The Impact of Soil Applied Potassium on Cotton Yield and Quality in the Texas Blacklands and Coastal Plain Production Regions

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TEXAS A&M UNIVERSITY

TEXAS A&M AGRILIFE EXTENSION


07/12/2012

Potassium Overview

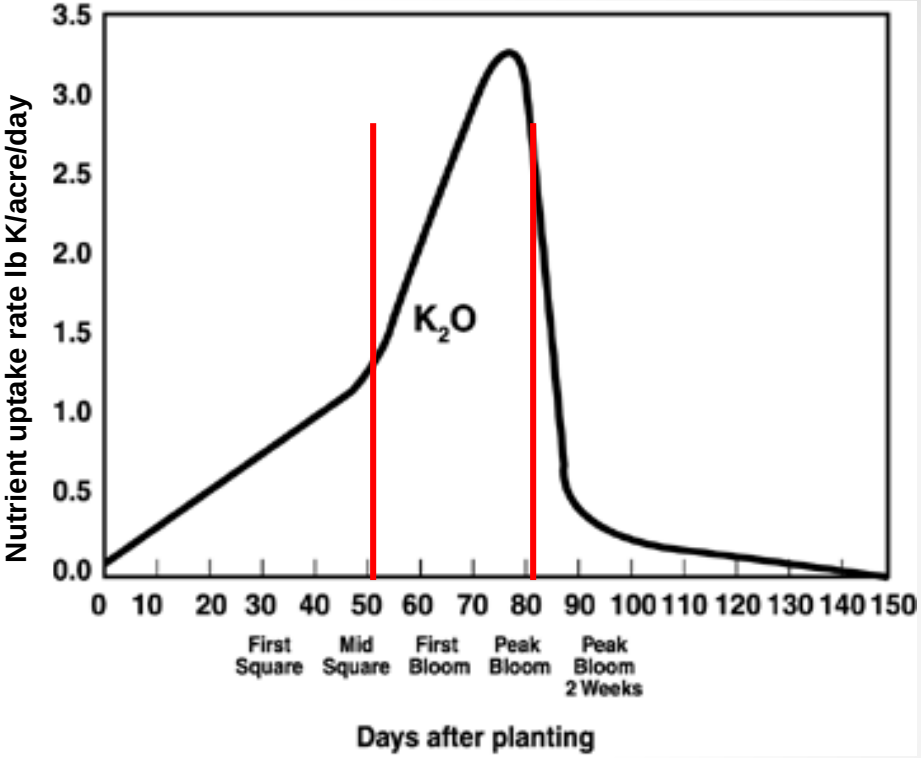
- **Next to N, K is the mineral nutrient required in the largest amount by plants**
- **Adsorbed by plants as K^+ and is not a component of biochemical compounds**
- **K requirement: 2 – 5% of plant dry weight of vegetative parts, fleshy fruits, and tubers**
- **Plays a vital role in physiological and biochemical plant processes**

Many functions of K^+

- **Builds cellulose and reduces lodging**
- **Activates at least 60 enzymes involved in growth**
- **Aids in photosynthesis and fruit formation**
- **Helps translocate sugars and starches**
- **Produces grains rich in starch**
- **Increases protein content of plants**
- **Enhances drought and disease resistance**

Potassium in Cotton

- **Potassium (K) is needed for:**
  - Boll development and filling
  - Fiber development
  - Plant stress mitigation
  - Water relations
  - Reduced diseases
    - Alternaria macrospora (Zhao et. al., 2013)
    - Cercospora gossypina
    - Ascochyta gossypii
- **Peak uptake occurs between**
  - First bloom
  - Peak bloom
- **Estimated 60 lb K/bale**



Mullins and Burmester, 1990

Many functions of K^+

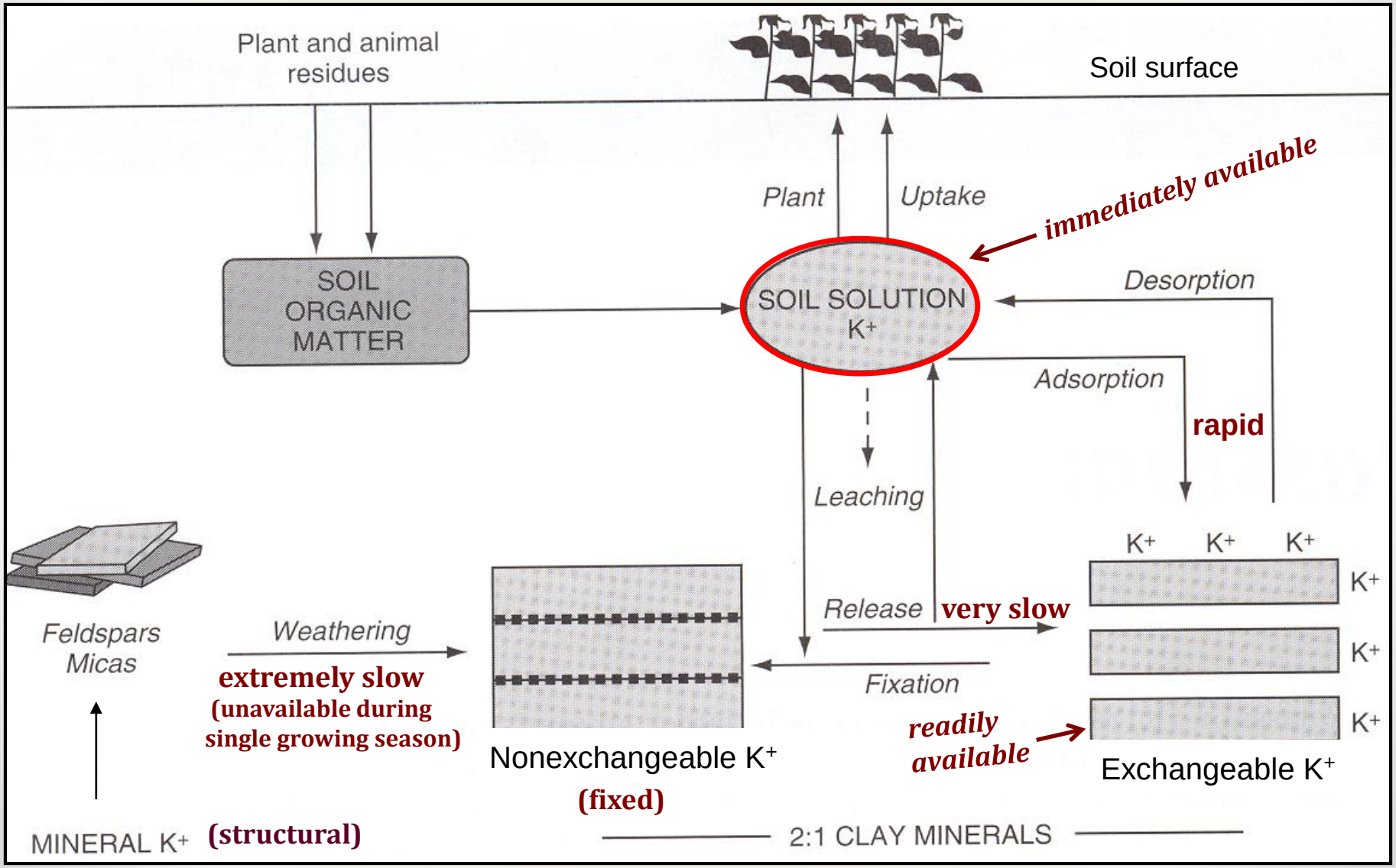
- **Increases root growth thereby improving drought tolerance**

Table 2 Changes in root dry weight and root/shoot ratio of wheat cv Wyalkatchem as a function of soil K supply

Soil K supply (mg kg^{-1})	DAS 28	DAS 49	DAS 63	DAS 77	DAS 91
Root dry weight (g pot^{-1})					
15	0.08 d	0.11 e	0.10 c	0.09 d	0.05 c
22.5	0.26 c	0.99 d	0.96 c	0.93 cd	0.43 c
30	0.37 b	1.83 c	1.82 c	2.06 c	1.30 c
45	0.51 a	3.38 b	6.05 b	8.75 b	5.98 b
75	0.53 a	5.09 a	10.1 a	19.4 a	15.5 a
135	0.60 a	4.86 a	12.1 a	21.3 a	15.4 a

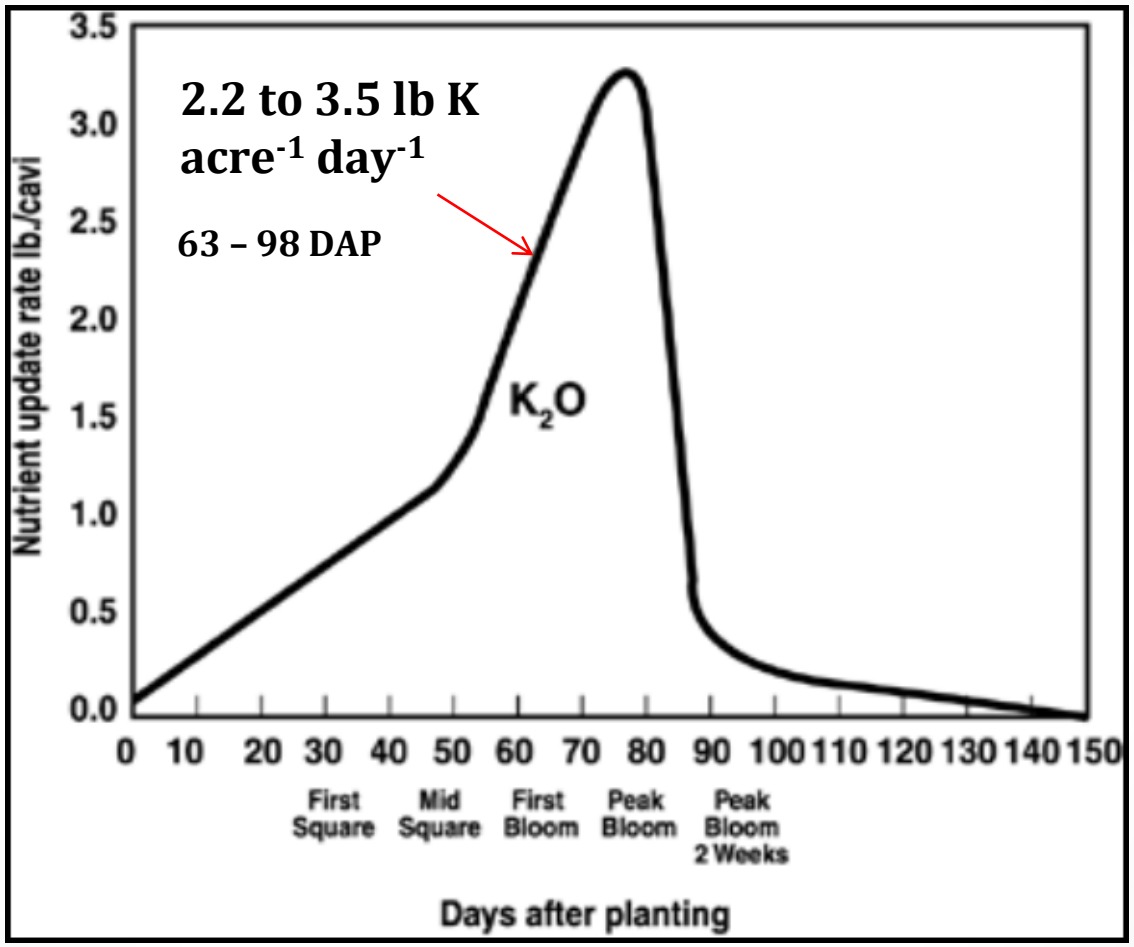
Source: Ma et al., Plant Soil (2013) 373:373-384

Potassium Cycle



K^+ Uptake in Cotton

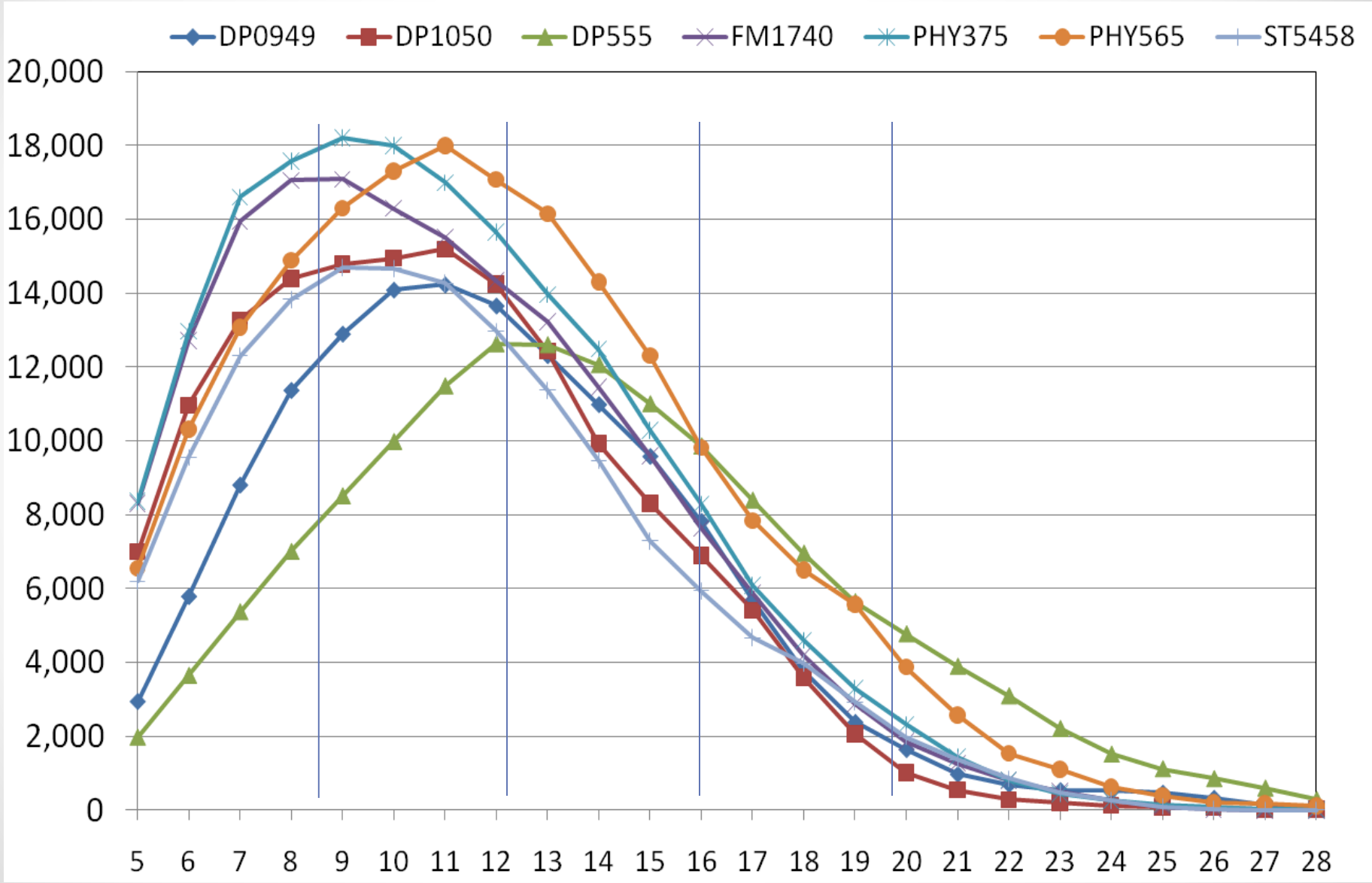
Possible that soil solution K is not being replenished quickly enough during this time of maximum uptake



Source: Mullins and Burmester, 1990

Especially if the soil has a low K^+ buffering capacity and high Ca^{2+} and Mg^{2+} on soil cation exchange sites

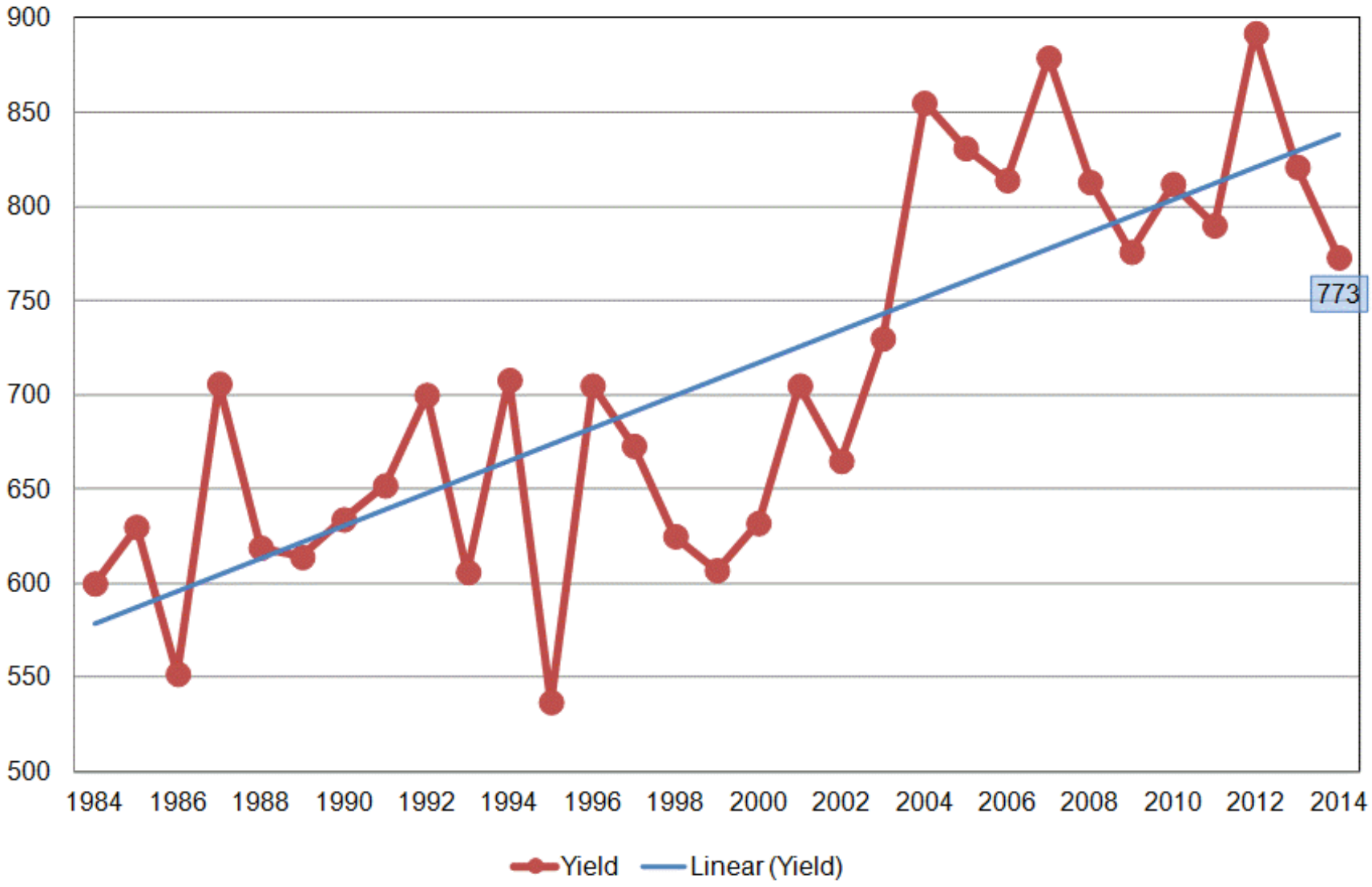
Distribution of 1st Position Bolls



Whitaker, Collins, and Ritchie

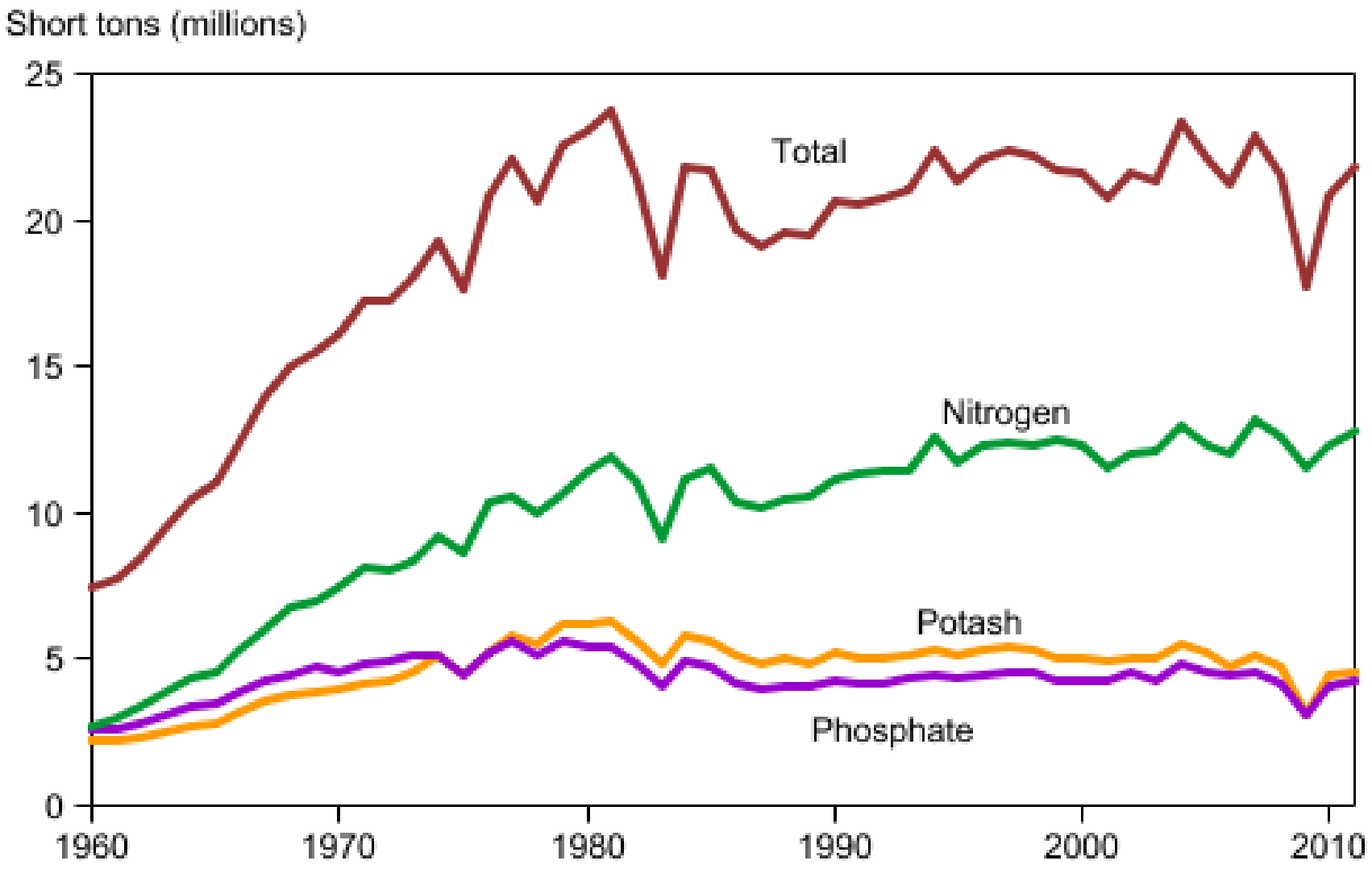
All Cotton Yield

United States



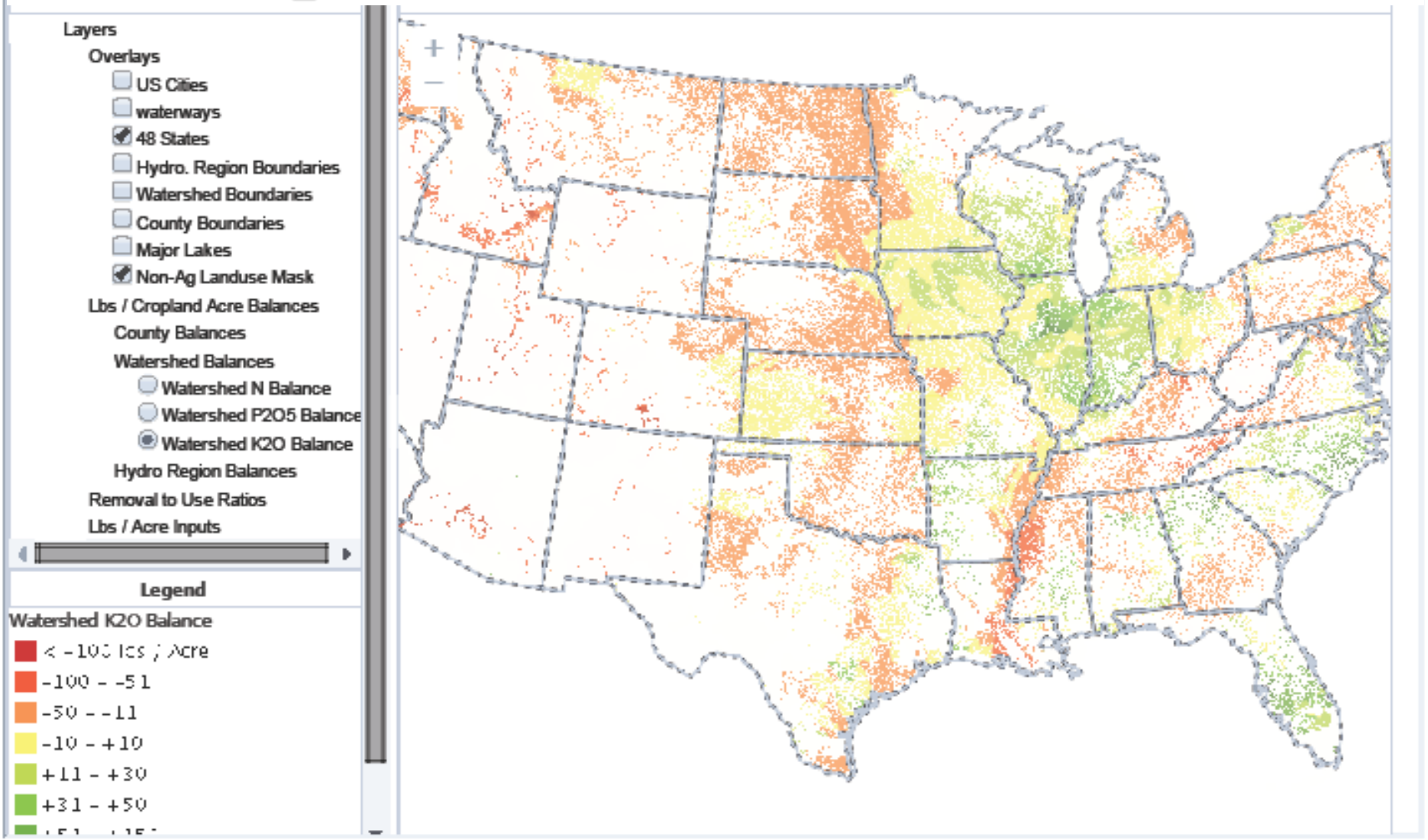
USDA-NASS
12-10-14

Fertilizer use in U.S. agriculture, 1960-2011



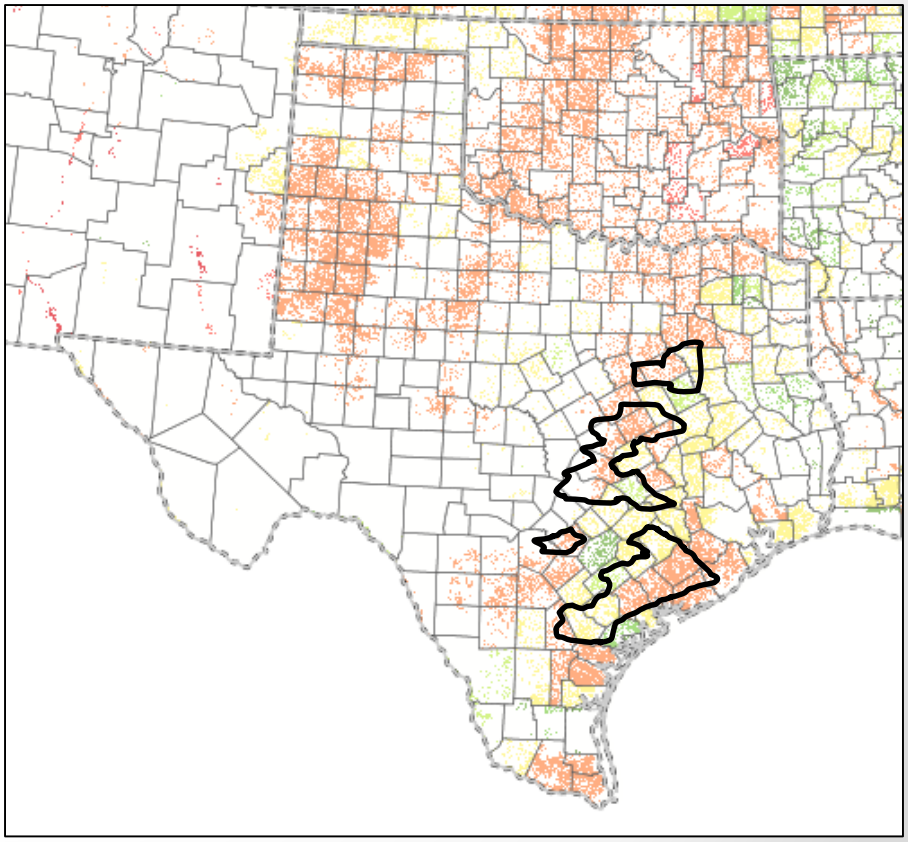
Source: USDA, Economic Research Service, using data from Association of American Plant Food Control Officials and The Fertilizer Institute.

NuGIS
K_2O Balance Estimate - 2012



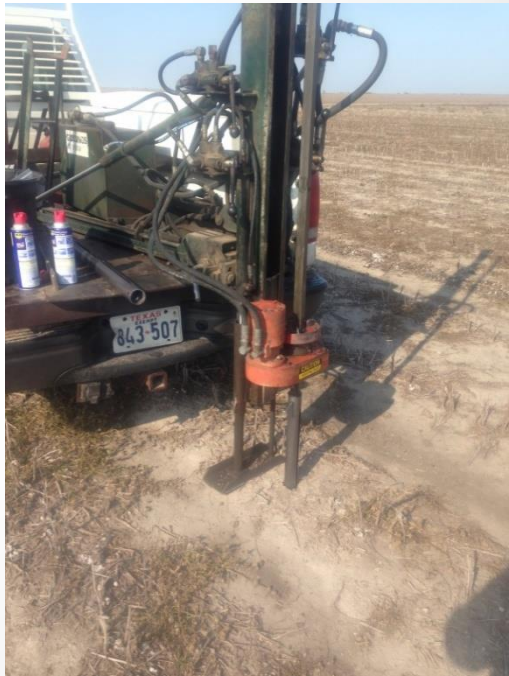
Objectives

Determine the rate and application method of potassium for optimal lint yield and fiber quality.



Materials and Methods

- **Two locations in 2012, 2015**
- **Four locations in 2013, 2014**
- **Incremental soil samples collected to 48 inches, December – February**
- **>4 replicates in a RCBD**
- **Plots 4-6 rows wide X 40+ feet long**
- **Row spacing 30-40 inches**



Materials and Methods

- **Varieties adapted to local growing conditions**
- **HVI analysis from grab samples**
- **ANOVA followed by means separation using Fisher's LSD(.05)**

1. Untreated
2- 20 lbs/A liquid inj. KCl
3- 40 lbs/A liquid inj. KCl
4- 80 lbs/A liquid inj. KCl
5- 120 lbs/A liquid inj. KCl
6- 160 lbs/A liquid inj. KCl
7- 40 lbs/A granular brdcst KCl
8- 80 lbs/A granular brdcst KCl
9- 120 lbs/A granular brdcst KCl
10- 160 lbs/A granular brdcst KCl

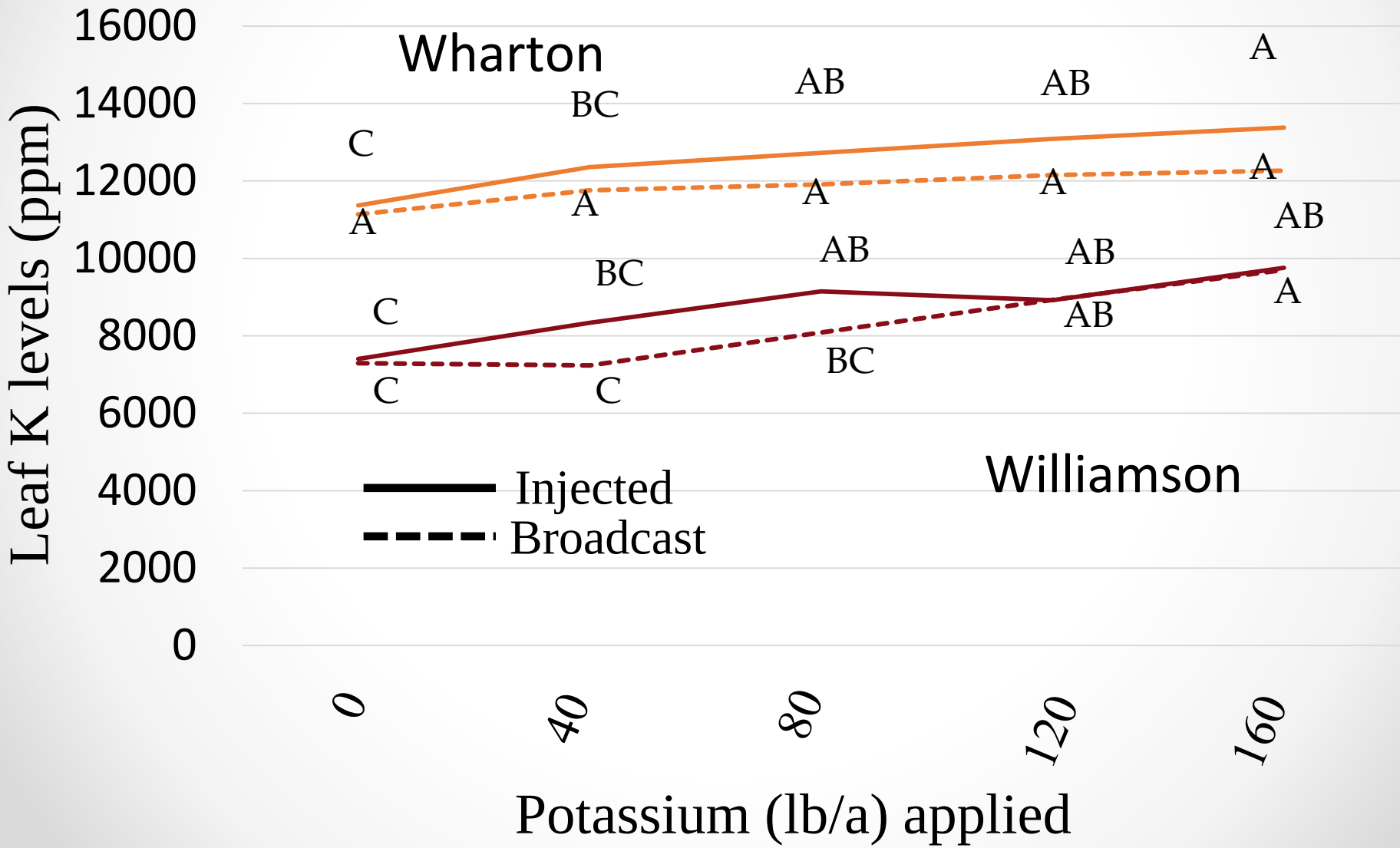
Site details

- **Williamson county- 6 locations**
  - **Burleson clay**
  - **50- 287 ppm K**
  - **0-60 lb/a K_2O recommended**

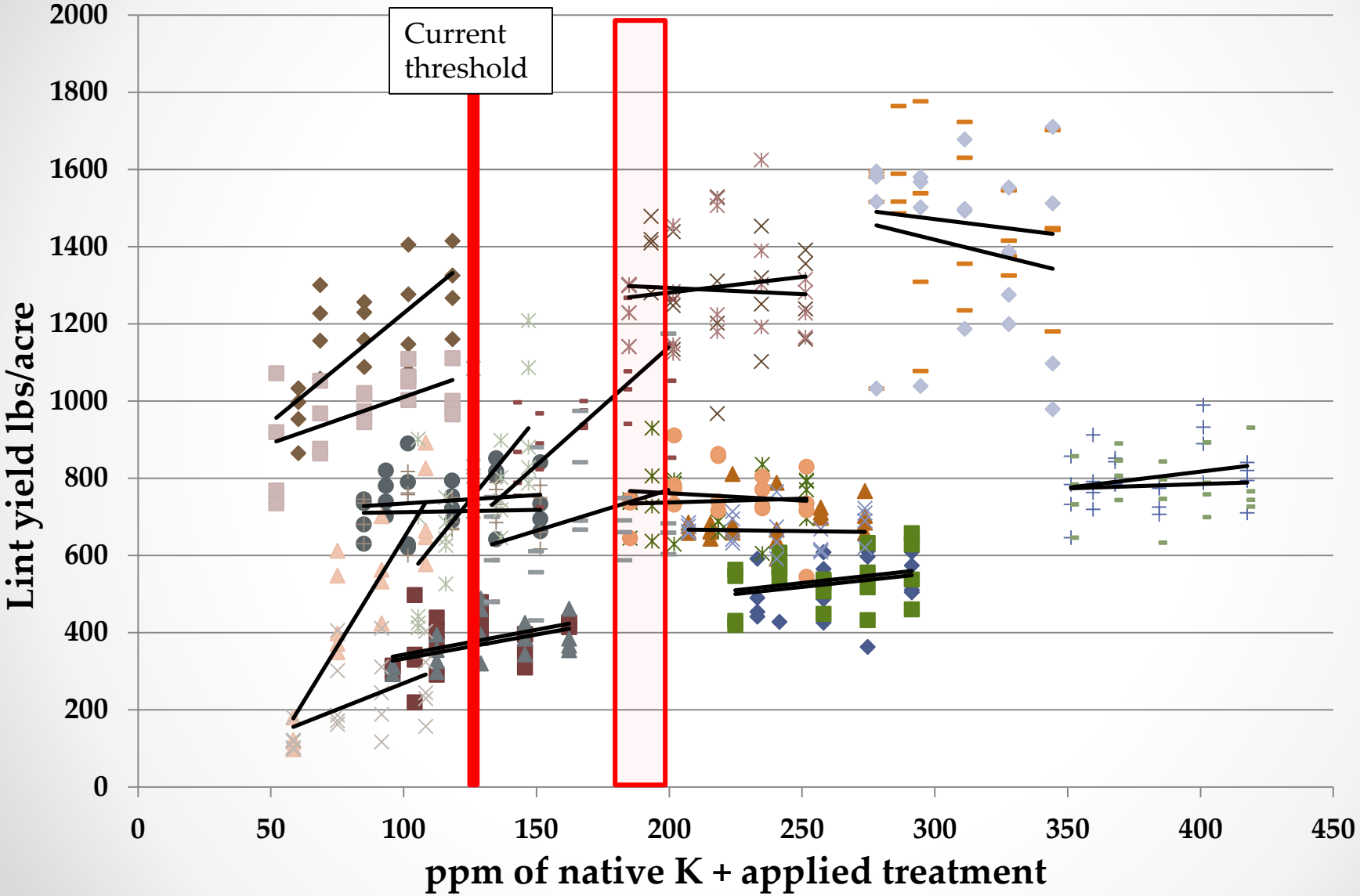
- **Wharton county- 4 locations**
  - **Lake Charles clay loam**
  - **85- 205 ppm K**
  - **0- 30 lb/a of K_2O recommended**

- **Hill county- 2 locations**
  - **Branyon clay**
  - **230- 390 ppm K**
  - **0 lb/a of K_2O recommended**

2015 Leaf K Levels

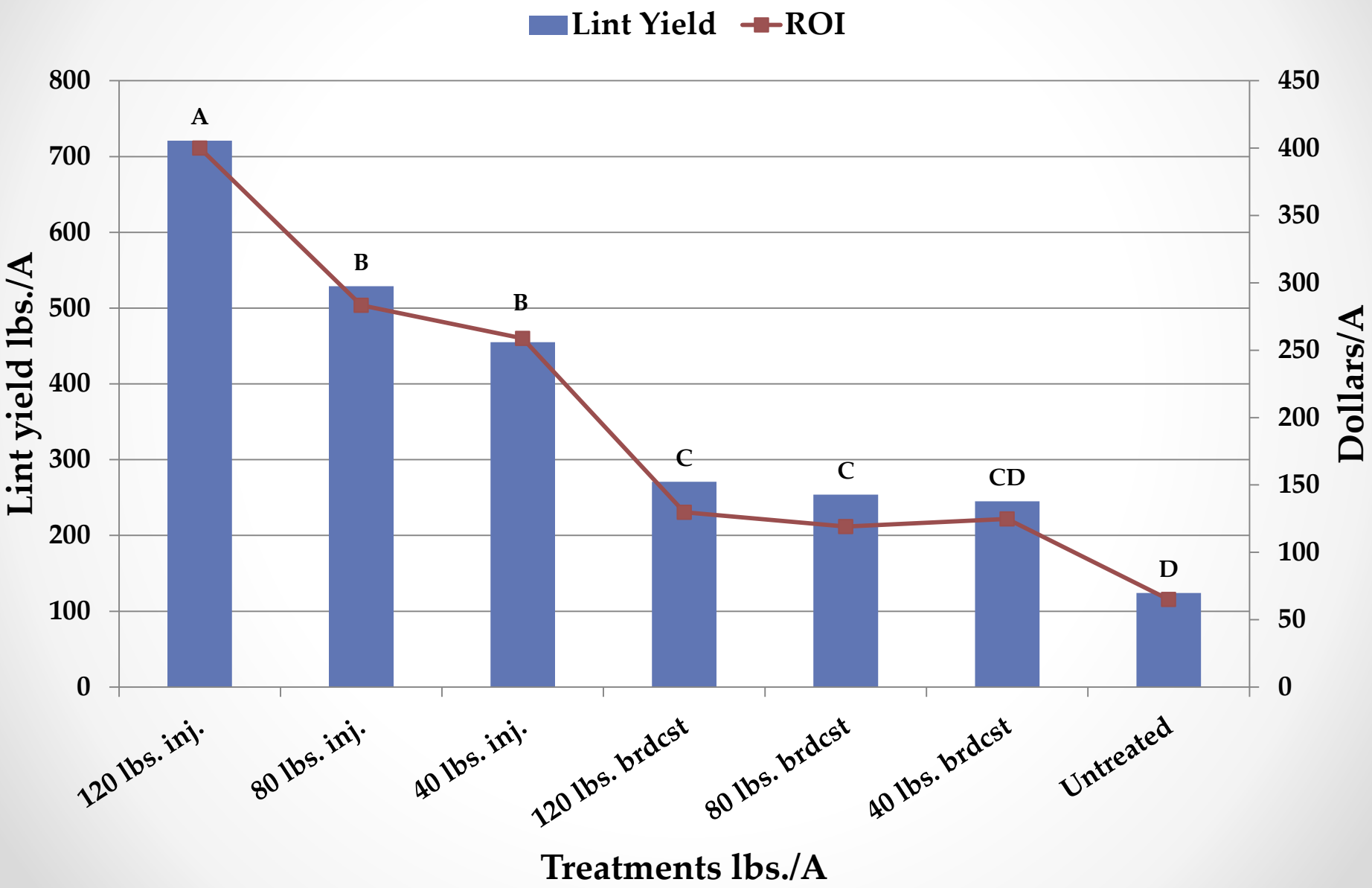


Lint yield- 12 site years

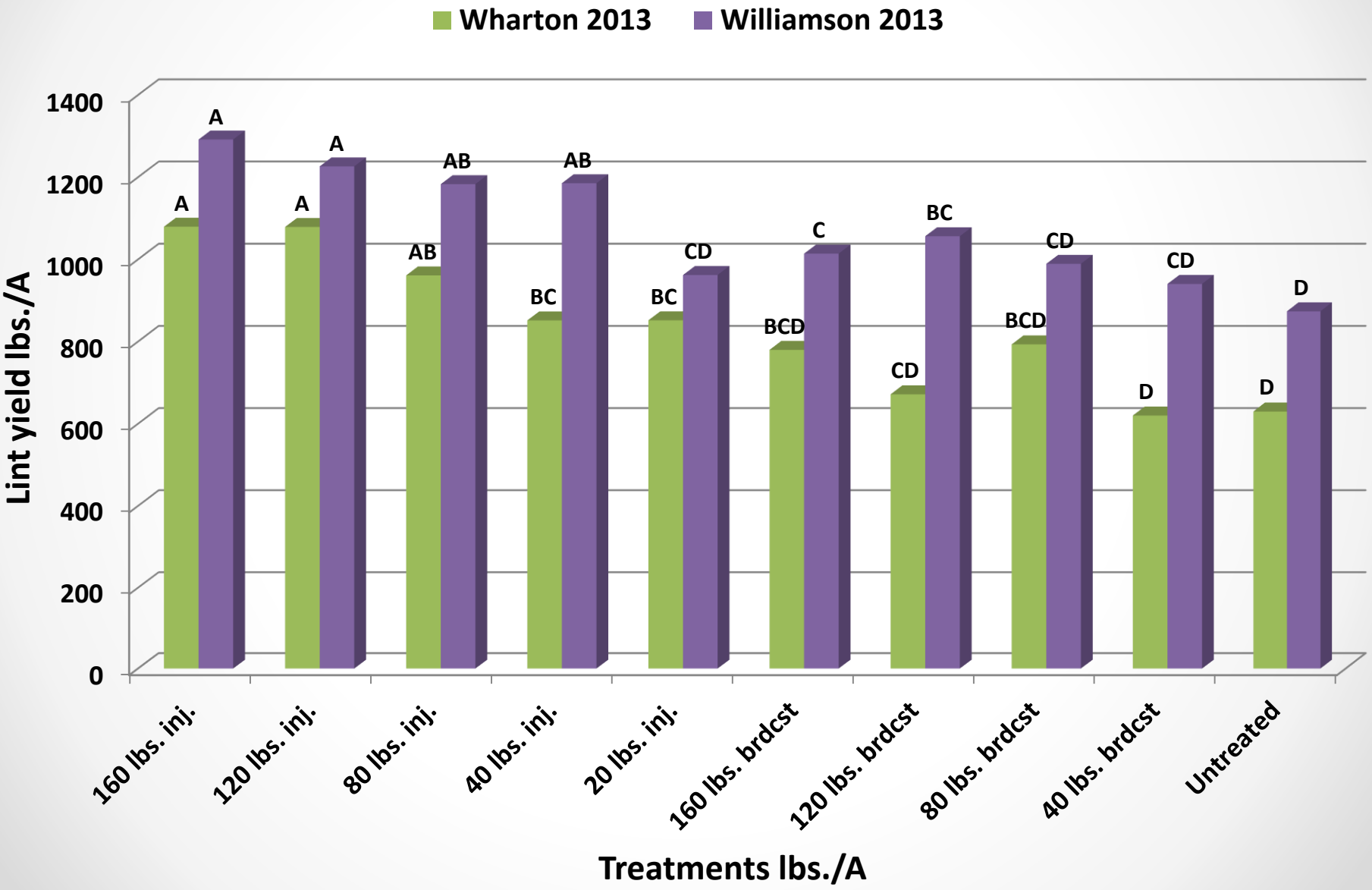


2012-2015: Williamson, Wharton, and Hill Counties

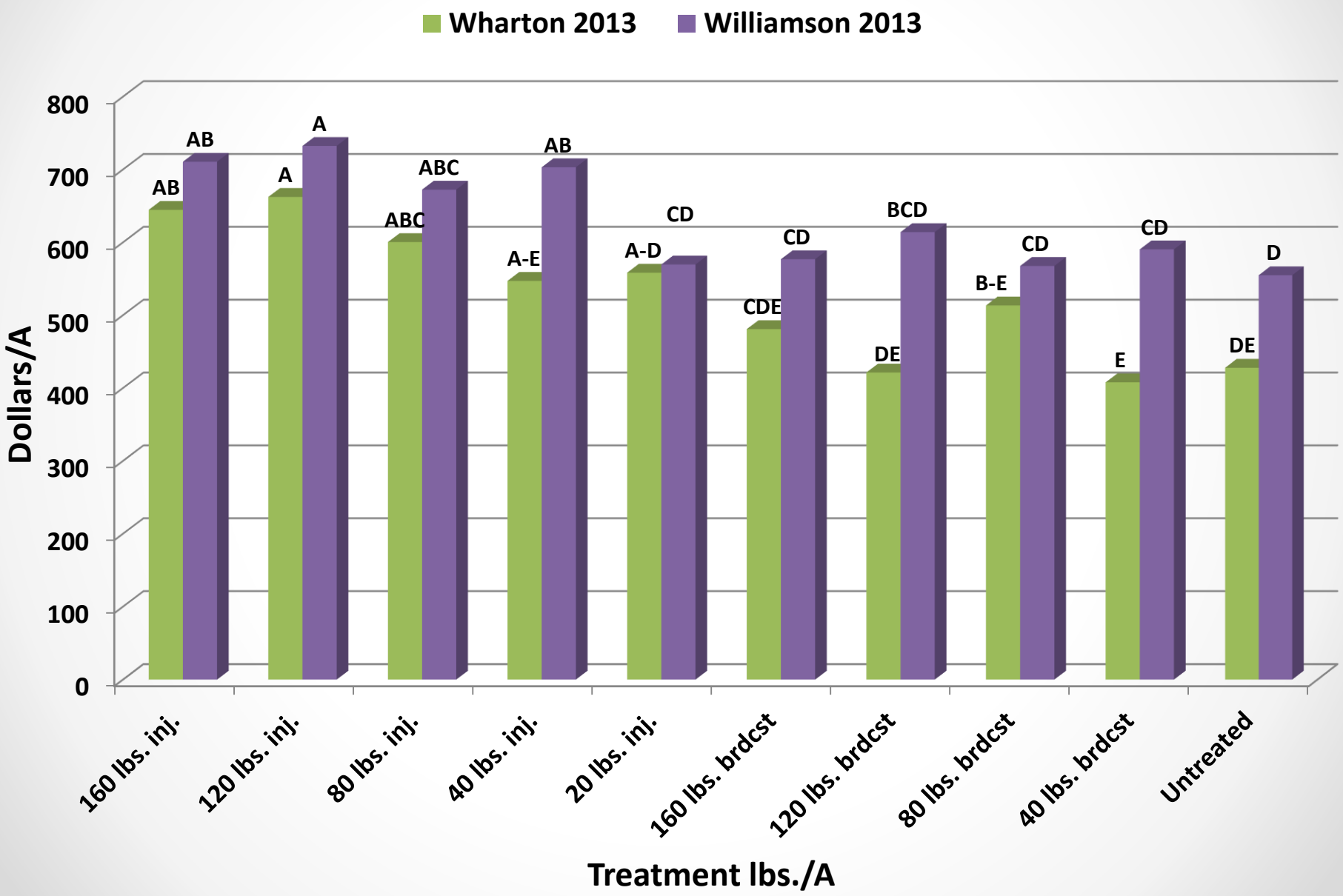
Williamson 2012



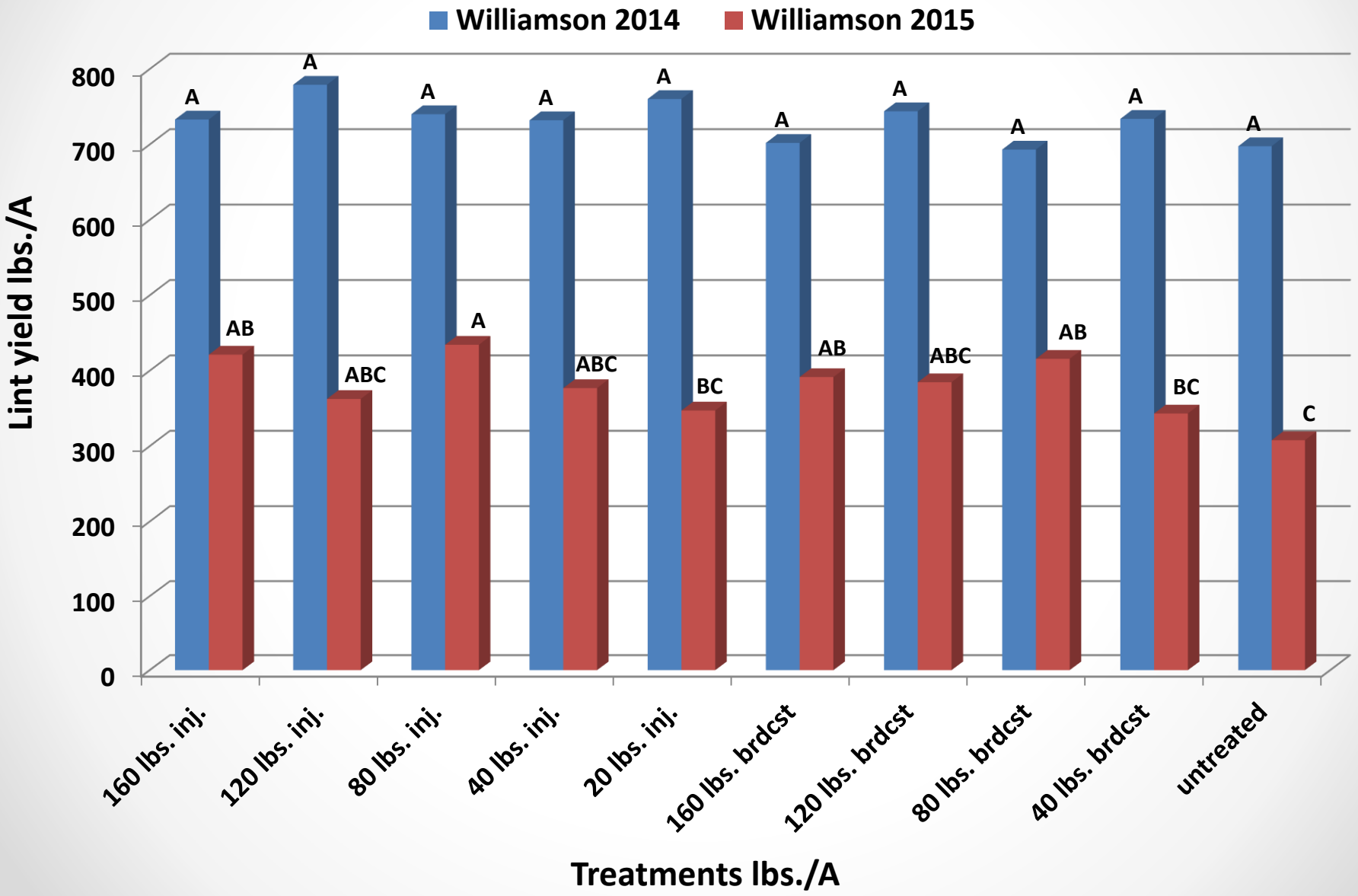
Lint yield


Wharton 2013
Williamson 2013
Lint yield lbs./A
1400
1200
1000
800
600
400
200
0
A
A
A
A
AB
AB
AB
AB
BC
BC
BC
CD
BCD
C
CD
BC
BCD
CD
D
CD
D
D
160 lbs. inj.
120 lbs. inj.
80 lbs. inj.
40 lbs. inj.
20 lbs. inj.
160 lbs. brdcst
120 lbs. brdcst
80 lbs. brdcst
40 lbs. brdcst
Untreated
Treatments lbs./A

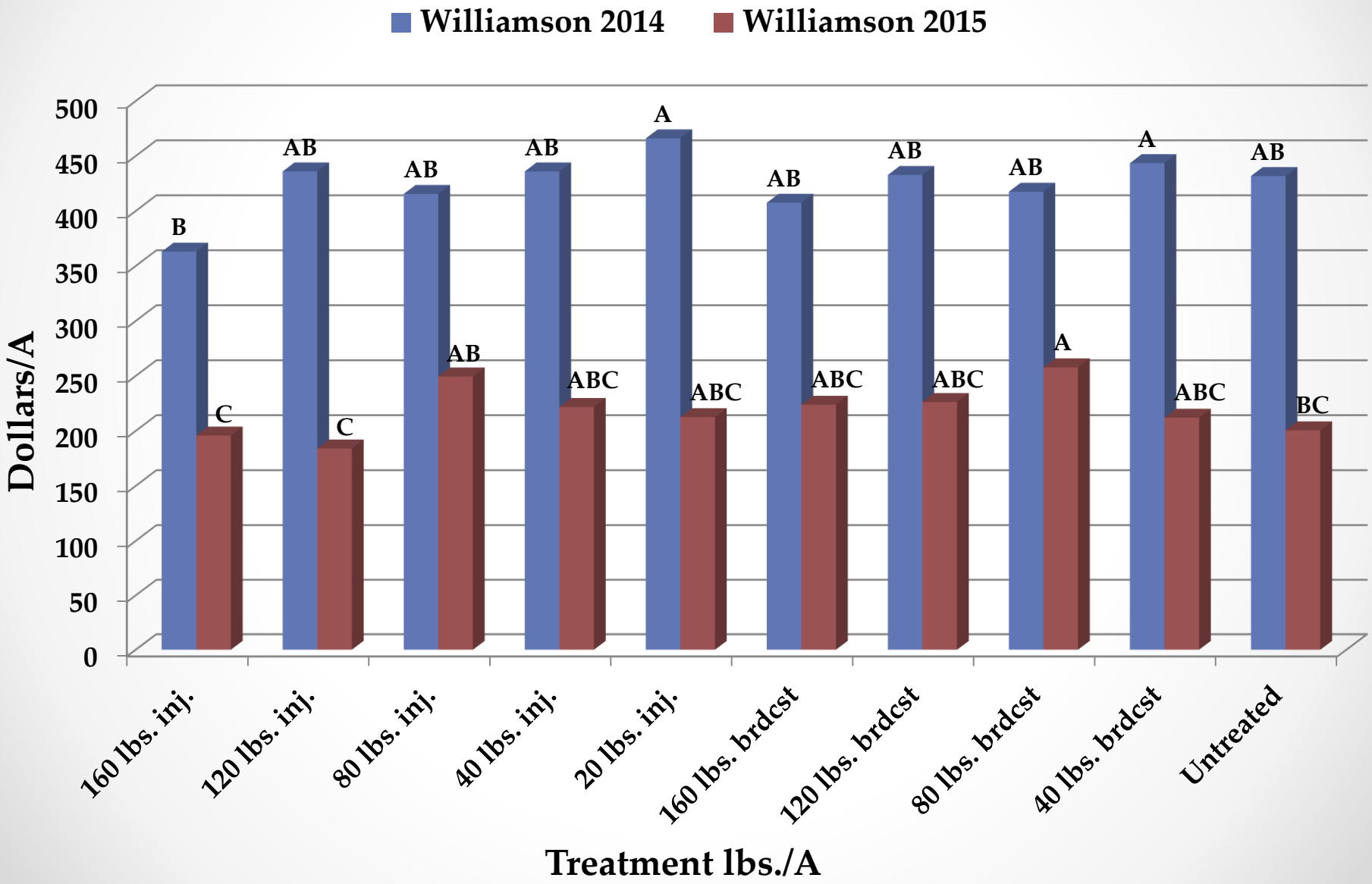
Return on investment



Lint yield


Williamson 2014
Williamson 2015
Lint yield lbs./A
800
700
600
500
400
300
200
100
0
A
AB
A
ABC
A
A
A
ABC
A
BC
A
AB
A
ABC
A
AB
A
BC
A
C
160 lbs. inj.
120 lbs. inj.
80 lbs. inj.
40 lbs. inj.
20 lbs. inj.
160 lbs. brdcst
120 lbs. brdcst
80 lbs. brdcst
40 lbs. brdcst
untreated
Treatments lbs./A

Return on investment



2013

Fiber analysis

- >200 ppm K
  - Micronaire, strength, and length were non- responsive to treatments
- <200 ppm K
  - Length was non- responsive in all years
  - Micronaire response in liquid treatments in 2012&2013
  - Bundle strength responded in both application methods in 2012, but only liquid application in 2013&2014

Conclusions

- **Sites with >200ppm K were non-responsive to either application method or rate.**

- **K application method and rate have an effect on lint yield up to ~200ppm K in 2/3 of sites.**
  - **Liquid injected treatments have a more consistent positive impact on lint yield than granular broadcast.**
  - **Liquid injected increased K use efficiency.**
  - **ROI was greater with liquid injected applications in higher yielding enviroments.**
  - **Current soil K threshold of 125 ppm should be reevaluated for cotton for liquid injected applications.**

Future Research

- Four locations will be evaluated to K removal and replenishment over 3 years.
- Mineralogy survey of the sites to better understand the exchangeable and non-exchangeable K.
- Meet with Texas A&M Soil Testing Lab to determine the need for modification of current K threshold.

CottonBelt Potassium Project
2016

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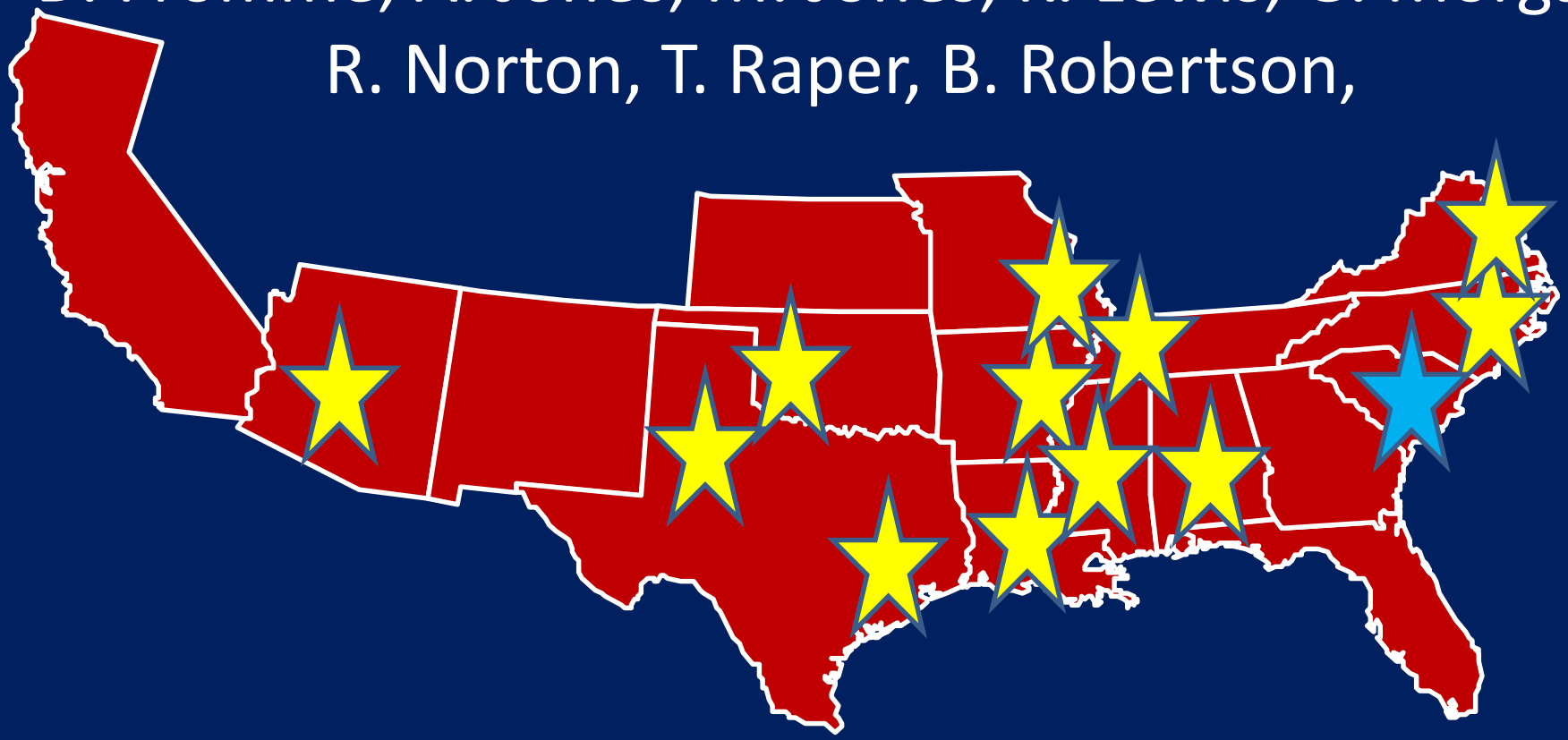

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Questions

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