Potassium Management in Cotton

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TEXAS A&M AGRILIFE RESEARCH

The Issues

- Increased reports of K deficiency symptoms across the Cotton Belt
- Soil analysis often indicates sufficient K; however, uptake can be low – potential later season K deficiency

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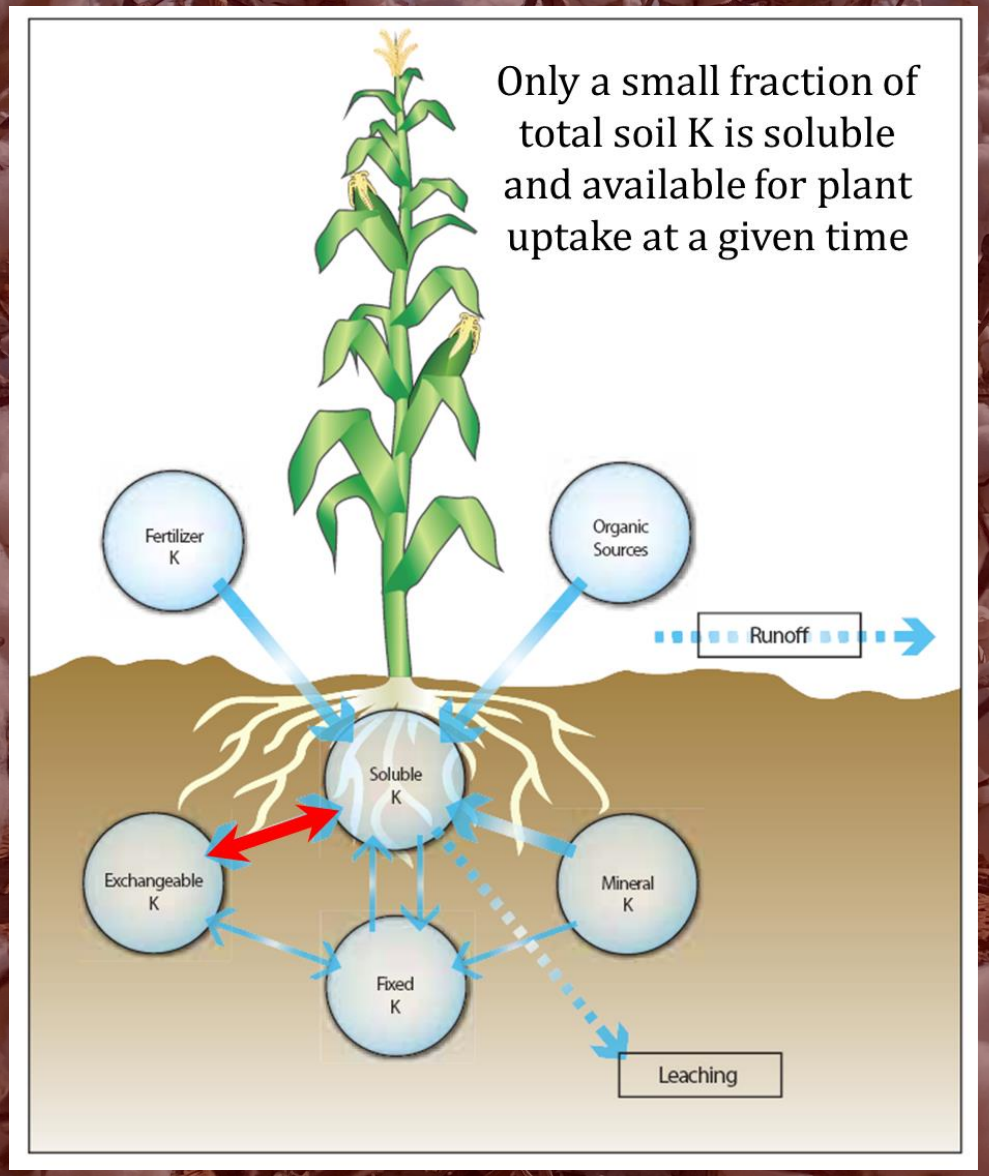
K availability and uptake complicated by many interacting factors

- Soil
- Plant factors

- Solution
  - Fertilizer and management practices

Texas A&M AgriLife Research



Soil Factors Affecting K Availability

- Quantity of available K
  - Extraction method and critical level
- Cation exchange capacity
- Nonexchangeable or slowly available K
- K fixation potential
- Subsoil K (mining at depth)
- Soil temperature and moisture
- Soil tilth

Year	Location	Mehlich-3 K concentrations at different soil depths								
		0-6"		6-12"		12-24"		*P > F*	0-12"	0-24"
		mg K kg^{-1} soil							mg K kg^{-1} soil	
2016	VA	30	a	40	a	37	a	0.748	35	36
2016	**AL**	**39**	**b**	**56**	**a**	**44**	**b**	**0.002**	**48**	**46**
2017	AL	56	a	54	a	67	a	0.153	55	59
2015	AL	61		64		82			63	69
2017	VA	61	a	47	a	61	a	0.184	54	56
2017	NC	73	a	69	a	63	a	0.344	71	68
2016	WM	83	a	77	a	86	a	0.133	80	82
2016	**NC**	**86**	**a**	**66**	**b**	**57**	**b**	**0.007**	**76**	**70**
2015	VA	92	a	99	a	93	a	0.393	95	94
2015	WM	96	a	96	a	98	a	0.694	96	97
2017	**MS**	**100**	**a**	**90**	**b**	**89**	**b**	**0.071**	**95**	**93**
2017	**LA**	**152**	**a**	**129**	**b**	**92**	**c**	**0.003**	**140**	**124**
2017	**AR**	**158**	**b**	**167**	**b**	**212**	**a**	**0.005**	**163**	**179**
2015	**LA**	**159**	**a**	**144**	**b**	**129**	**c**	**0.0004**	**151**	**144**
2016	**AR**	**168**	**ab**	**153**	**b**	**174**	**a**	**0.099**	**160**	**165**
2015	**AR**	**174**	**a**	**112**	**b**	**99**	**c**	**<.0001**	**143**	**128**
2016	**LA**	**177**	**a**	**139**	**b**	**92**	**c**	**0.0004**	**158**	**136**

AL, AR, LA, & MS

- 39 ppm – 177 ppm K @ 0-6”
- No yield response even with soil K < 125 ppm

Loc.	Soil	Broadcast K, lb K_2O acre^{-1}					*P > F*	LSD	Injected K, lb K_2O acre^{-1}					*P > F*	LSD
	K	0	40	80	120	160			0	40	80	120	160		
	mg kg^{-1}	lb acre^{-1}							lb acre^{-1}						
VA	30	78	236	427	406	321	**0.002**	**268**	114	319	456	296	469	**0.004**	**302**
AL	39	1123	1120	1093	1166	1147	0.888	ns	1130	1176	1129	1159	1112	0.652	ns
AL	56	1777	1569	1609	1526	1552	**0.034**	**347**	1657	1386	1489	1583	1499	0.428	ns
AL	61	1382	1500	1407	1530	1334	0.630	ns	1393	1429	1453	1536	1619	0.174	ns
VA	61	1342	1633	1970	1868	1597	**0.005**	**486**	1806	1932	1588	1638	1691	0.541	ns
NC	73	1411	1497	1426	1475	1478	0.515	ns	1344	1425	1518	1430	1533	**0.067**	**257**
WM	83	219	246	218	306	317	**0.094**	**112**	185	209	257	244	309	**0.031**	**111**
NC	86	661	590	648	743	636	0.924	ns	627	654	655	609	625	0.956	ns
VA	92	1237	1216	1228	1220	1235	0.850	ns	1260	1210	1173	1224	1283	0.599	ns
WM	96	318	343	416	385	392	**0.032**	**107**	298	377	434	363	421	**0.001**	**98**
MS	100	600	506	507	528	537	0.228	ns	543	545	530	561	512	0.926	ns

Nutrient	% increase (from the 1990s report to current report)	
	Total uptake	*Lint yield/unit of nutrient taken up*
N	**36%**	**66%**
P	**12%**	**88%**
K	**26%**	**64%**
S	**48%**	**30%**
Ca	**44%**	**44%**
Mg	**47%**	**40%**

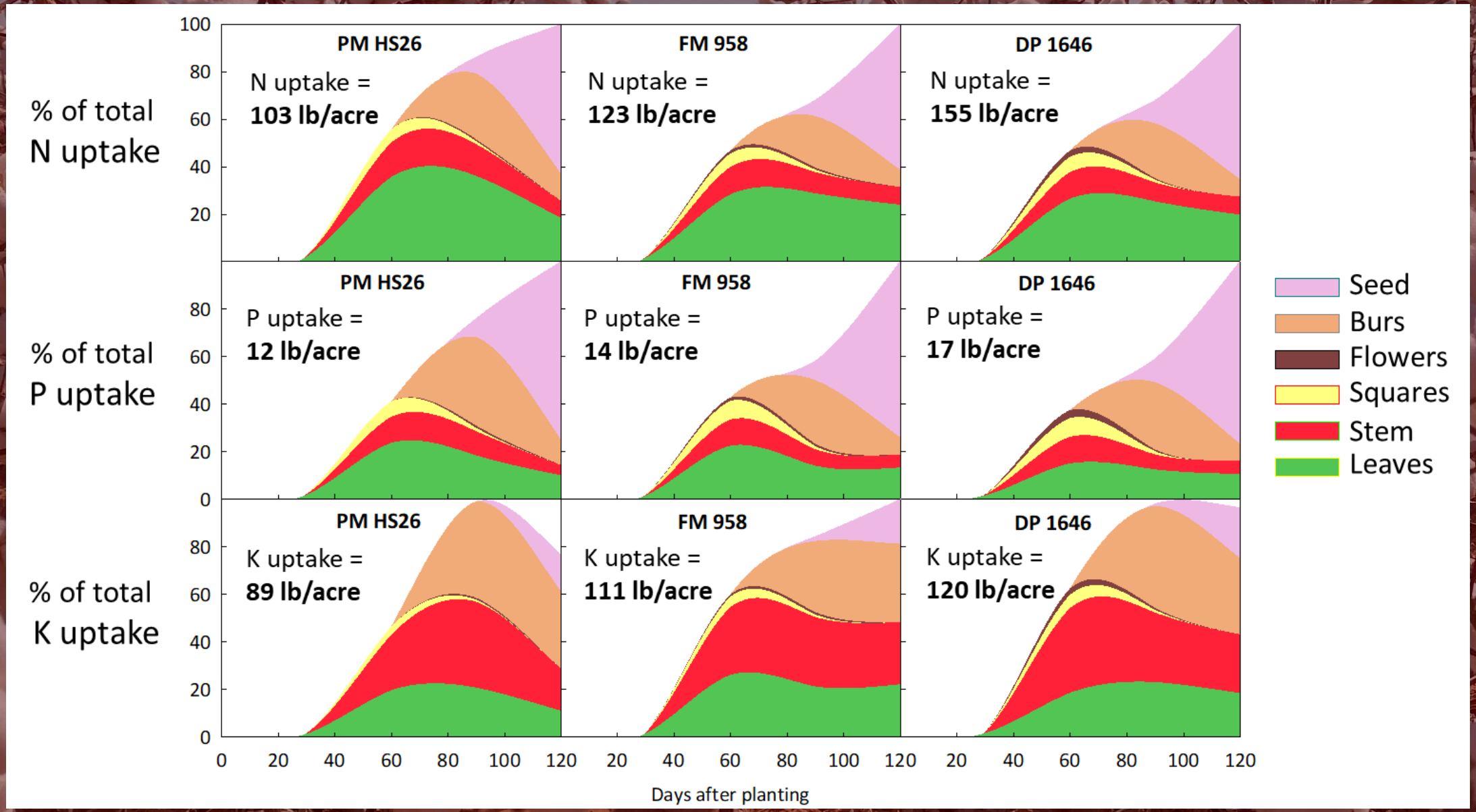
Note: current report based on the performance of DP 1646 under favorable growing environment

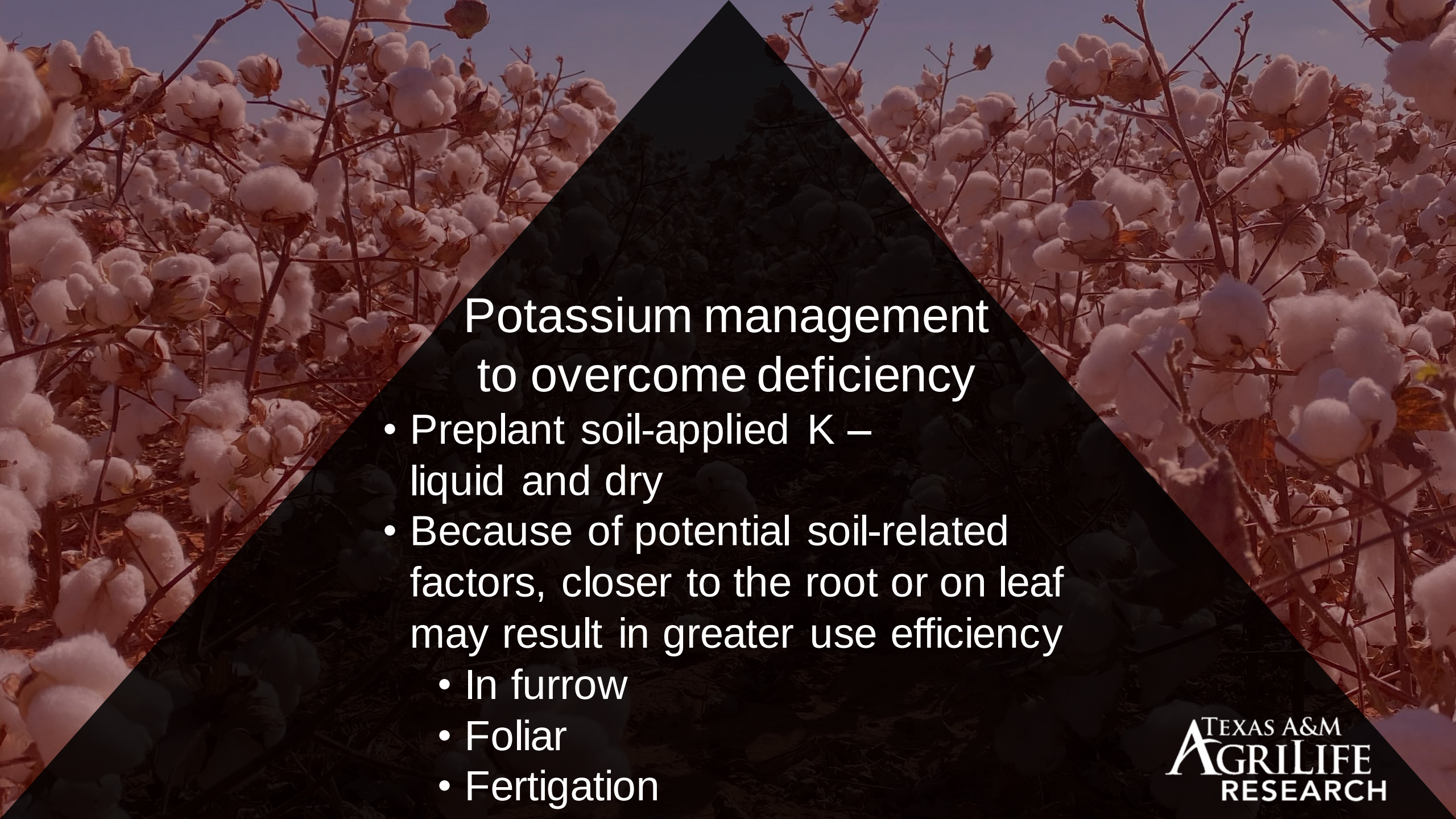
Modern Cotton Varieties

- Improved management strategies
- Better efficiency in using and remobilizing macronutrients
- Faster fruit production

- Increased yield potential (*increased number of fibers per ovule, increased number of seeds per boll, increased number of bolls per plant, increased boll weight*)

Fruit of modern cultivars are more nutrient-dense than previously reported





Potassium management to overcome deficiency

- Preplant soil-applied K – liquid and dry
- Because of potential soil-related factors, closer to the root or on leaf may result in greater use efficiency
  - In furrow
  - Foliar
  - Fertigation

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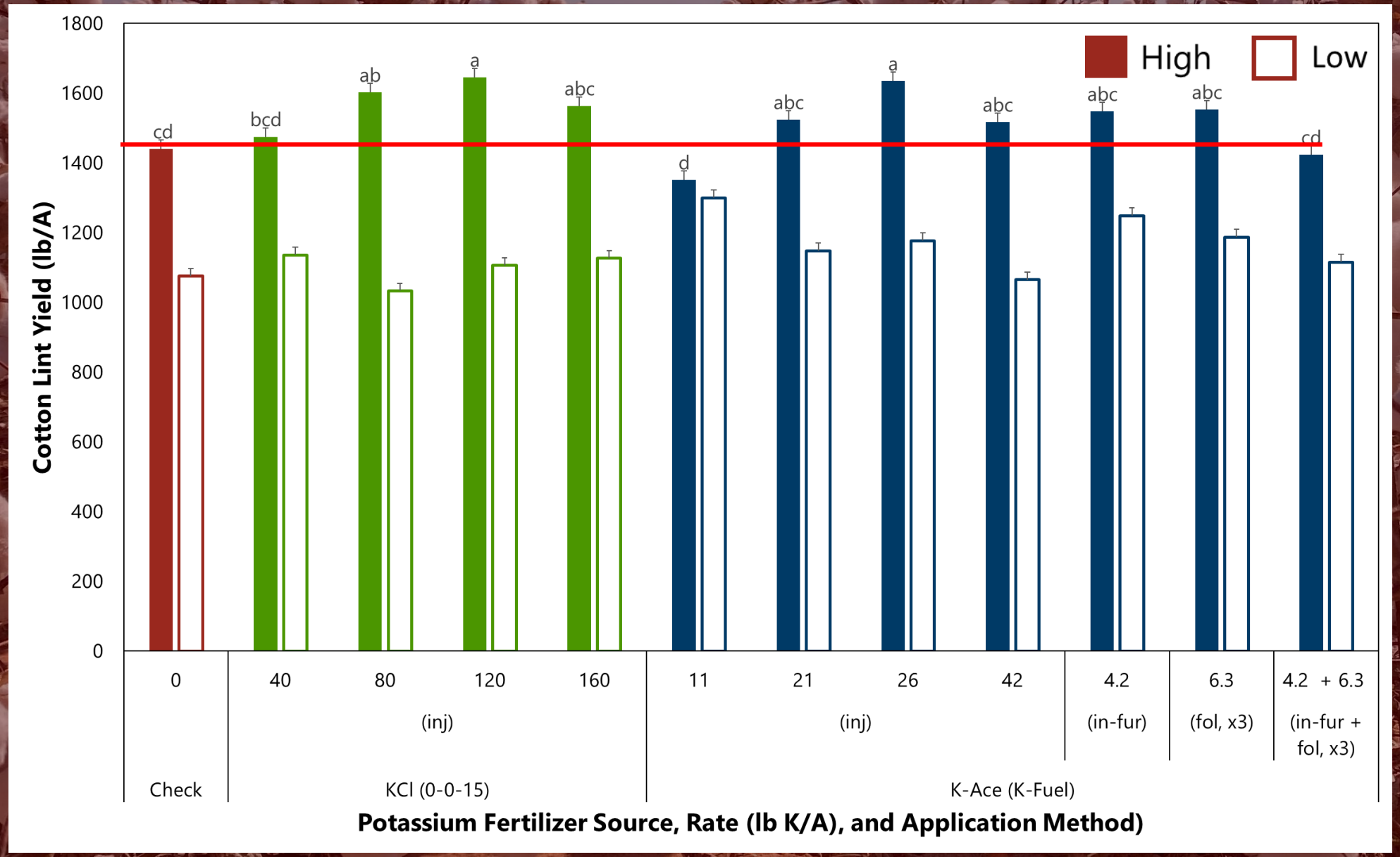
Soil-applied vs In-furrow vs Foliar

Lubbock County, 2017



Soil-applied vs In-furrow vs Foliar

Lubbock County, 2017

2017 Texas A&M Extension Cotton Trial – New Deal, TX

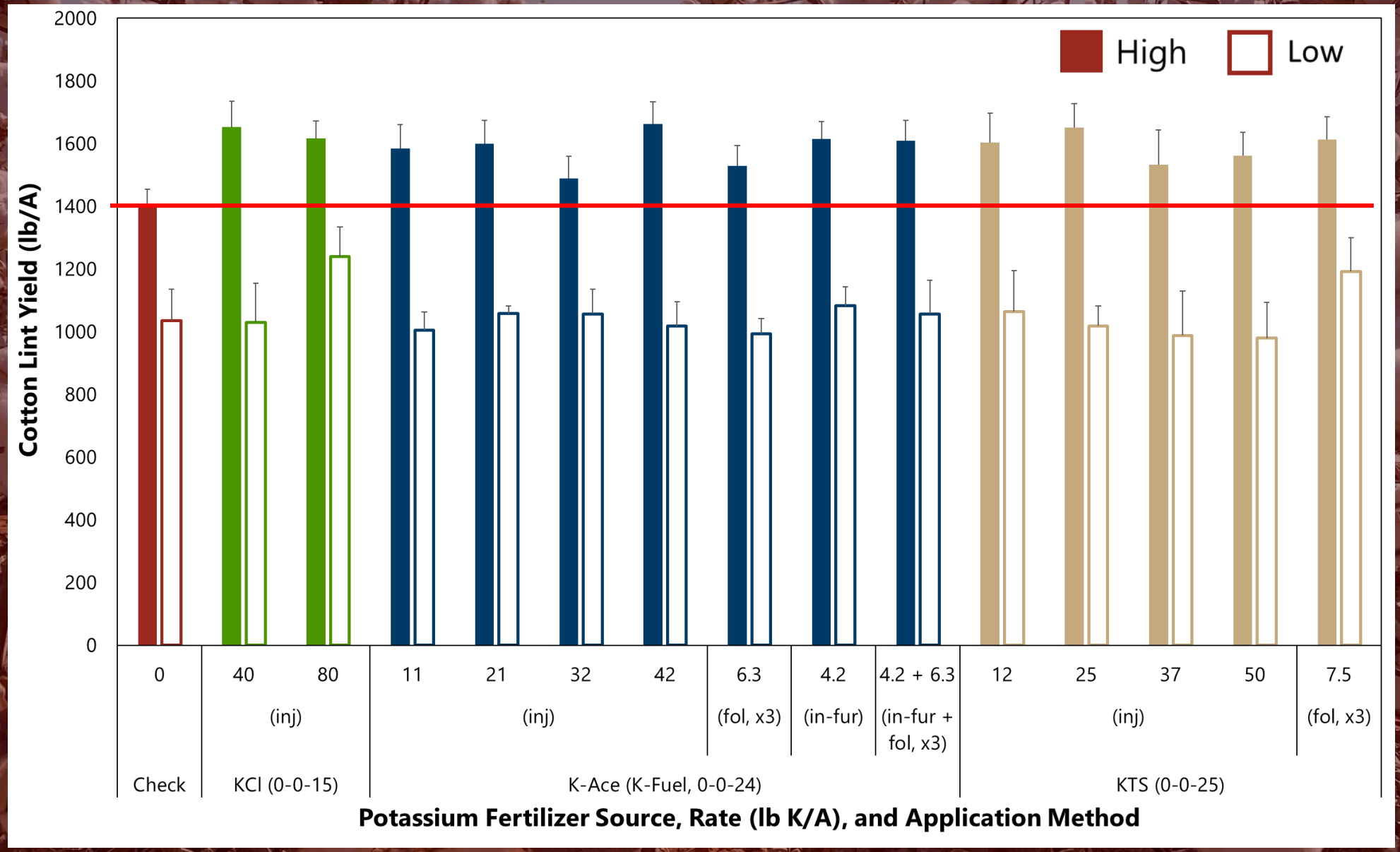
Effect of potassium fertility on lint yield & nutrient use efficiency

Treatment	Application method	Rate (gal/ac)	Pounds K_2O/acre	Lint yield (lbs/ac)	NUE over check (yield/lb of K_2O)
	Limited Irrigation (6.0" water)				
Untreated check		0	0	1075	0.00
KCl (0-0-15)	Injection	32.45 gal	48.2	1136	1.27
KCl (0-0-15)	Injection	97.37 gal	144.6	1106	0.21
NACHURS K-fuel (0-0-24)	injection	5.19 gal	13.3	1300	16.92
NACHURS K-fuel (0-0-24)	injection	12.27 gal	31.3	1177	3.26
★ NACHURS K-fuel (0-0-24)	In-furrow	1.89 gal	4.8	1249	36.25
NACHURS K-fuel (0-0-24)	foliar	2.83 gal	7.2	1187	15.56

KCl 0-0-15 = 9.9 lbs/gal; NACHURS K-fuel = 10.65 lbs/gal.

Soil-applied vs In-furrow vs Foliar

Lubbock County, 2018



Foliar K Fertilization in Cotton

- Some reports suggest foliar applications of K can have potential yield benefits (Oosterhuis, Bednarz, and others)
- However, **successful** fertilizer management starts with a **soil-based program** regardless of nutrient
- Risks/Cons of foliar fertilizers:
  - Response is often temporary and inconsistent
  - Risk of phytotoxicity
  - Efficacy dependent on crop condition, plant water status, and environment
  - Can be expensive $$$ (only supply plant with small amount of nutrient)

Potassium Enigma

- Inconsistent response across the Cotton Belt to added K fertilizer
  - 36% of sites positively responded to added K where soil tests were less than 125 ppm (0-6” depth with Mehlich III)
  - Positive response documented for sites with > 125 ppm K
  - Is this a soil test calibration issue??
- Limited response to foliar applications when not combined with soil-applied or in-furrow (at planting) applications
- Greatest ROI with in-furrow applied K fertilizer – be careful with source
- In high-yielding environments, 40 lb/A soil-applied K_2O and 5-10 lb/A in-furrow applied K_2O reduces potential for deficiency

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Cotton Incorporated

Fluid Fertilizer Foundation

IPNI International Plant Nutrition Institute