	19.2	0.8	0.5	0.1	10.6	1.0	10.6
10-34-0	5.0	19.8	3.5	2.0	15.7	0.8	0.5	0.1	10.6	1.0	10.6
10-34-0	5.0	19.8	7.1	2.0	12.2	0.8	0.5	0.1	10.6	1.0	10.6
10-34-0	15.0	59.4	0.1	5.3	15.8	2.3	0.6	0.1	12.0	3.0	4.0
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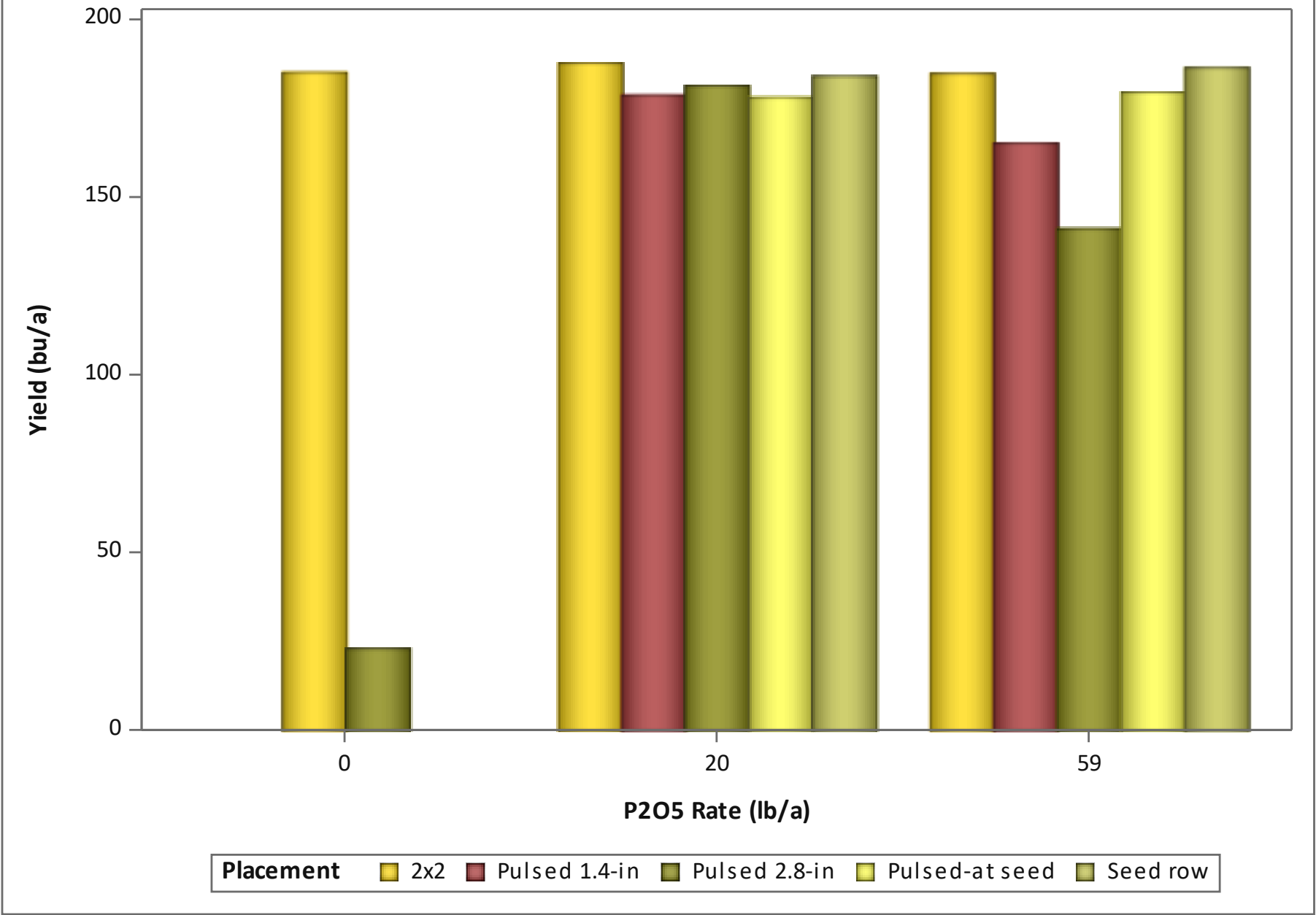
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10-34-0	5.0	19.8	0.1	2.0	19.2	0.8	0.5	0.1	10.6	1.0	10.6
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Results – does not include poly-pulsed @Hodges

- Because of factorial design analysis does not include 2x2 UAN or pulsed UAN – they were reference/control treatments
- Main effect of product not significant – average yield 180 bu/acre across all treatments-sites
 - This might change after we clean poly data at hodges
- Phosphorus rate had significant effect
- Placement had a significant effect
- There was an interaction between rate and placement

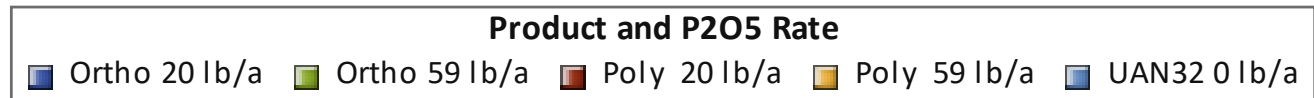
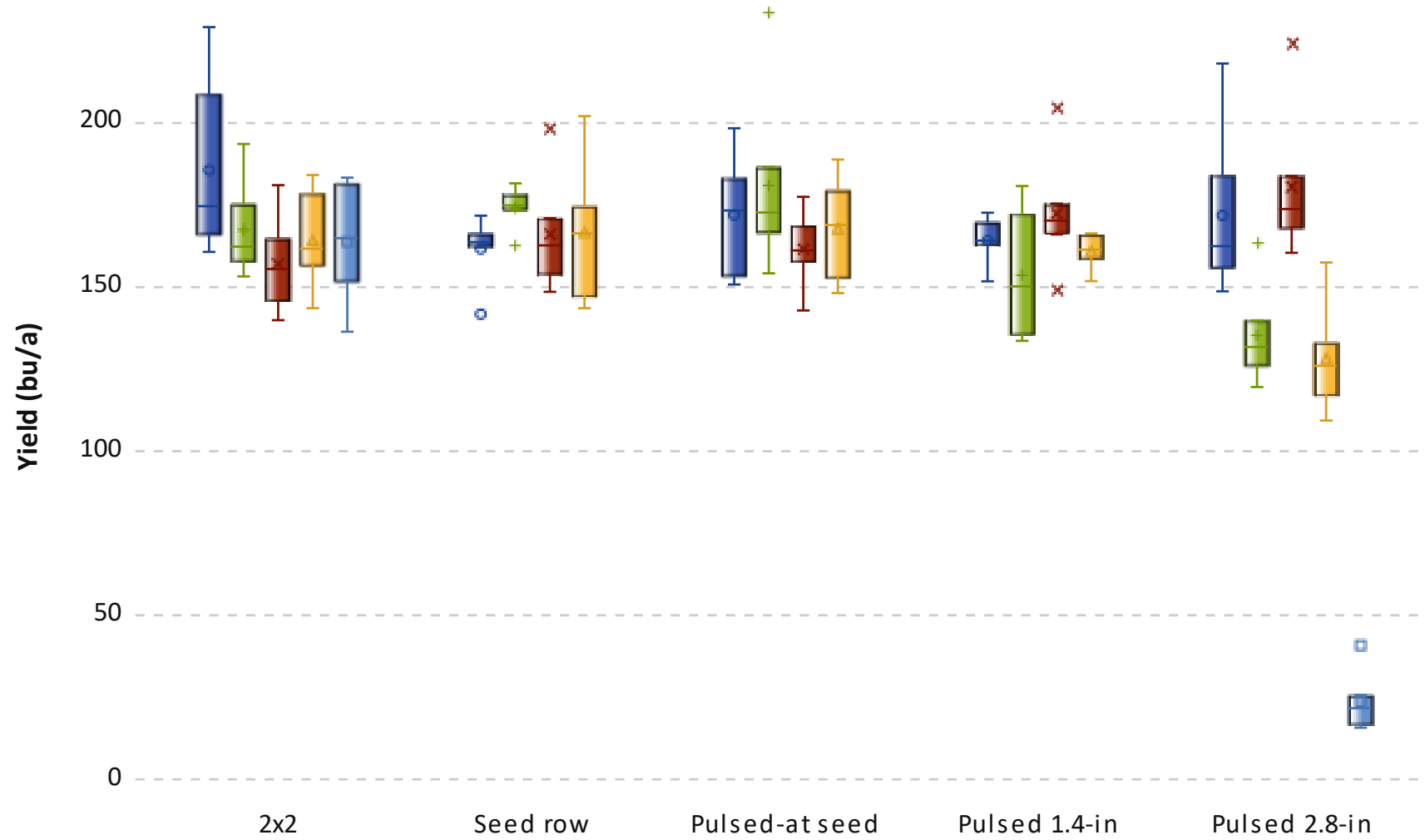
Placement	P ₂ O ₅ (lb/a)	Yield (bu/a)	
Pulsed 2.8 in	20	188.53	A
2x2	20	187.79	A
Seed row	59	186.55	A
2x2	59	184.83	A
Pulsed 1.4 in	20	184.61	A
Pulsed at-seed	59	184.33	A
Seed row	20	184.16	A
Pulsed at-seed	20	181.72	A
Pulsed 1.4 in	59	171.59	A
Pulsed 2.8 in	59	145.57	B

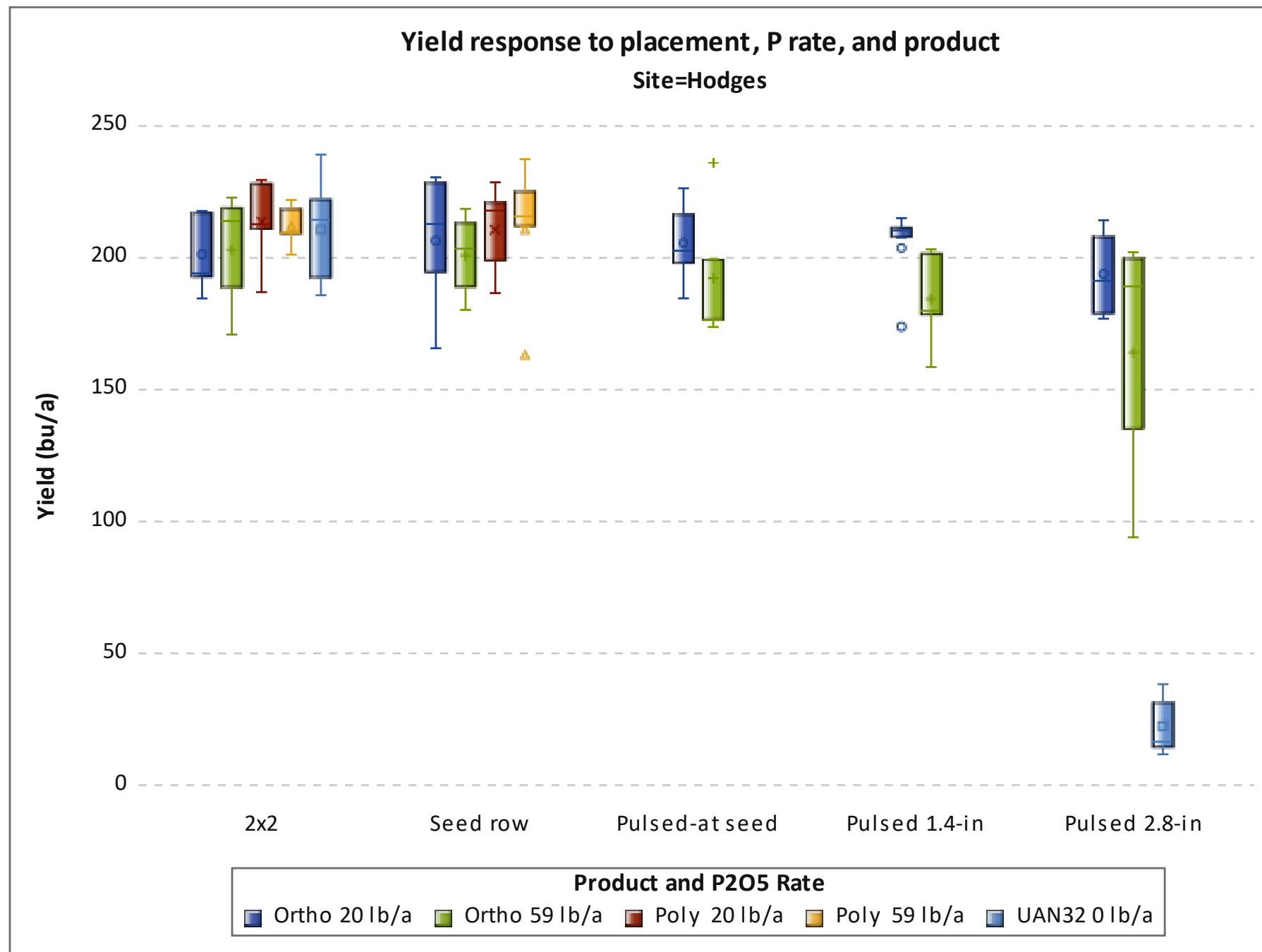
Yield response to placement and P rate - across sites

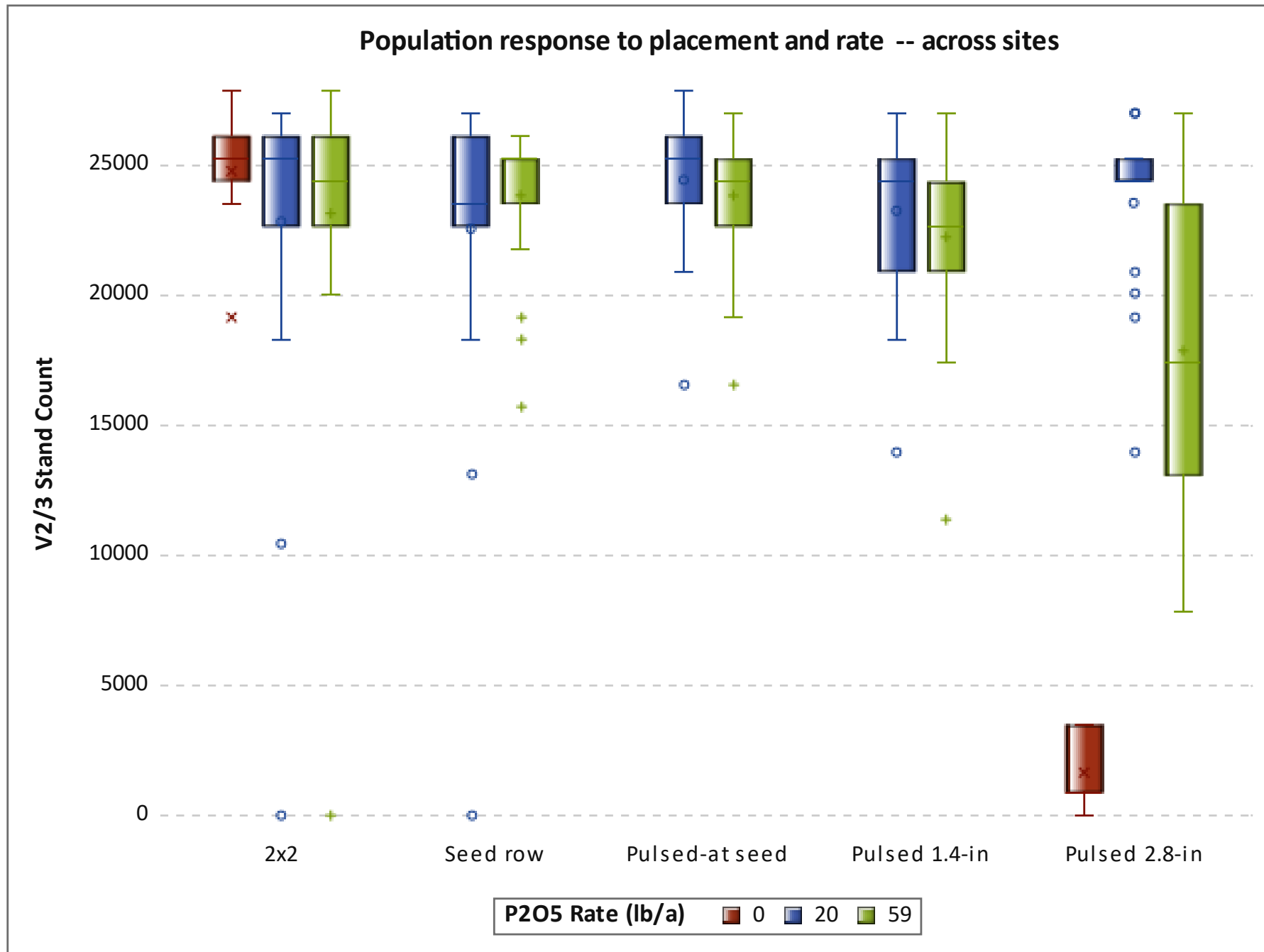


Yield response to placement, P rate, and product

Site=Bivens







Conclusions

- Russian roulette to put fertilizer close to seed
- Pulsing showed the potential we expected with lower P rate
 - Future studies should simplify and look at lowering P rates to highlight diffusion benefit
- We ran slow and low population – this is not practical
- Shot selection should be based on front and back distance
 - Lower analysis product had longer shot length and caught the next seed
- We need guidance on ***product x shot length*** and ***distance*** from seed!

Thanks!

