

Potassium Management in Virginia Cotton

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VA TECH TIDEWATER AREC





Studies Evaluating Potassium Response in Cotton

- 1) Phosphorus and Potassium Placement
 - i. Five nutrient management systems
 - ii. K applied at soil test levels
- 2) Polyhalite as a new K fertilizer source in cotton
 - i. Four fertilizer sources (MOP, POLY, MOP+POLY, and MOP+)
 - ii. Four K application rates (30, 60, 90, and 120 lb K₂O per acre)
- 3) Potassium rate by placement
 - i. Injected (0-0-15) vs. broadcast (0-0-60)
 - ii. Five K rates (0, 40, 80, 120, and 160 lb K₂O per acre)
- 4) Potassium rate by application timing
 - i. Three application timings (100% at-planting, 50% AP + 50% 4-5 leaf stage, and 100% 4.5 leaf stage)
 - ii. Five K rates (0, 40, 80, 120, and 160 lb K₂O per acre)

Mehlich I Soil Test Results for 2013-2015 Locations

Depth	TAREC		Lewiston	
inches	P	K	P	K
	ppm			
0-3	45 (H+)¶	95 (H-)	22 (H-)	96 (H-)
3-6	36 (H)	89 (H-)	16 (M+)	59 (M)
6-9	24 (H-)	72 (M)	12 (M)	43 (M-)
9-12	17 (M+)	76 (M+)	6 (L+)	40 (M-)

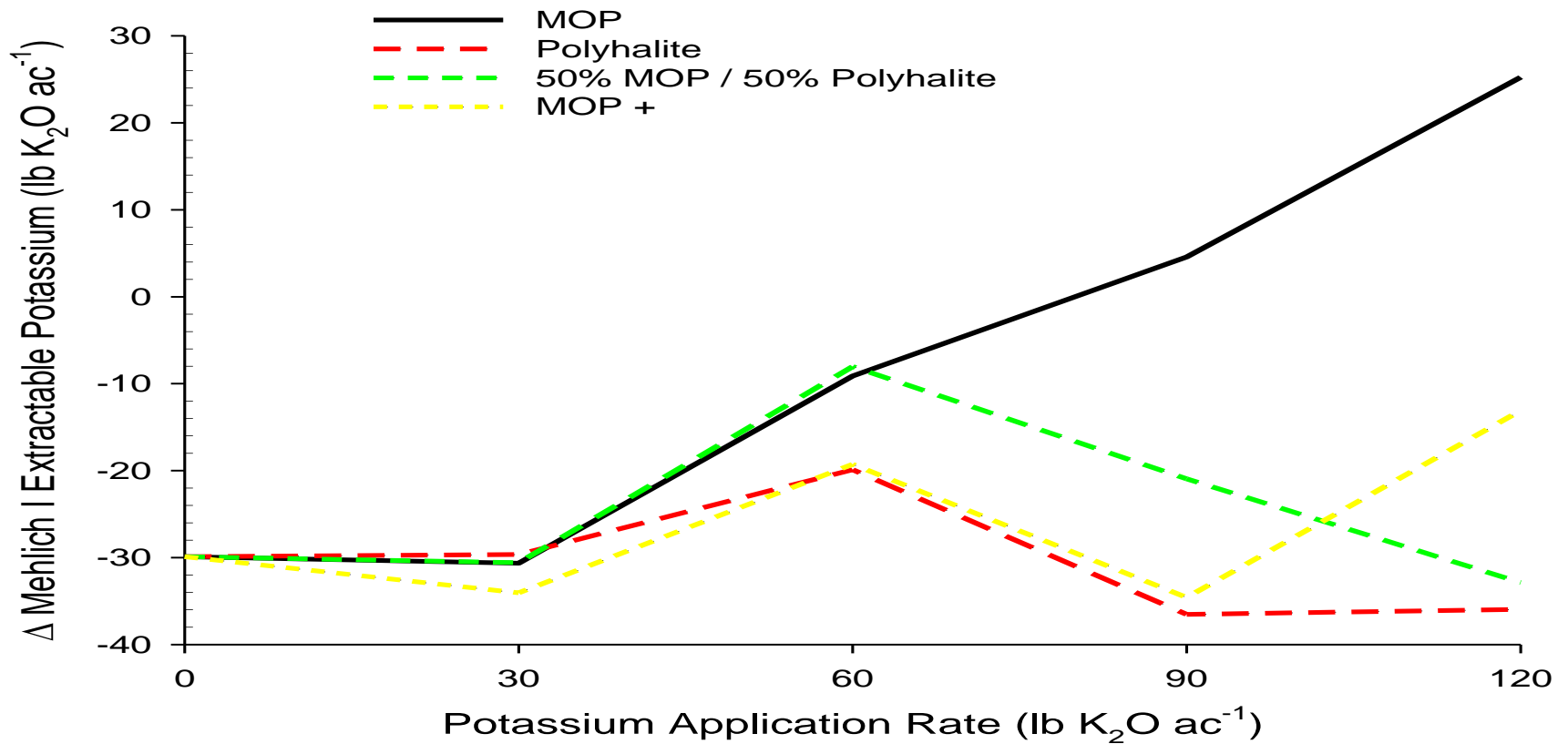
¶ Indicates the soil test level based on Virginia's soil test calibration

Soil Test Levels for Locations

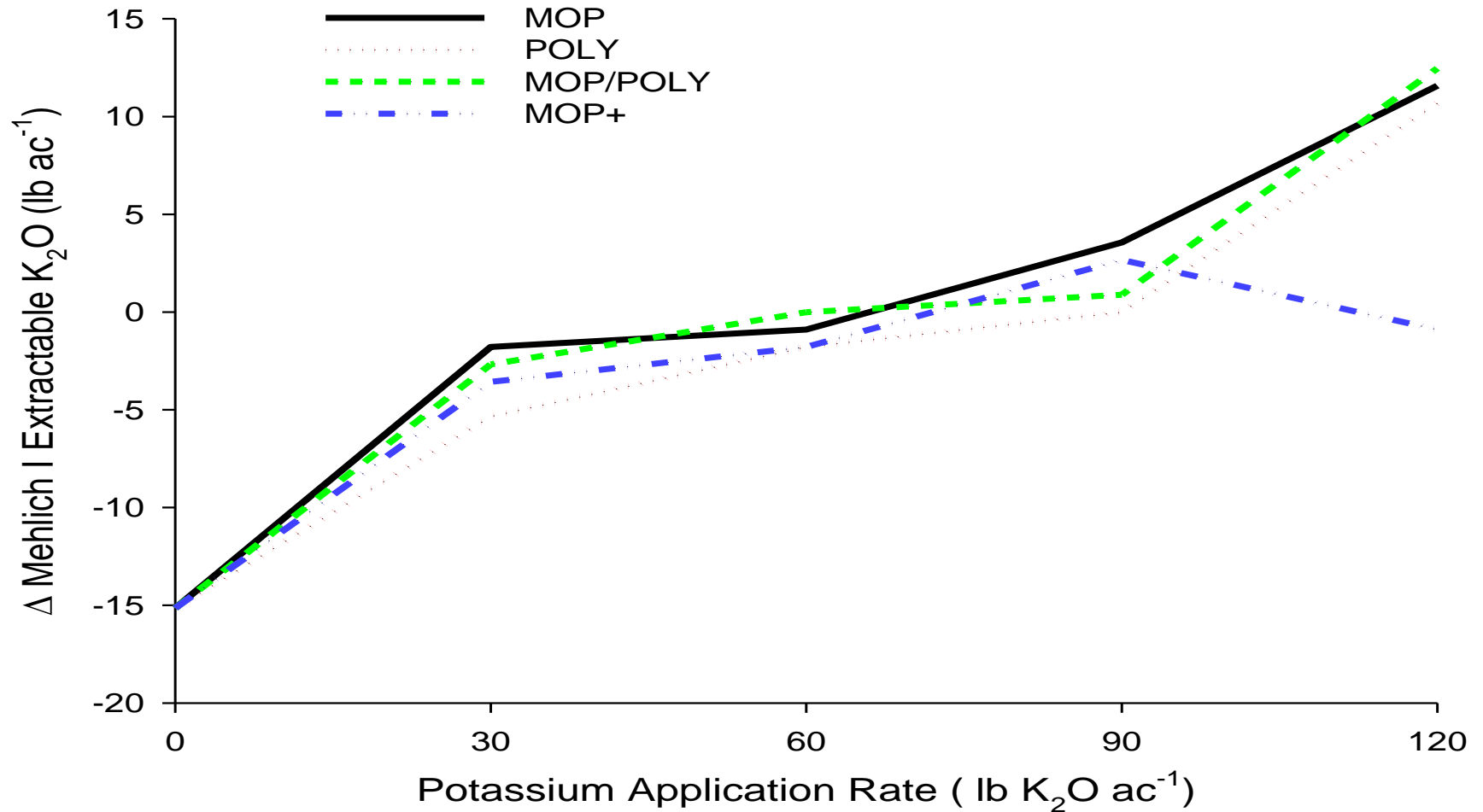
Location	Mehlich I Extractable Nutrients			
	P	K	Ca	Mg
	mg kg ⁻¹			
2015	35 (H [¶])	73 (M)	211 (L)	33 (L+)
2016	23 (H-)	18 (L)	345 (L+)	40 (M-)

¶ Indicates the soil test level based on Virginia's soil test calibration

2015 Change in Soil Test Potassium



2016 Change in Soil Test Potassium



Uptake of K, Ca, Mg, and S at 1st square (45 Days after Planting)

Trt #	Source	Potassium Rate lb K ₂ O ac ⁻¹	Nutrient Uptake at MHS			
			K ₂ O	Ca	Mg	S
			----- lb ac ⁻¹ -----			
1	Control	0	33.6	18.1	4.0	3.9
2	MOP	30	33.7	14.4	3.5	2.9
3	MOP	60	32.4	16.4	3.8	3.1
4	MOP	90	30.4	13.9	3.1	2.4
5	MOP	120	32.0	17.5	3.7	4.0
6	Polyhalite	30	31.6	15.3	3.5	5.4
7	Polyhalite	60	34.2	15.2	3.5	7.1
8	Polyhalite	90	34.4	17.9	4.0	7.7
9	Polyhalite	120	29.8	17.4	3.5	8.6
10	MOP/Poly	30	30.5	16.1	3.7	5.0
11	MOP/Poly	60	34.7	17.9	3.9	6.3
12	MOP/Poly	90	30.8	16.7	3.6	6.6
13	MOP/Poly	120	31.0	16.4	3.6	6.4
14	MOP+	30	28.1	15.1	3.4	4.6
15	MOP+	60	31.2	15.4	3.6	4.8
16	MOP+	90	34.6	18.4	4.2	6.1
17	MOP+	120	31.1	17.4	3.8	5.7

Impact of Drought in August at SHC location

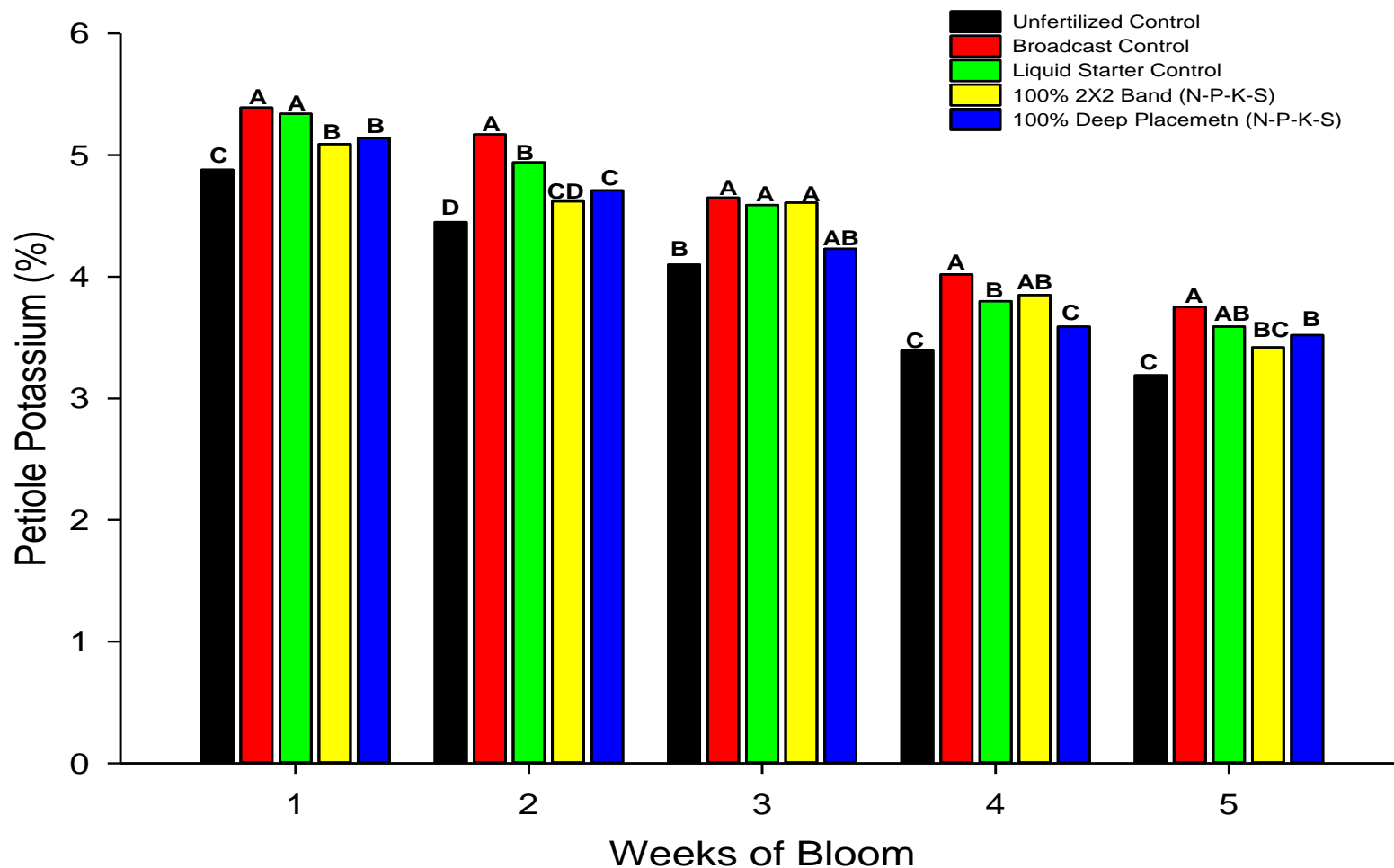


Petiole Potassium Sufficiency Range for Cotton

“California” Petiole K Interpretation (Bassett and MacKenzie 1976)

<i>Time of sampling</i>	<i>% Potassium (K)</i>
Week of first bloom	4.0–5.5
Bloom + 4 weeks	3.0–4.0
Bloom + 6 weeks	1.5–2.5
Bloom + 8 weeks	1.0–2.0

Petiole Potassium Concentrations During Bloom Period for All Sites 2013-2015



Leaf Tissue Nutrient Concentrations at TAREC from 2013-2015

Nutrient Systems	Leaf Nutrient Concentrations							
	1 st †				5 th			
	N	P	K	S	N	P	K	S
	----- % -----							
Unfertilized Control	3.41 c*	0.34	1.57	0.54 b	2.76 c	0.26	1.29	0.71
Broadcast Agronomic Control	4.32 a	0.32	1.77	0.76 a	3.49 ab	0.24	1.47	0.77
Liquid Starter Control	4.23 a	0.32	1.67	0.68 a	3.45 ab	0.23	1.44	0.75
100% 2X2 N-P-K-S	4.29 a	0.31	1.76	0.77 a	3.46 ab	0.23	1.44	0.78
100% Deep Placement N-P-K-S	4.16 b	0.31	1.66	0.76 a	3.56 a	0.23	1.47	0.77

*Values with the same letter are not significantly different at $\alpha = 0.05$

† Week of bloom

<i>Macronutrients (%)</i>						
	N	P	K	Ca	Mg	S
early bloom	3.0–4.5	0.2–0.65	1.5–3.0	2.0–3.5	0.3–0.9	0.25–0.8
late bloom / maturity	3.0–4.5	0.15–0.6	0.75–2.5	2.0–4.0	0.3–0.9	0.3–0.9

Adapted from Mitchell and Baker (2009)

Leaf Tissue Nutrient Concentrations at Lewiston from 2013-2015

Nutrient Systems	Leaf Nutrient Concentrations							
	1 st ‡				5 th			
	N	P	K	S	N	P	K	S
	----- % -----							
Unfertilized Control	4.42	0.29 a*	1.09	0.60 c	3.95	0.28	1.26	0.71 c
Broadcast Agronomic Control	4.26	0.28 ab	1.12	0.69 b	3.92	0.29	1.29	0.79 b
Liquid Starter Control	4.31	0.26 c	1.09	0.67 bc	3.93	0.28	1.27	0.80 b
100% 2X2 N-P-K-S	4.40	0.27 bc	1.22	0.85 a	3.91	0.29	1.31	0.89 a
100% Deep Placement N-P-K-S	4.28	0.29 a	1.17	0.75 b	3.87	0.28	1.25	0.82 b

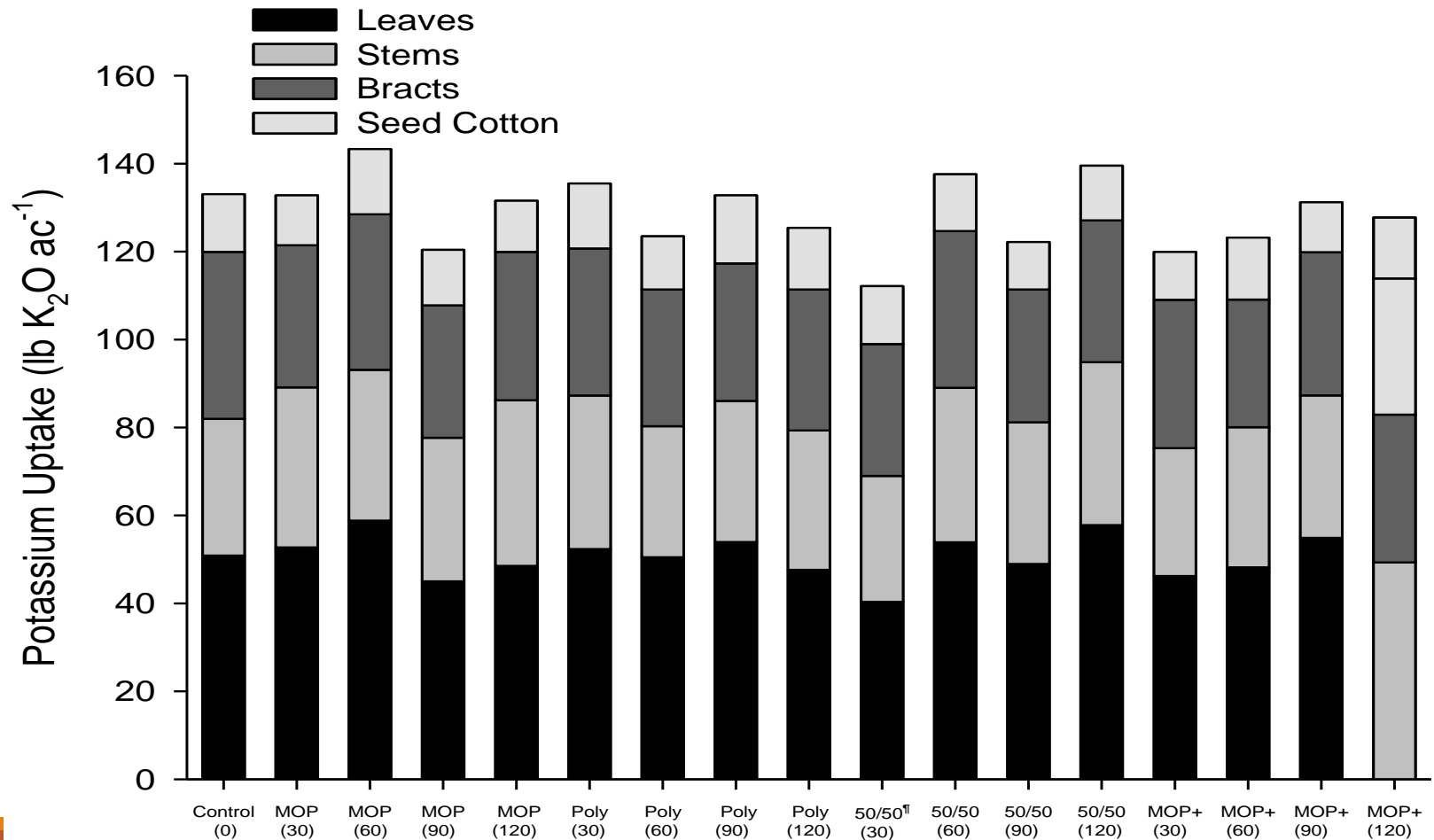
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‡ Week of bloom

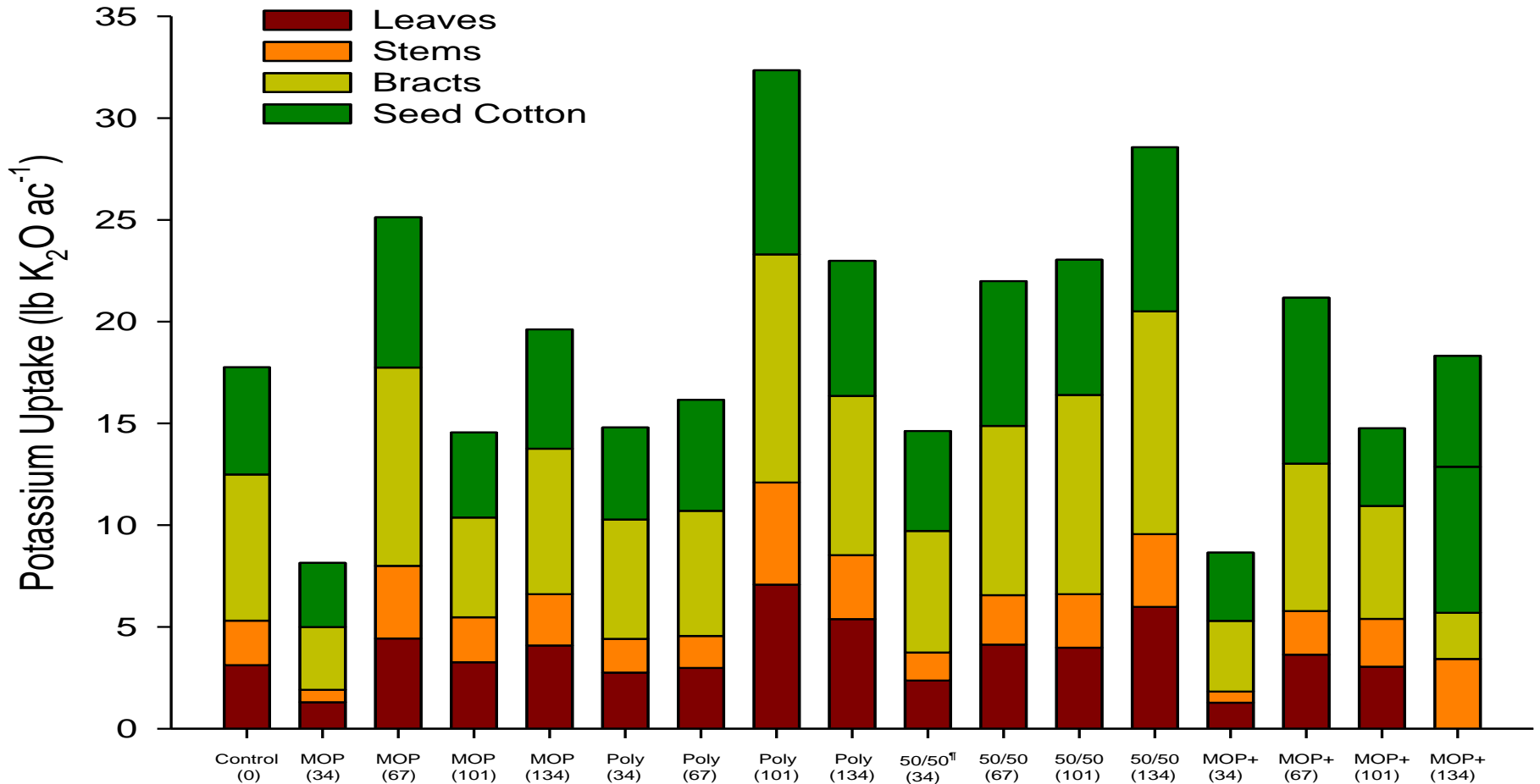
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early bloom	3.0–4.5	0.2–0.65	1.5–3.0	2.0–3.5	0.3–0.9	0.25–0.8
late bloom / maturity	3.0–4.5	0.15–0.6	0.75–2.5	2.0–4.0	0.3–0.9	0.3–0.9

The following sufficiency ranges were compiled from several sources (Anderson and others 1971; Hodges and Hadden 1992; Mullins and Burmester 1990, 1992, 1993; Plank 1988; Reeves and Mullins 1993; Sabbe and Mackenzie 1973; Sabbe and others 1972).

2015 Potassium Uptake at Cutout (85 days after planting)

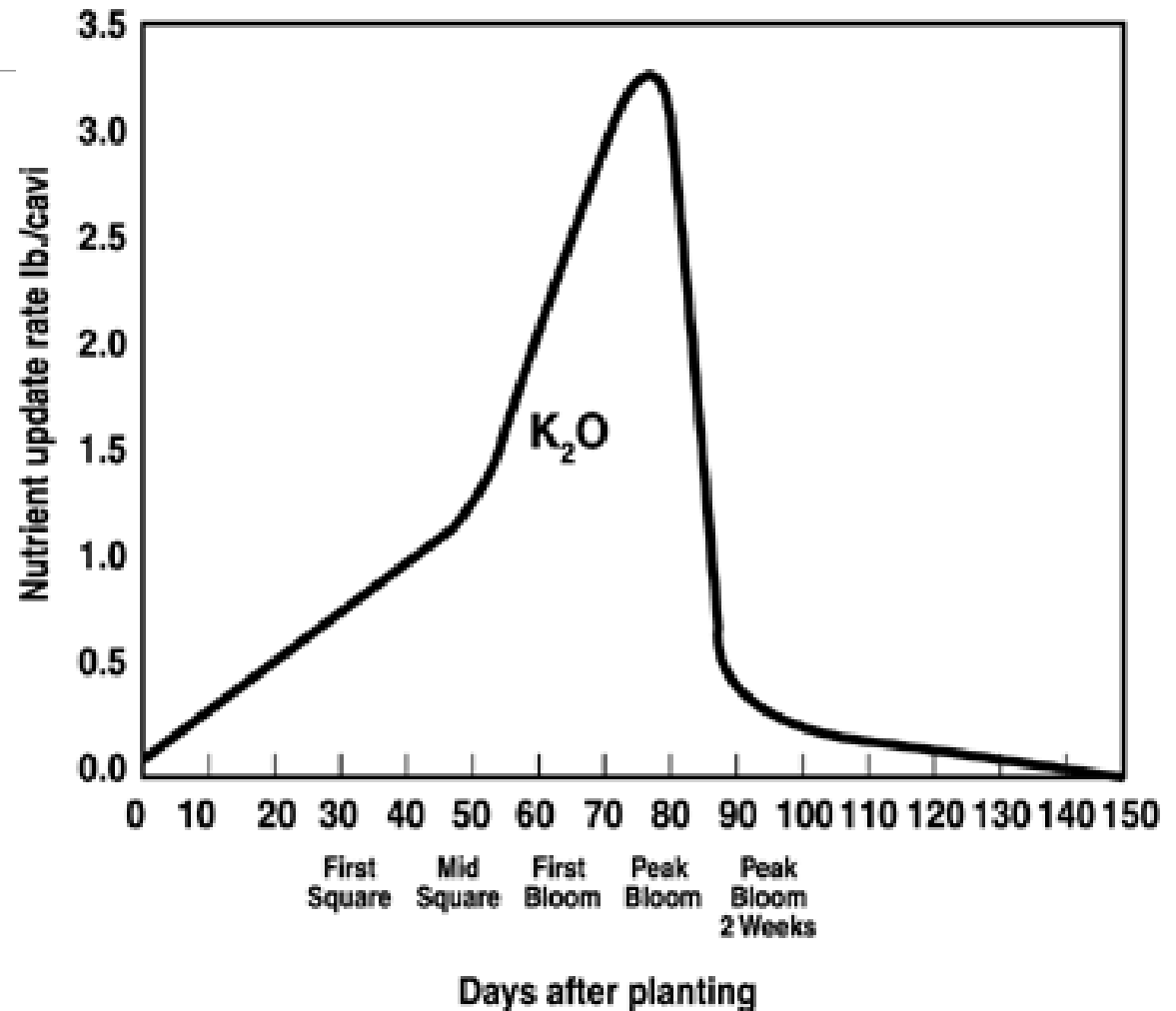


2016 Potassium Uptake at Cutout (85 days after planting)



Potassium Uptake in Cotton

- If we apply 10 lbs/acre 13-0-44 (potassium nitrate) as a foliar spray in 15 gal mix/acre
- 4.4 lb. K_2O / acre
- The max uptake rate is 3.2 lb. K_2O /acre
- You have applied 1.5 days of K demand... assuming 100% efficiency of your application



Courtesy of Mullins and Burmester (1990)

Let's look at this another way...

Say we want to use 0-0-25-17S to foliar feed...

- 1 Qt/acre = 3 lbs K_2O /acre

Soil test K = 180 lbs K_2O /acre (Medium)

Assume that 75% of K uptake is supplied by soil

- 200 lbs K_2O uptake for 1,500 lbs lint per acre

Need and additional 50 lbs K_2O /acre

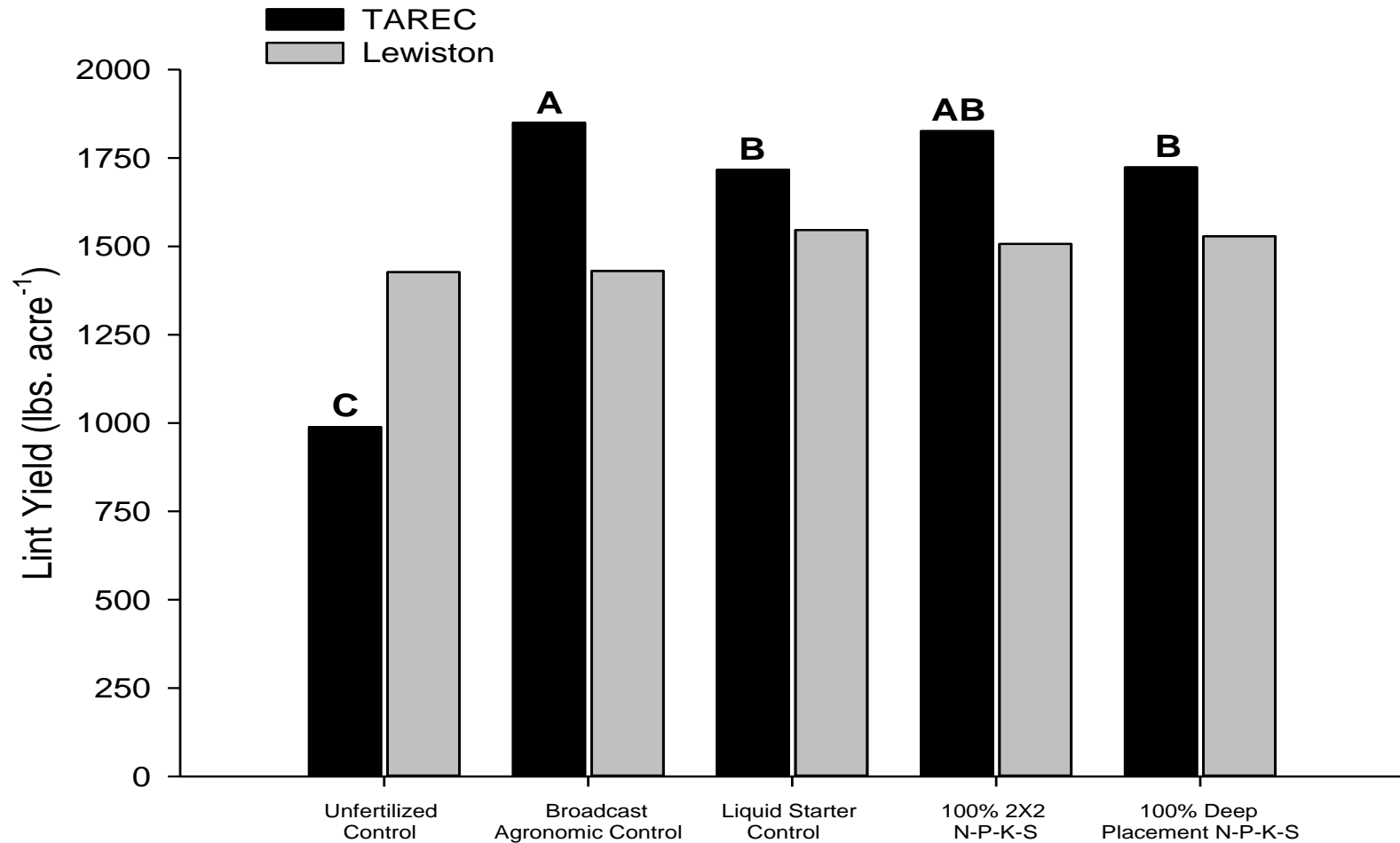
50 lbs K_2O /acre / 3 lbs K_2O /acre applied per trip

17 trips to supply the needed K

If you foliar feed once a week.... That's 3-4 months of applications

THIS IS ASSUMING ALMOST COMPLETE DEPLETION OF SOIL TEST K AND 100% EFFICIENCY IN FOLIAR FEEDING OF K

Lint Yield and Nutrient Management Systems from 2013-2015 (Phytogen 499)

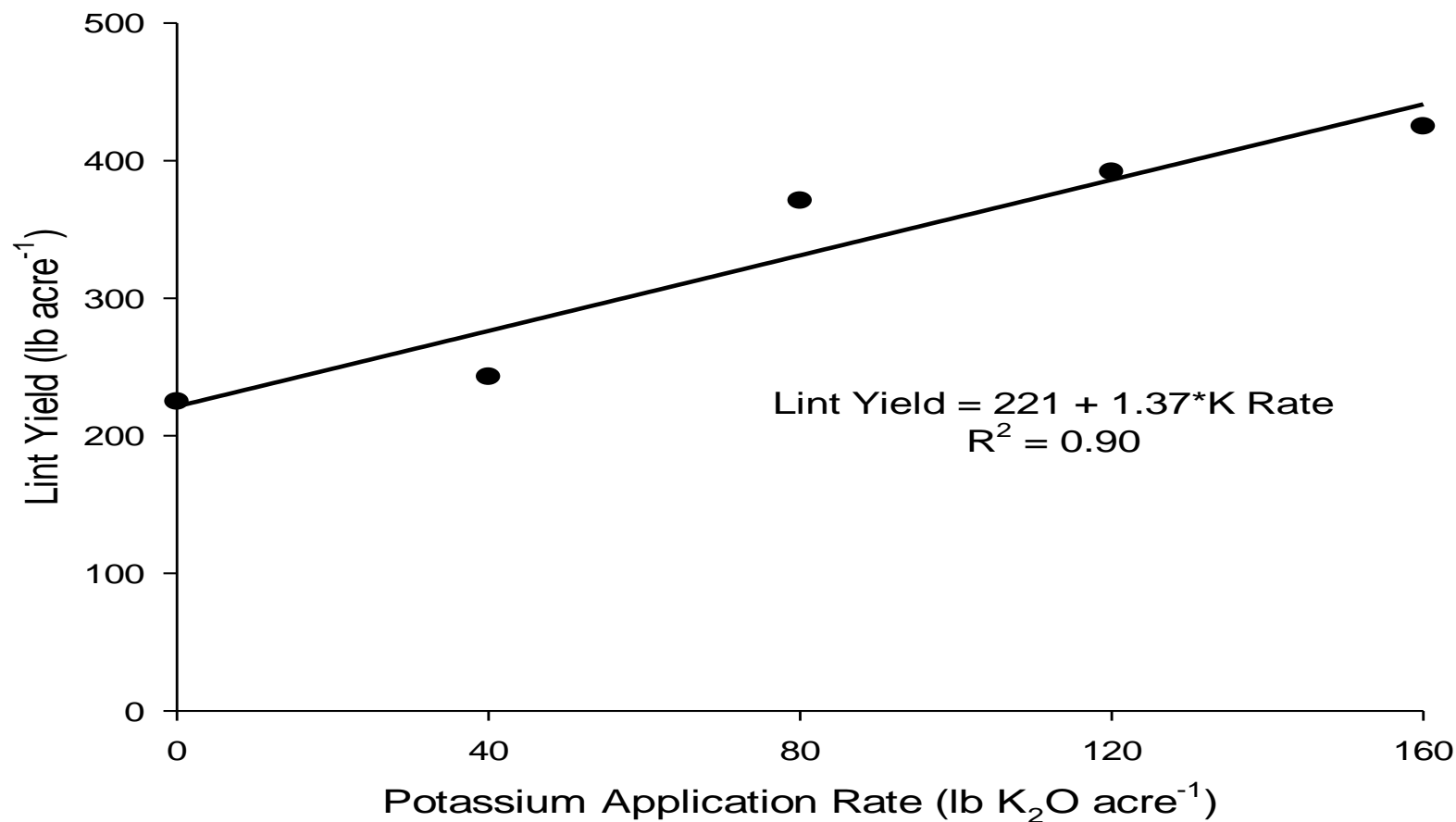


Potassium Rate Response in 2016 (Deltapine 1522)

Potassium Rate lb K ₂ Oacre ⁻¹	Leaf K (%)		Lint Turnout	Lint Yield
	1 st	5 th	lb lint lb ⁻¹ seed cotton	lb ac ⁻¹
0	0.83	0.23 c*	0.45	96 c
40	0.97	0.33 bc	0.45	277 b
80	0.94	0.44 b	0.45	441 a
120	1.15	0.73 a	0.46	351 ab
160	1.16	0.75 a	0.44	395 ab

* Values with the same letter are not significantly different at alpha = 0.05.

Potassium Rate Response in 2016 (Phytogen 333)



Summary of Potassium Research

- Responses to K rate on M+ to VH soil tests have been rare...
 - Especially when receiving adequate rainfall
- In 2016 the low soil test K site was responsive to K rates up to 60 lb K20 per acre
 - Yields were severely limited due to weather conditions
- Leaf K concentrations were not responsive to K application rates
 - Petiole K was sensitive to K source and nutrient management system



Summary of Potassium Research (cont.)

- Leaf K and petiole K concentrations decreased from the 1st to 5th weeks of bloom
- Foliar feeding of K is not practical as the sole source of providing K
- The broadcast system produced higher petiole K concentrations and is a faster and cheaper method of applying K
 - No differences in lint yield and K placement have been documented
- No timing of application differences were observed in 2016, but only 1 year of data is available
- More to come on K demand and changes in soil test K over time...

