Foliar K: Rates and Sources in New Generation Cotton Cultivars.

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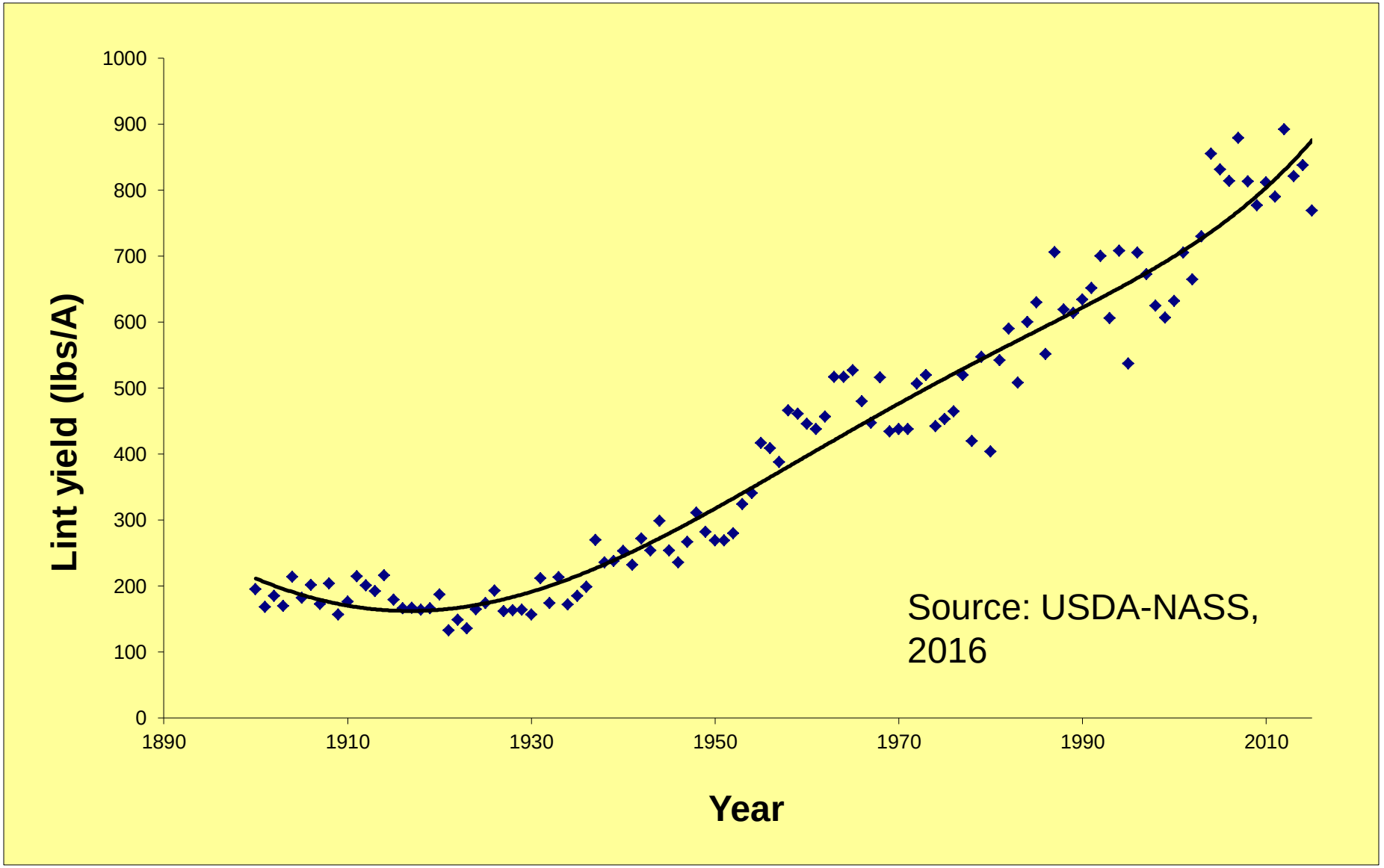
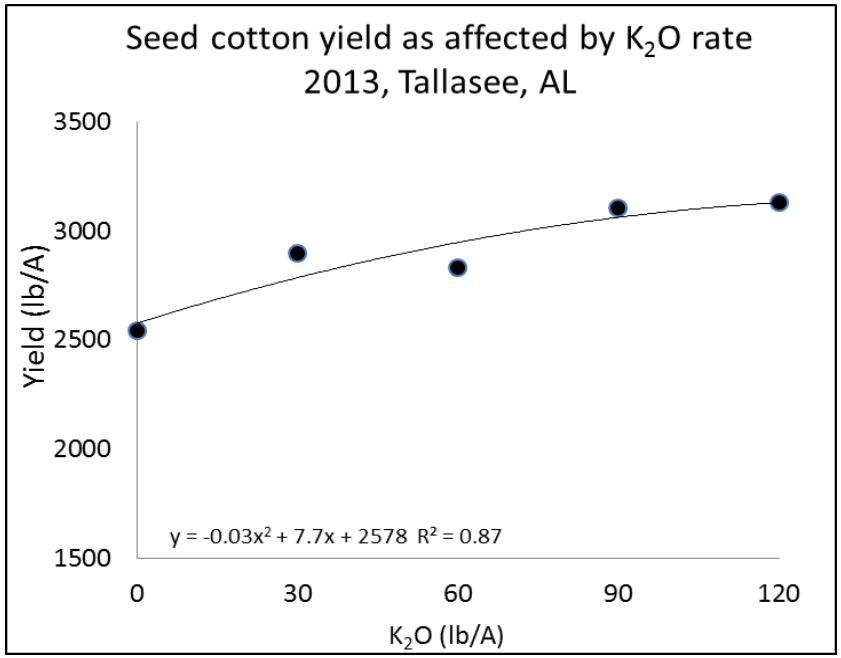
Rationale


Lint yield (lbs/A)
1000
900
800
700
600
500
400
300
200
100
0
1890
1910
1930
1950
1970
1990
2010
Year
Source: USDA-NASS, 2016

Rationale

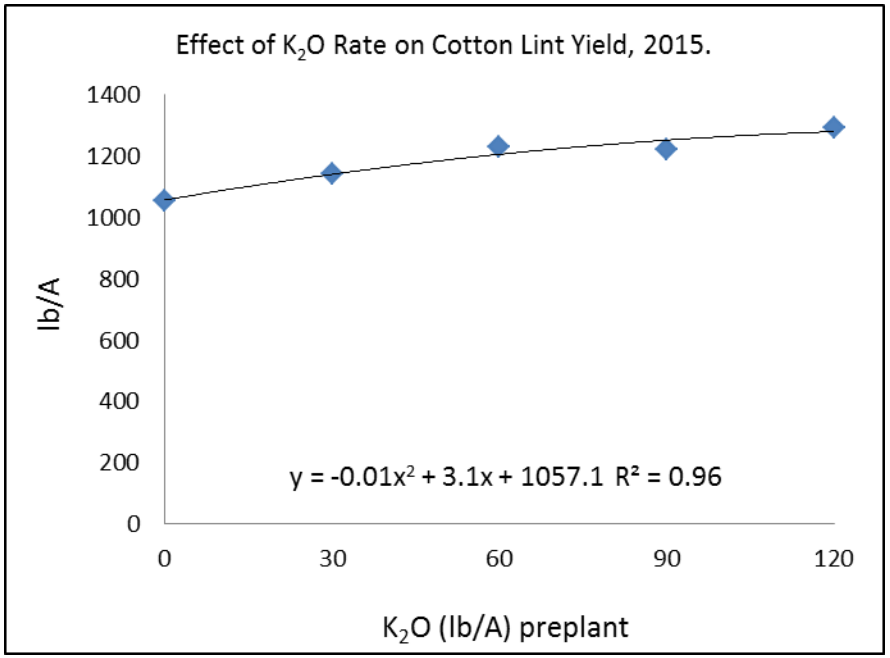
- K deficiencies may be observed in fields that do not test low in soil K (Cassman et al., 1989).
- Foliar K may (Pettigrew et al., 1996; Howard et al 1998) or may not (Coker et al., 2009) produce increases in lint yield (and/or quality).
- The impact of foliar K is affected by soil K levels and soil water (Cassman et al., 1989).
- New and emerging K sources for cotton need further study (Oosterhuis and Howard, 2008).
- Are we seeing differences in K use by high performing cultivars?

Soil-Applied K



Initial soil-test K: 126 lb/A

Seed cotton, 2013



Initial soil-test K: 76 lb/A

Lint, 2015

We are seeing responses to soil-applied K at rates above those recommended by soil test. Significant, but slight, responses in 3 years of trials (trials in 2013, 2014 and 2015). K as KCl, all PPI.

So…

- Seeing responses to additional K – PPI.
- What about foliar application of K?
- Wanted to look at K sources and rates.

Cotton – 2 tests in 2015

- Both conducted at the EV Smith Field Crops Unit.
- Test 1 – examined crop response with and without foliar K. One K source. Four cultivars.
- Test 2 – Examined crop response as a function of K rate (3, plus zero) and K source (4). One cultivar.
- 4 replications, no irrigation.
- Each plot was 4 rows wide, 36 inch row spacing.

Basic Methods – Test 1

- Field had an initial soil test value of 62 pounds K/A (Medium).
- Four cotton cultivars: two new generation releases (Phytogen 499 WRF and Deltapine 1050 B2RF) and two older cultivars that were widely used in the past decade (Deltapine 90 and Deltapine 491).
- Treatments consisted of the four cotton cultivars and one foliar K source (Trisert K - 5-0-20, urea, urea triazone and potassium thiosulfate).
- One K rate (40 lbs K_2O/acre in total).
- K applied as four split foliar applications of 10 lbs K_2O bi-weekly beginning 2 weeks after mid-bloom in a 10 gpa spray volume.
- Zero K (foliar) treatments also included.
- Four replications (4 cultivars x 2 foliar K (yes or no) = 8 treatments)
- Cotton planted June 5th 2015 and harvested September 25th 2015.

Basic Methods – Test 2

- Field tested 'Medium' for soil test K (67 lb/A).
- No irrigation.
- Cultivar was Phytogen 499 WRF.
- 4 rows of cotton (36 inch row spacing), four replications of each treatment.
- Four K sources: 1) Trisert K (5-0-20, urea, urea triazone and potassium thiosulfate), 2) potassium nitrate, 3) potassium acetate, and, 4) potassium carbonate.
- Three K rates (8, 16 or 24 lbs K/acre total), applied as four split applications of 2, 4 or 6 lbs K.
- Split K applications at 120, 134, 148 and 162 DAP. A zero K (no foliar K treatment) was also included.
- Treatments were not balanced for the N content in the KNO_3 or Trisert K.

The Cultivars

Characteristics	Cultivar
Newer, high performing, GMO	Phytogen 499
Newer, high performing, GMO	Deltapine 1050
Older (~15 years), Non-GMO	Deltapine 491
Old, Non-GMO	Deltapine 90

Test 1 – Four cultivars, 1 K source/rate Harvested 7-26-15

	Plant part harvested			
	Leaves	Stems	Petioles	Squares
	weight in grams (3 plants per plot)			
Phytogen 499 - N	23 ab	12.6 ab	5.4 ab	0.8 b
Phytogen 499 – Y	21 bc	10.7 ab	4.3 bc	0.8 b
Deltapine 1050 – N	20 bc	10.5 ab	4.1 c	1.0 b
Deltapine 1050 – Y	19 c	9.5 b	3.9 c	0.7 b
Deltapine 90 – N	19 bc	9.7 b	3.8 c	0.9 b
Deltapine 90 – Y	26 a	13.4 a	5.8 a	1.4 a
Deltapine 491 – N	20 bc	20.4 b	3.8 c	0.7 b
Deltapine 491 - Y	22 abc	11.3 ab	4.5 abc	1.5 a

Means separation at alpha = 0.05.

Test 1 – Foliar Burn
Ratings taken 24 hr after foliar spray

	July 22	July 30	Aug 13	Aug 26
	Relative damage (1= none, 5 = complete)			
Phytogen 499	1.5 a	1.8 a	1.5 a	1.0 a
Deltapine 1050	1.3 a	1.8 a	1.2 a	1.1 a
Deltapine 491	1.9 a	1.9 a	1.1 a	1.1 a
Deltapine 90	1.6 a	1.9 a	1.4 a	1.0 a
Yes Foliar	1.5 a	1.9 a	1.4 a	1.1 a
No Foliar	1.6 a	1.7 a	1.3 a	1.0 a

Means separation at alpha = 0.05.

Test 1- Lint Yield and Other Fiber Characteristics

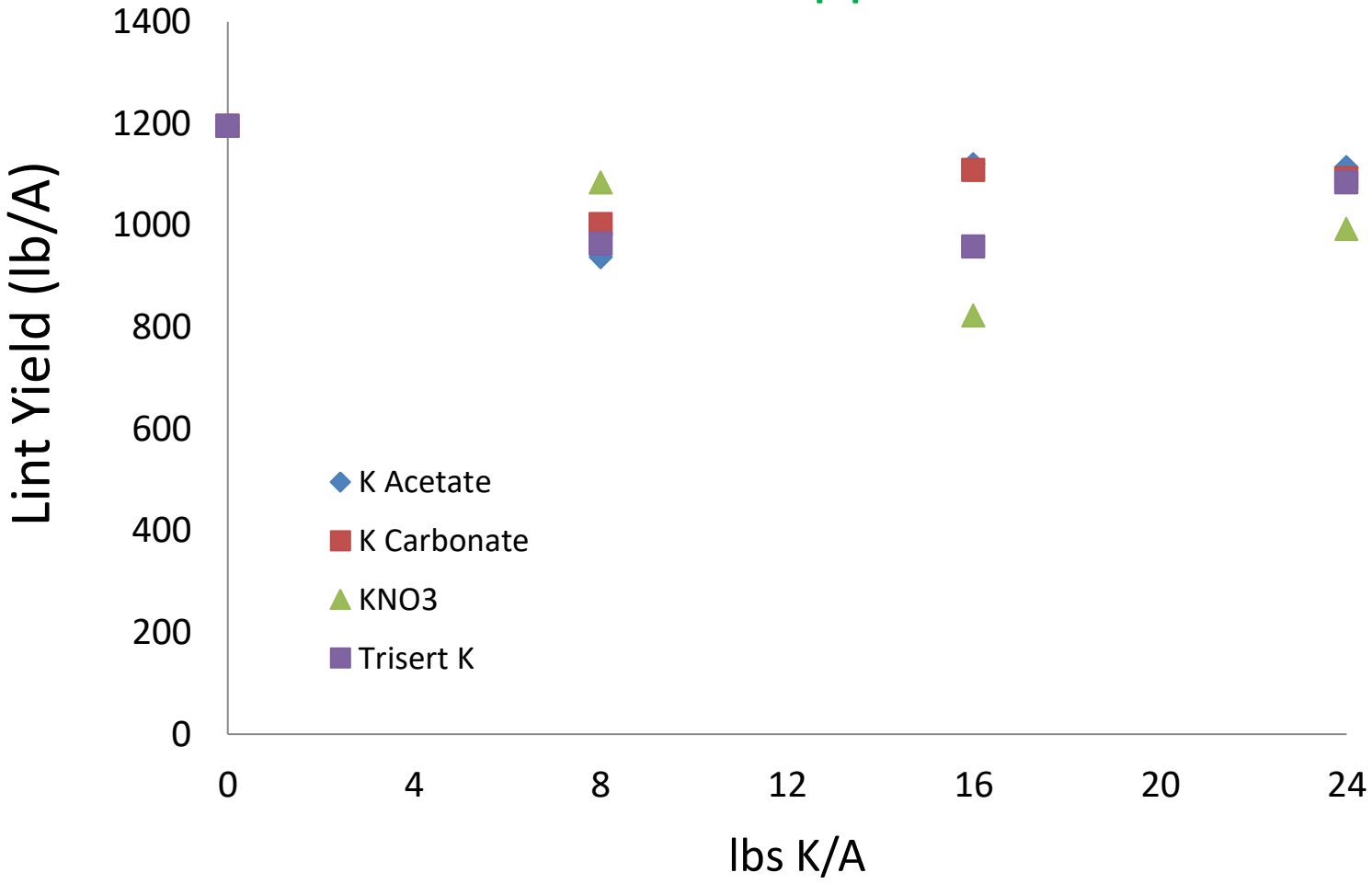
	Lint	Micronaire	Length	Strength	Uniformity
	lb/A		inches	g-tex	%
Phytogen 499	960 a	5.0 ab	0.9 c	34.1 a	84.8 a
Deltapine 1050	881 a	5.2 a	1.1 ab	30.6 b	83.8 b
Deltapine 491	764 b	4.9 ab	1.2 a	34.0 a	82.9 c
Deltapine 90	692 b	4.8 b	1.0 bc	34.1 a	83.9 b
Yes Foliar	806 a	5.0 a	1.11 a	33.3 a	83.8 a
No Foliar	843 a	5.0 a	1.12 a	33.1 a	83.9 a

Means separation at alpha = 0.05.

Test 2 – 1 cultivar, 4 K sources, 3 K rates
Harvested 7-26-15

	Plant part harvested			
K rate (lb K/A)	Leaves	Stems	Petioles	Squares
	weight in grams (3 plants per plot)			
0	33 b	16 b	8.8 b	1.3 b
8	37 ab	18 ab	11.2 ab	1.6 ab
16	36 ab	19 ab	11.0 ab	1.5 ab
24	40 a	20 a	12.4 a	1.9 a
Response	L	L	L	L
Potassium carbonate	38 a	20 a	12.3 a	1.9 a
Potassium acetate	37 a	19 a	11.2 ab	1.8 ab
Potassium nitrate	37 a	19 a	11.3 ab	1.6 abc
Trisert K	33 a	20 a	11.4 ab	1.4 bc
Control	33 a	16 a	8.8 b	1.3 c

Test 2 - Cotton Lint Yield as Affected by K Rate and K Source Alabama, 2015 Foliar K – 4 applications



Foliar burn (1 – 5 scale, 1 = no burn) as affected by K source.
Each date is 24 hr after foliar application.
K Rate x K source interaction was not significant. K Rate was significant.

K Source	Date of Rating			
	July 16	July 30	Aug 13	Aug 26
	Relative burn (1 – 5 scale)			
Control	1.0 b	1.0 b	1.0 a	1.0 a
K Acetate	1.6 a	1.8 a	1.2 a	1.1 a
Trisert K	1.4 a	1.7 a	1.1 a	1.0 a
KNO_3	1.1 b	1.1 b	1.0 a	1.0 a
K Carbonate	1.0 b	1.7 a	1.2 a	1.0 a

alpha = 0.05

Foliar burn (1 – 5 scale, 1 = no burn) as affected by K source. Each date is 24 hr after foliar application.
K Rate x K source interaction was not significant. K Rate was significant.

K Rate	Date of Rating			
lb K/A	July 16	July 30	Aug 13	Aug 26
	Relative burn (1 – 5 scale)			
0	1.0 b	1.0 b	1.0 a	1.0 a
8	1.2 ab	1.4 ab	1.0 a	1.0 a
16	1.4 a	1.8 a	1.1 a	1.0 a
24	1.3 ab	1.5 b	1.2 a	1.1 a
Response	Q	Q	L	NS

Cultivar does Matter

	Cultivar	Lint Yield, 2015
		lb/A
New, high performing →	Phytogen 499	960 a
New, high performing →	Deltapine 1050	836 b
Old (~ 15 years old, Non GMO) →	Deltapine 491	905 b
Old (Non GMO) →	Deltapine 90	692 c

But so far the various cultivars do not seem to be partitioning K differently – FOR YIELD. We do not tend to see significant K Rate x Cultivar interactions, regardless of method of K application.

Soybeans – Initial Explorations

Effect of the main effect of K Rate (applied as KNO_3) on K content of soybean leaves, and K content and dry weight of whole plants. Tennessee Valley Substation, Alabama, 2014. All samples collected at 48 hours after spraying.

K_2O Rate	R2 Spray and harvest (Aug 6th 2014)			
lb/A	leaves	whole plant	whole plant wt	whole plant K
	percent K		grams	
0	2.13 b	2.36 a	67.6 a	1.6 a
2.4	2.15 ab	2.36 a	70.8 a	1.7 a
4.8	2.20 ab	2.38 a	71.1 a	1.7 a
7.2	2.28 a	2.47 a	71.6 a	1.7 a
	R5 Spray and harvest (Aug 22th 2014)			
	leaves	whole plant	whole plant wt	whole plant K
	percent K		grams	
0	1.60 b	2.79 a	99.9 a	2.8 a
2.4	1.62 b	2.58 a	102.0 a	2.6 a
4.8	1.76 a	2.69 a	99.9 a	2.7 a
7.2	1.84 a	2.79 a	100.2 a	2.8 a

Foliar K on Soybeans – 2015 & 16

- Planted in late May 2015 and 2016 with Progeny 5555 soybean at 8 seeds per foot with a 36 inch row spacing.
- Each plot was 25 feet long and 4 rows wide, and there were 4 replications of each treatment.
- Treatments were arranged in a randomized complete block design, with a statistical design of a full factorial of K rate and K source, plus a zero-K control.
- Soil K of 114 - 120 (a ‘High’ test).
- Irrigation applied as needed.
- Specific foliar K treatments applied R2 and R5 growth stages.
- All foliar treatments were applied in a 10 gpa spray volume.

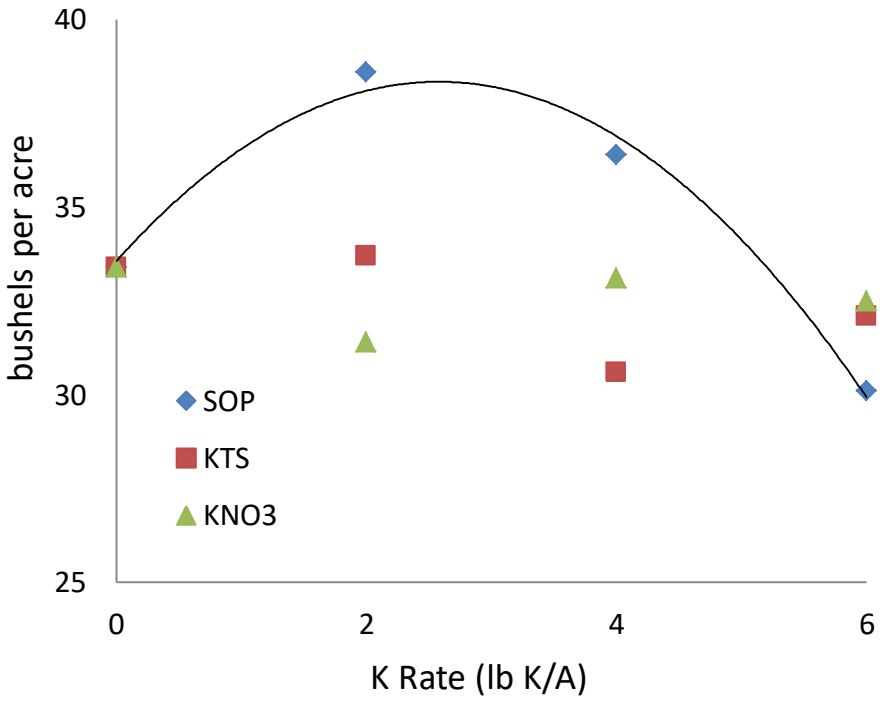
2015 Yield Results – Soybean K Fertility Study

Experimental treatments for Field Study, EVS Field Crops Unit, 2015.

Trt	K Source	K Rate
		lb K A^{-1}
1	Potassium sulfate (SOP)	2
2	Potassium sulfate (SOP)	4
3	Potassium sulfate (SOP)	6
4	Potassium thiosulfate (KTS)	2
5	Potassium thiosulfate (KTS)	4
6	Potassium thiosulfate (KTS)	6
7	Potassium nitrate (KNO_3)	2
8	Potassium nitrate (KNO_3)	4
9	Potassium nitrate (KNO_3)	6
10	No potassium	0

All K applied as foliar (10 gpa) sprays at R2 and R5 (rate above applied at each application).

Yield of soybean as affected by K Rate and K Source, 2015



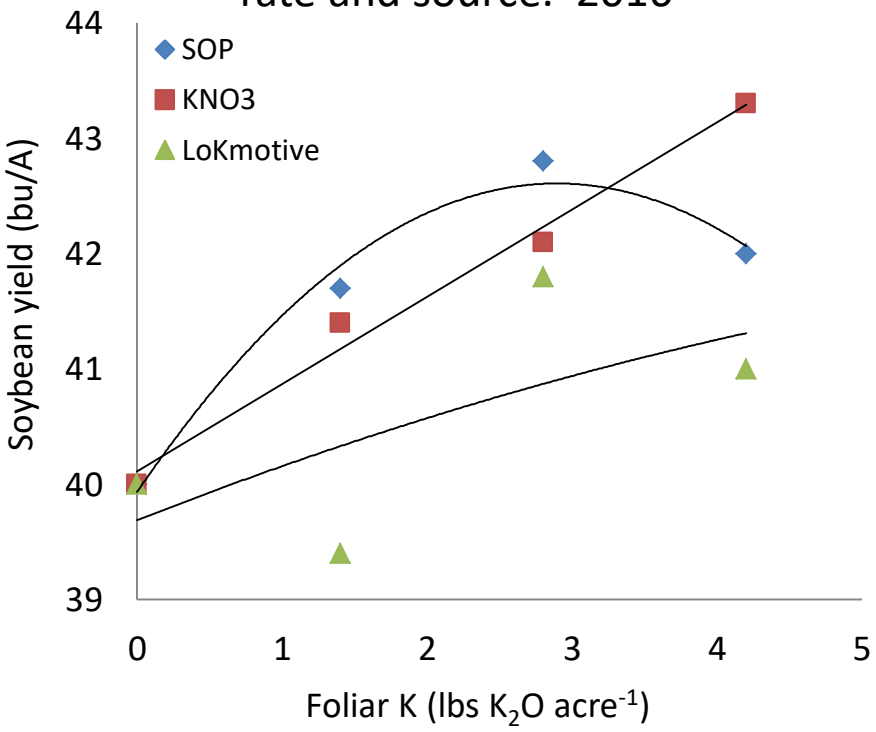
2016 Yield Results – Soybean K Fertility Study

Experimental treatments for Field Study, EVS Field Crops Unit, 2015.

Trt	K Source	K Rate
		lb K_2O A^{-1}
1	Potassium sulfate (SOP)	1.4
2	Potassium sulfate (SOP)	2.8
3	Potassium sulfate (SOP)	4.2
4	LoKomotive (K acetate)	1.4
5	LoKomotive	2.8
6	LoKomotive	4.2
7	Potassium nitrate (KNO_3)	1.4
8	Potassium nitrate (KNO_3)	2.8
9	Potassium nitrate (KNO_3)	4.2
10	No potassium	0

All K applied as foliar (10 gpa) sprays at R2 and R5 (rate above applied at each application).

Soybean yield as affected by foliar K rate and source. 2016



Results so far….

- Over 2 years never a K rate x K source interaction.
- As K rate increased (up to ~ 2.8 to 4.2 lb K_2O A^{-1}) yield often increased (~2-3 bu A^{-1}).
- This happened in soil that were high in soil-test K (> 110 lb K A^{-1}).
- Repeating in 2017 with all the K sources included.