Evaluation of Cotton Yield, Quality, and Growth Response to Soil-Applied Potassium

An Extension Cotton Specialist Project

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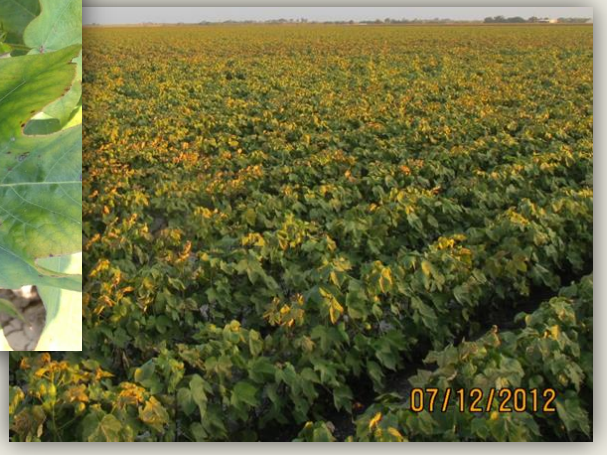
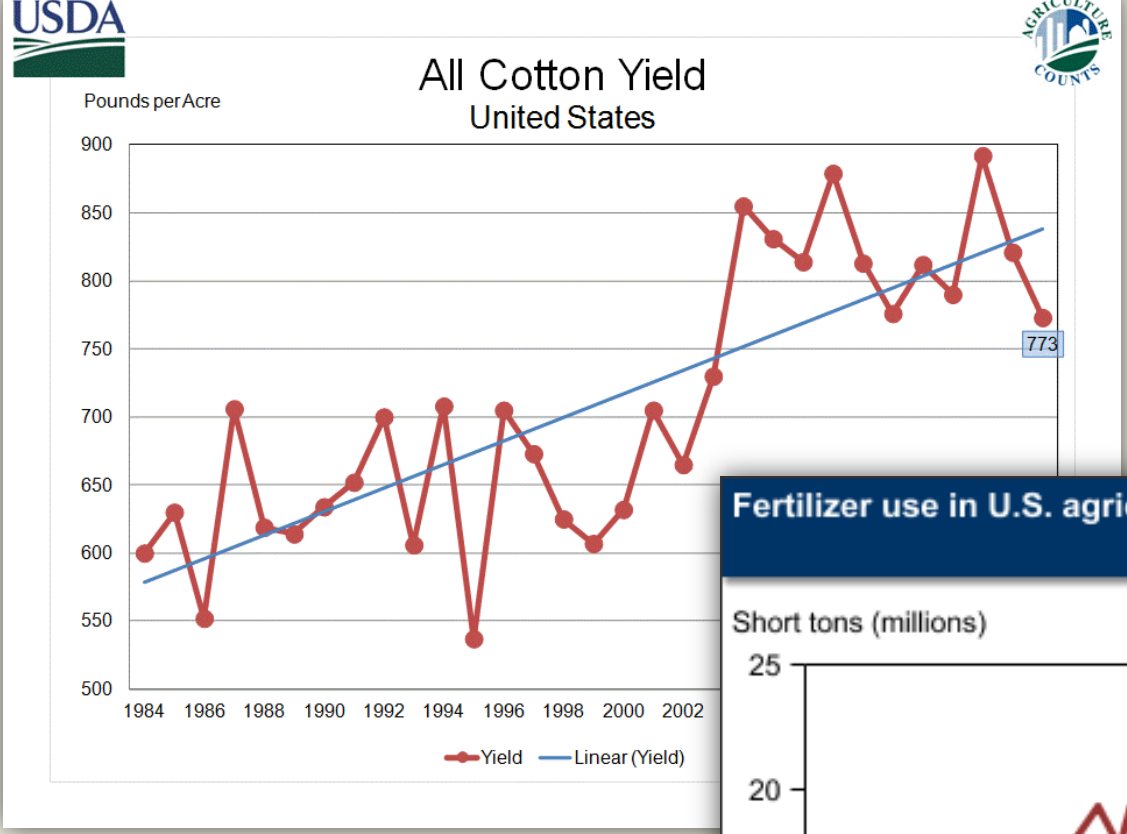
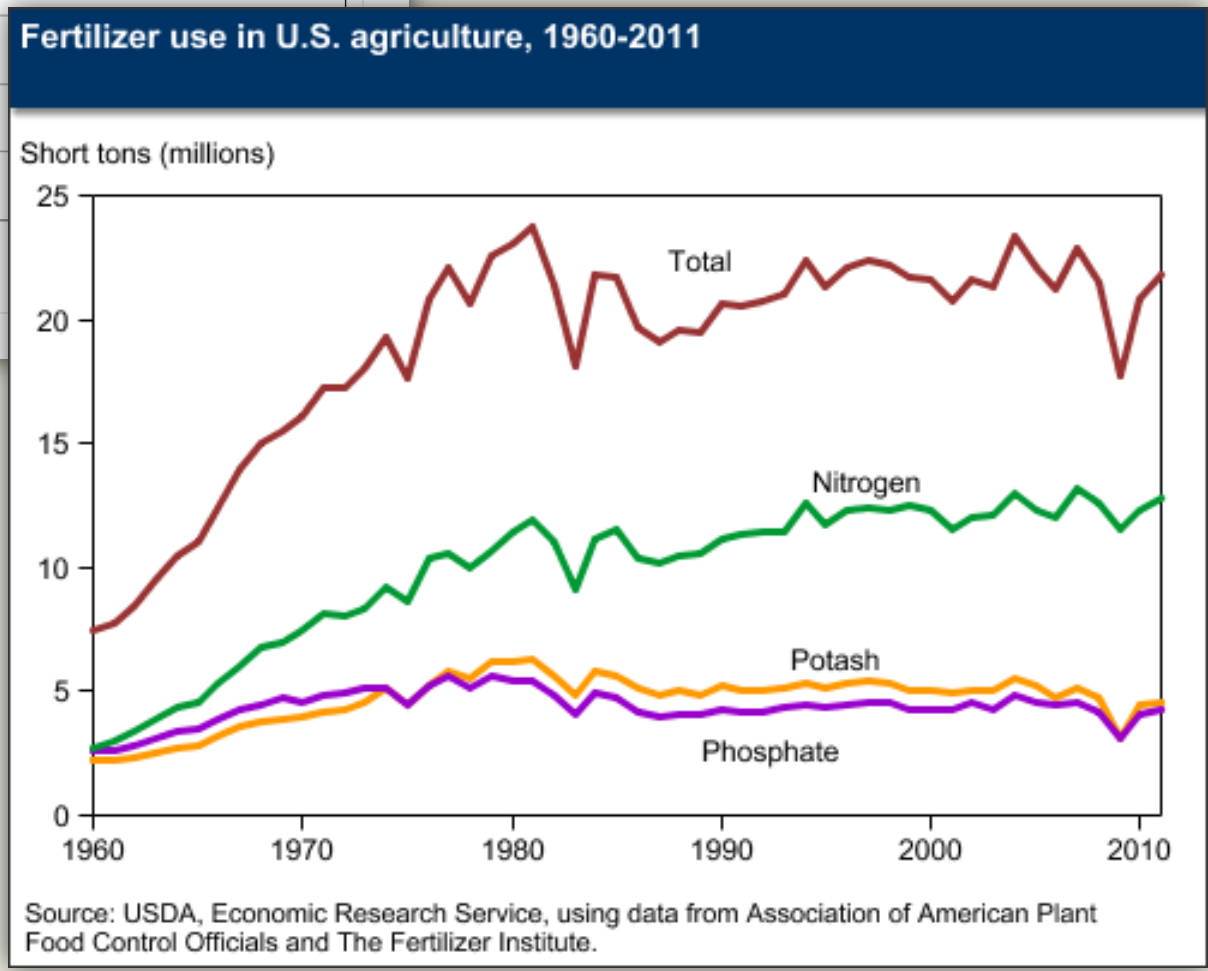
Introduction

- Increased reports of K deficiency symptoms from across the Cotton Belt
- Modern varieties – increased yields and in many cases faster fruiting – increased K demand in a shorter amount of time
- K deficient plants more prone to foliar diseases



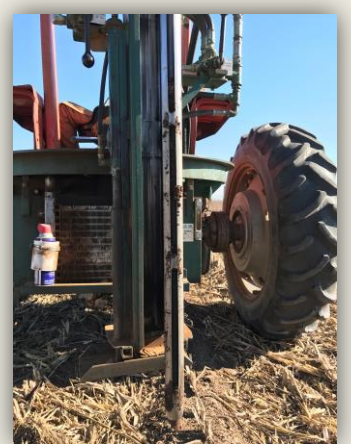

All Cotton Yield
United States
Pounds per Acre
900
850
800
750
700
650
600
550
500
773
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
Yield
Linear (Yield)


Fertilizer use in U.S. agriculture, 1960-2011
Short tons (millions)
25
20
15
10
5
0
Total
Nitrogen
Potash
Phosphate
1960
1970
1980
1990
2000
2010
Source: USDA, Economic Research Service, using data from Association of American Plant Food Control Officials and The Fertilizer Institute.

Objectives

1. Quantify soil K^+ levels with depth from major cotton production regions in the Cotton Belt
2. Evaluate the impact of application methods and rates of K^+ on cotton yield, quality, and return on investment
3. Determine the impact of K^+ application rate and method on soil K^+ levels over a 3 year cotton cropping system

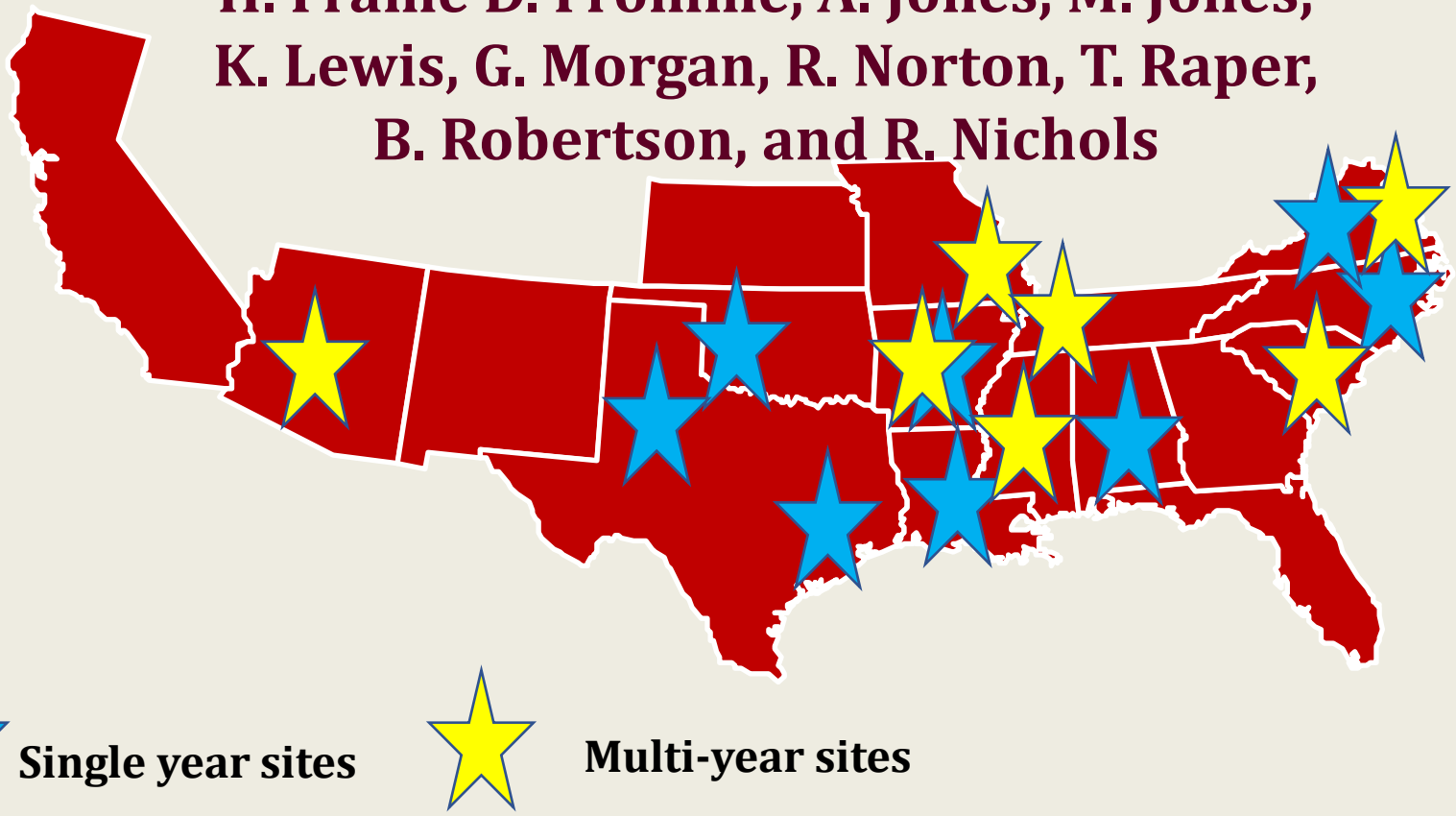
Based on these findings, soil K^+ recommendations will be reevaluated and modified as appropriate to optimize yields



Materials and Methods

- **2015-2017 Locations**

R. Boman, D. Delaney, D. Dodds, K. Edmisten, H. Frame D. Fromme, A. Jones, M. Jones, K. Lewis, G. Morgan, R. Norton, T. Raper, B. Robertson, and R. Nichols

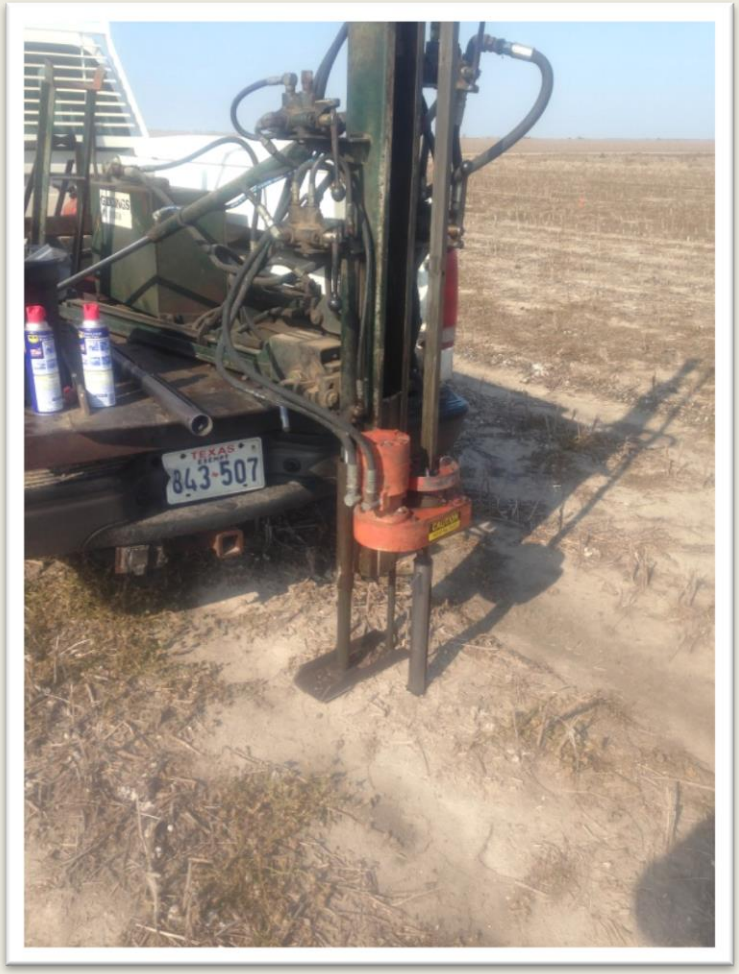


Materials and Methods

- Variety
  - DP 1321 B2RF – 2015
  - DP 1522 B2XF – 2016

- Soil Analysis
  - Sampling Depths
    - 0-6, 6-12, and 12-24 inch
    - Mehlich III extraction (all locations)

- Additional Analyses
  - Leaf K at first bloom
  - Lint yield
  - Fiber quality

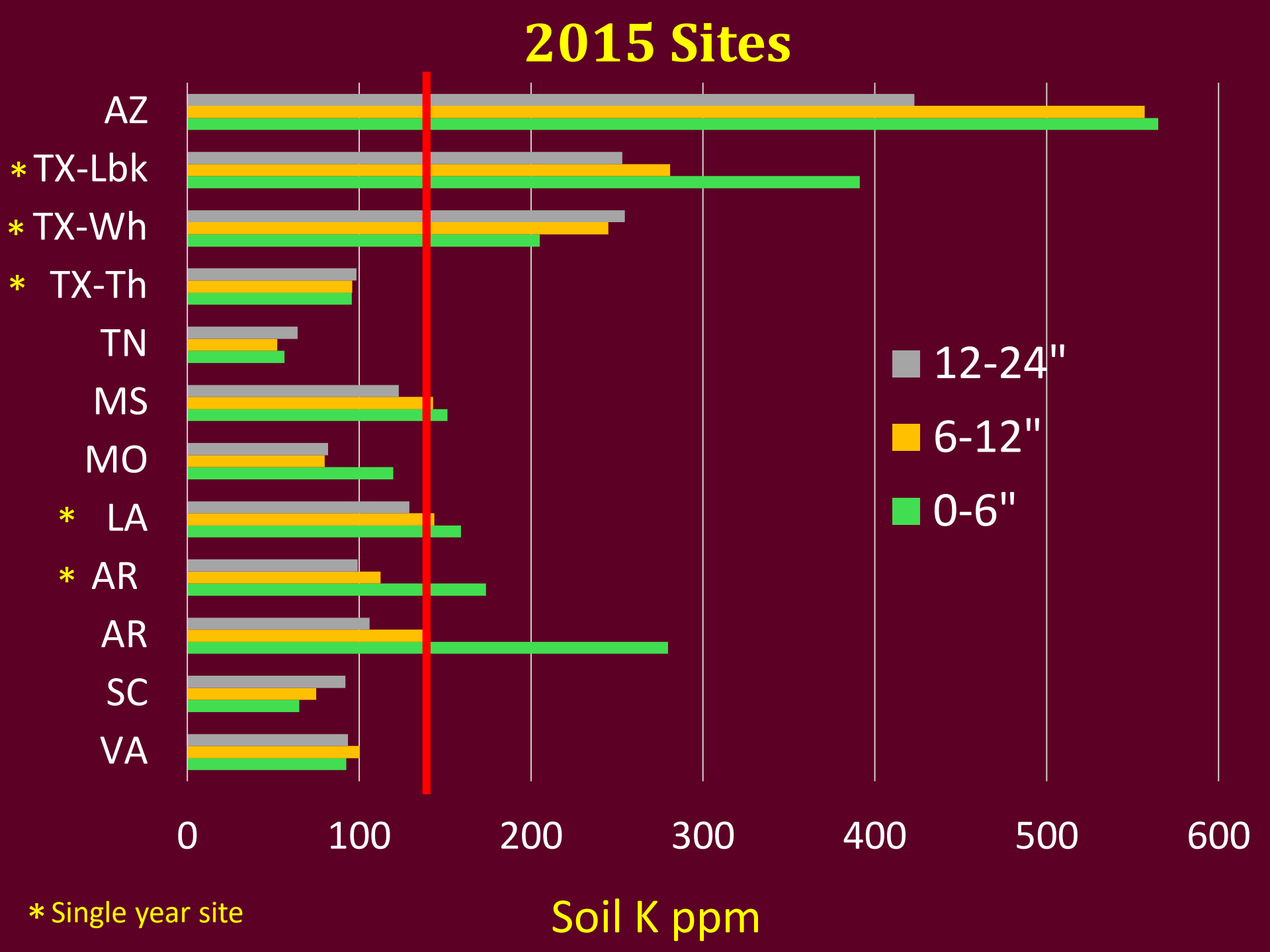


Materials and Methods

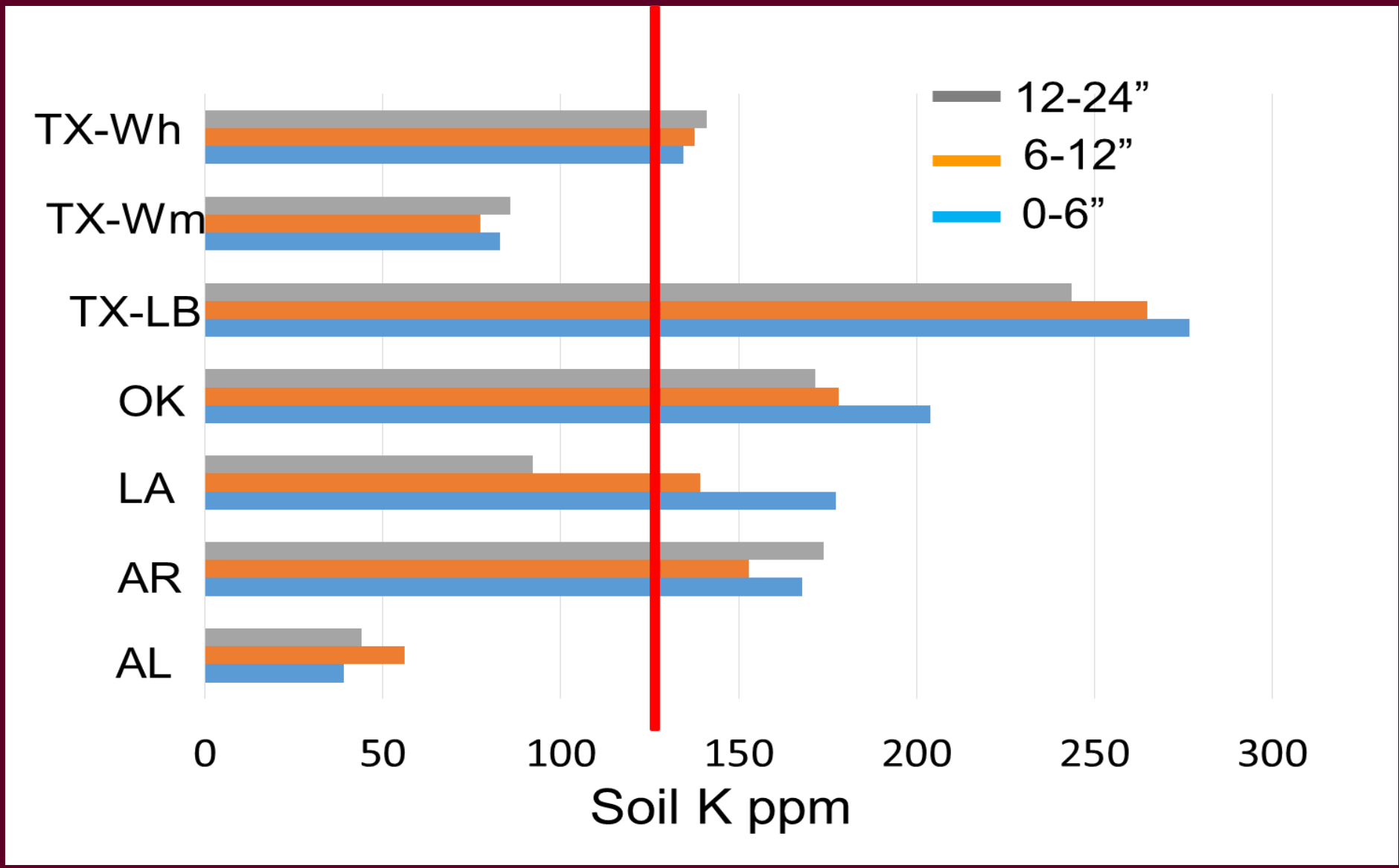
Treatment Factors:

- Application Method
  - Broadcast incorporated, > 3”
    - Granular KCl (0-0-60)
  - Knife injected, 4”x 6” from seed furrow
    - Liquid KCl (0-0-15),
    - Arizona used potassium sulfate all other locations used KCl
- Application Rate
  - 0, 40, 80, 120, and 160 lb K A^{-1}
  - All plots received equivalent amounts of N and P fertilizer
  - Fertilizer was applied 2 to 4 weeks before planting

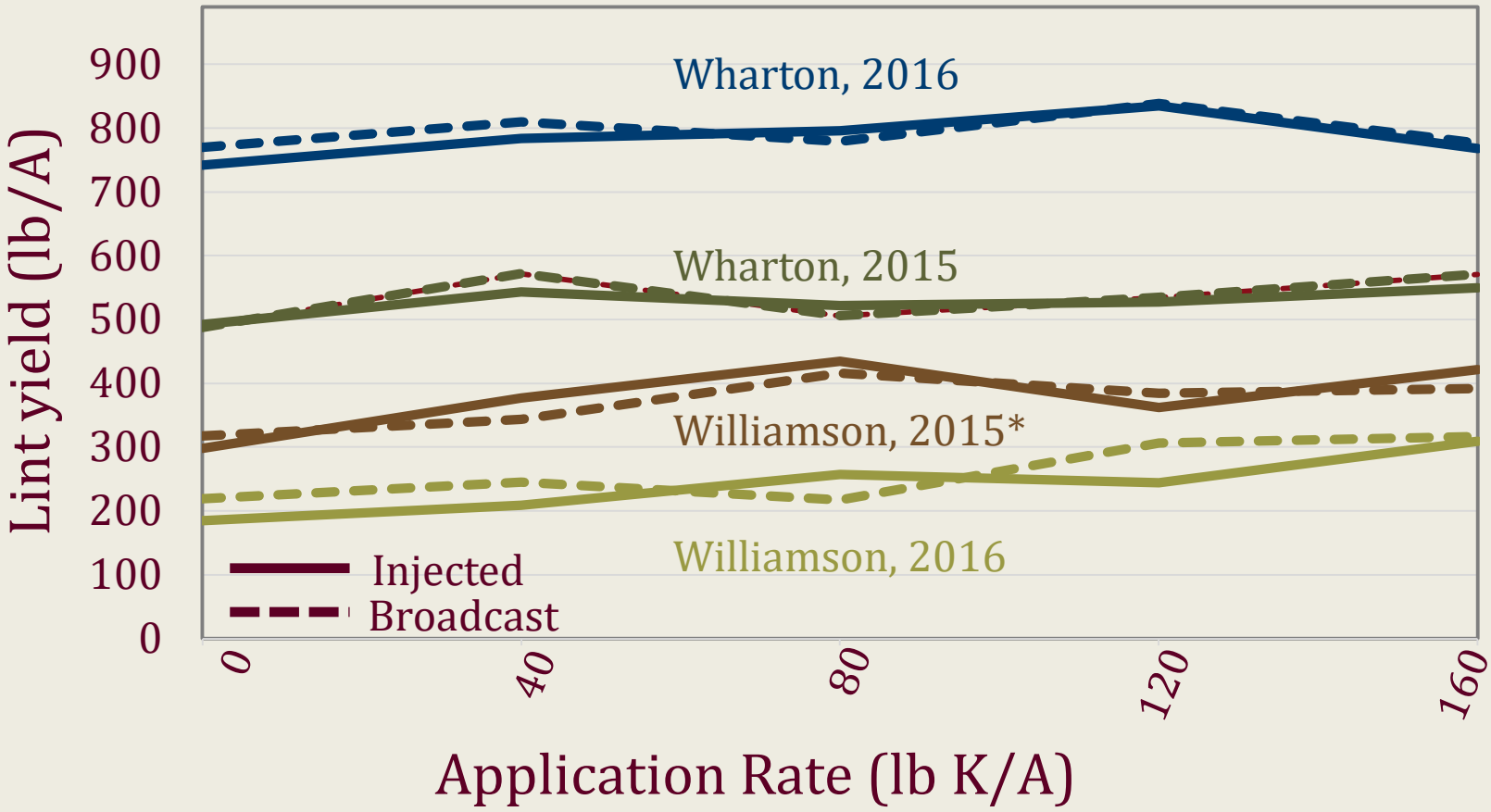
Results: Single-Year Sites


2015 Sites
AZ
* TX-Lbk
* TX-Wh
* TX-Th
TN
MS
MO
* LA
* AR
AR
SC
VA
12-24"
6-12"
0-6"
0
100
200
300
400
500
600
* Single year site
Soil K ppm

2016 Single-year Sites

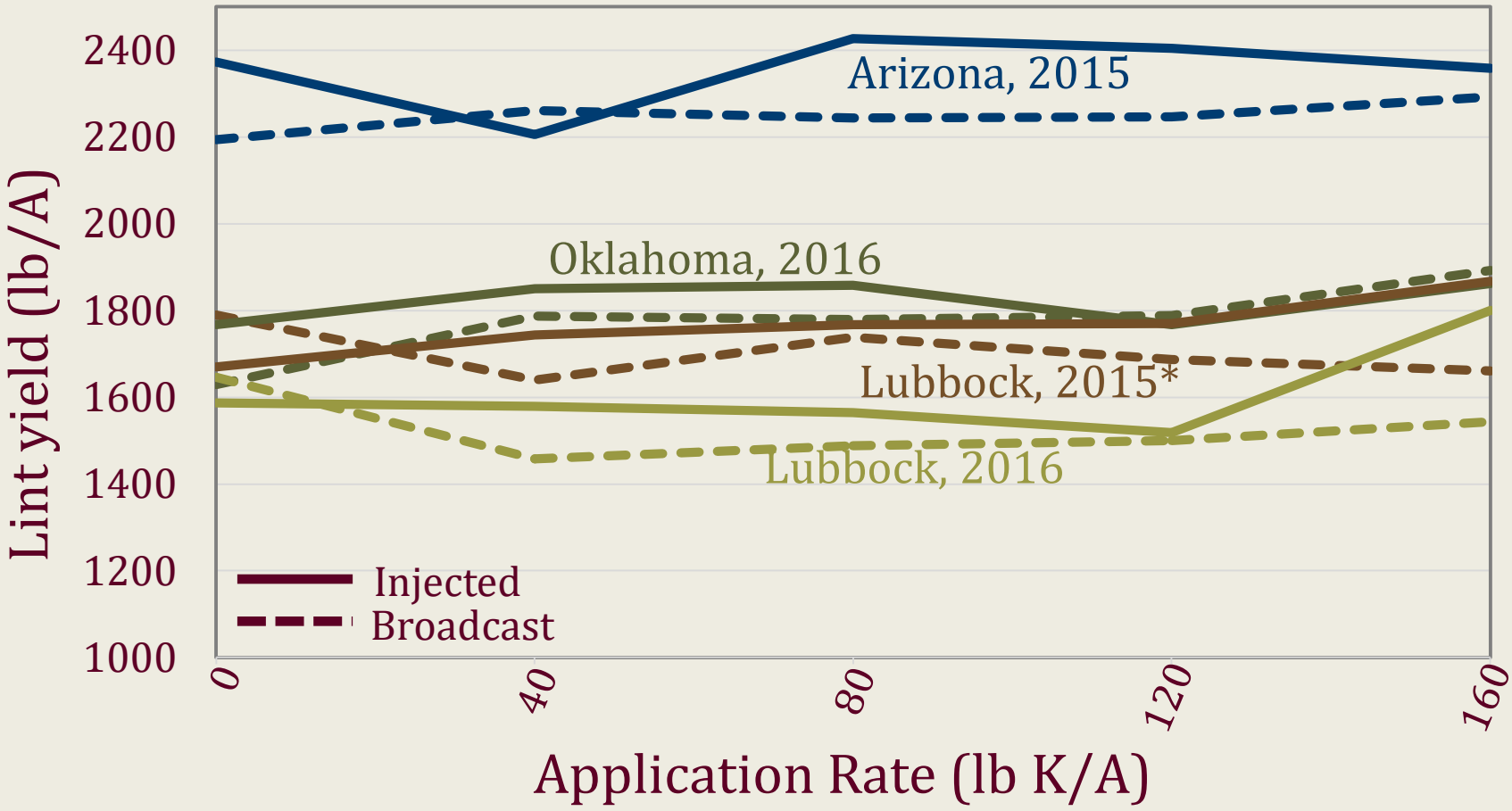


Lint Yield: South and East Texas (Dryland)



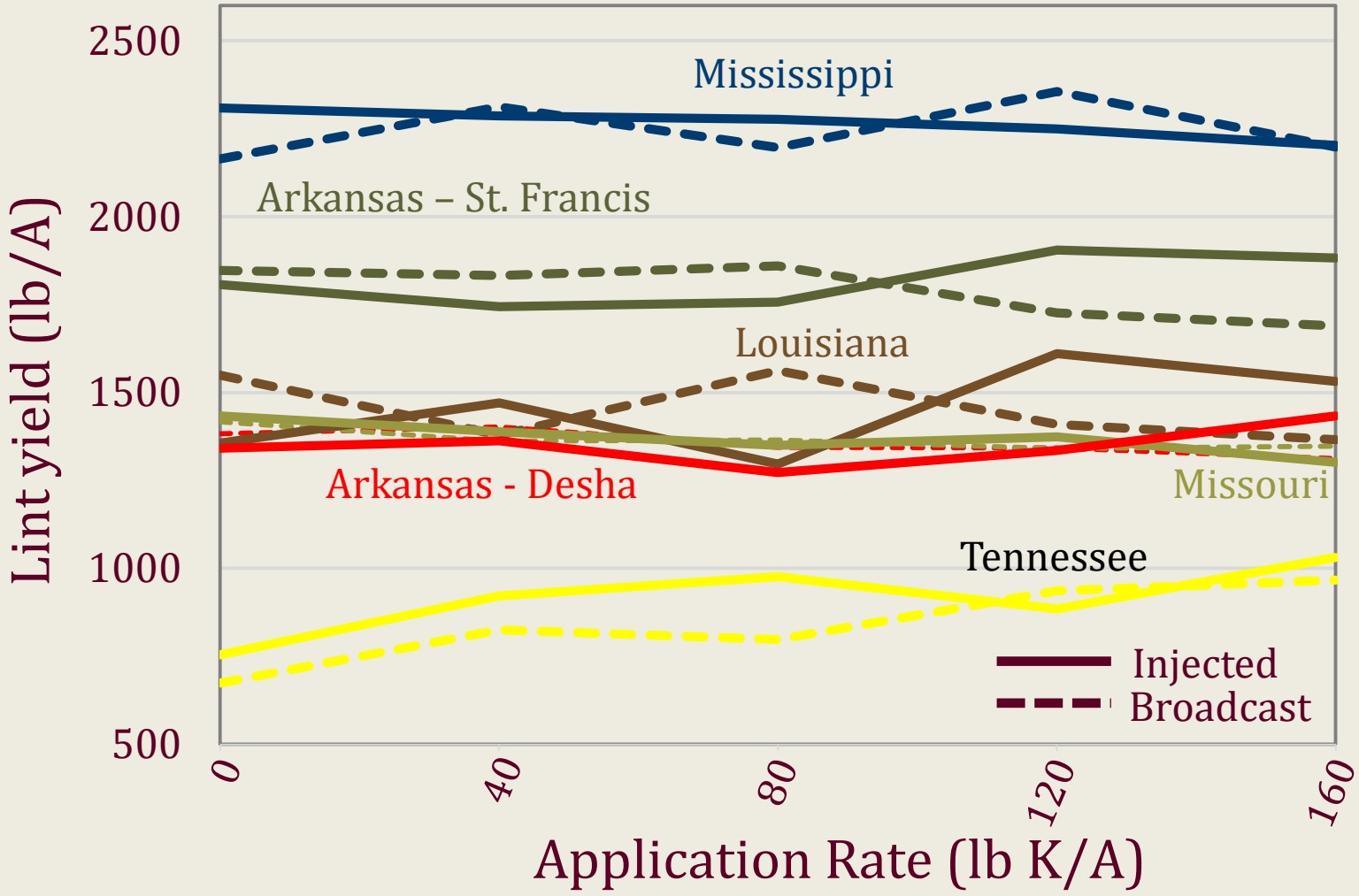
***Significant yield response ($P<0.05$)**

Lint Yield: TX, OK, and AZ (Irrigated)

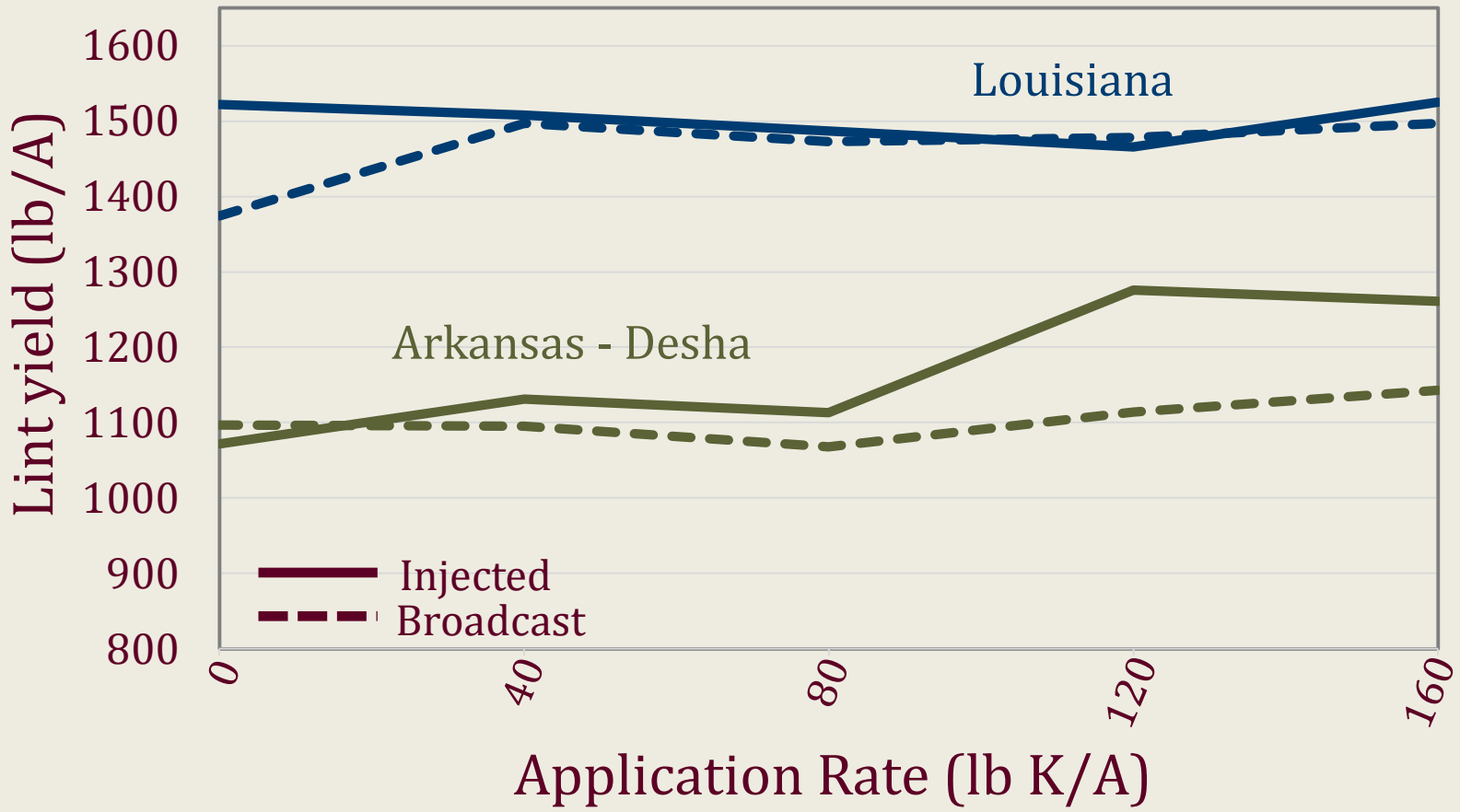


***Significant yield response (*P*<0.05)**

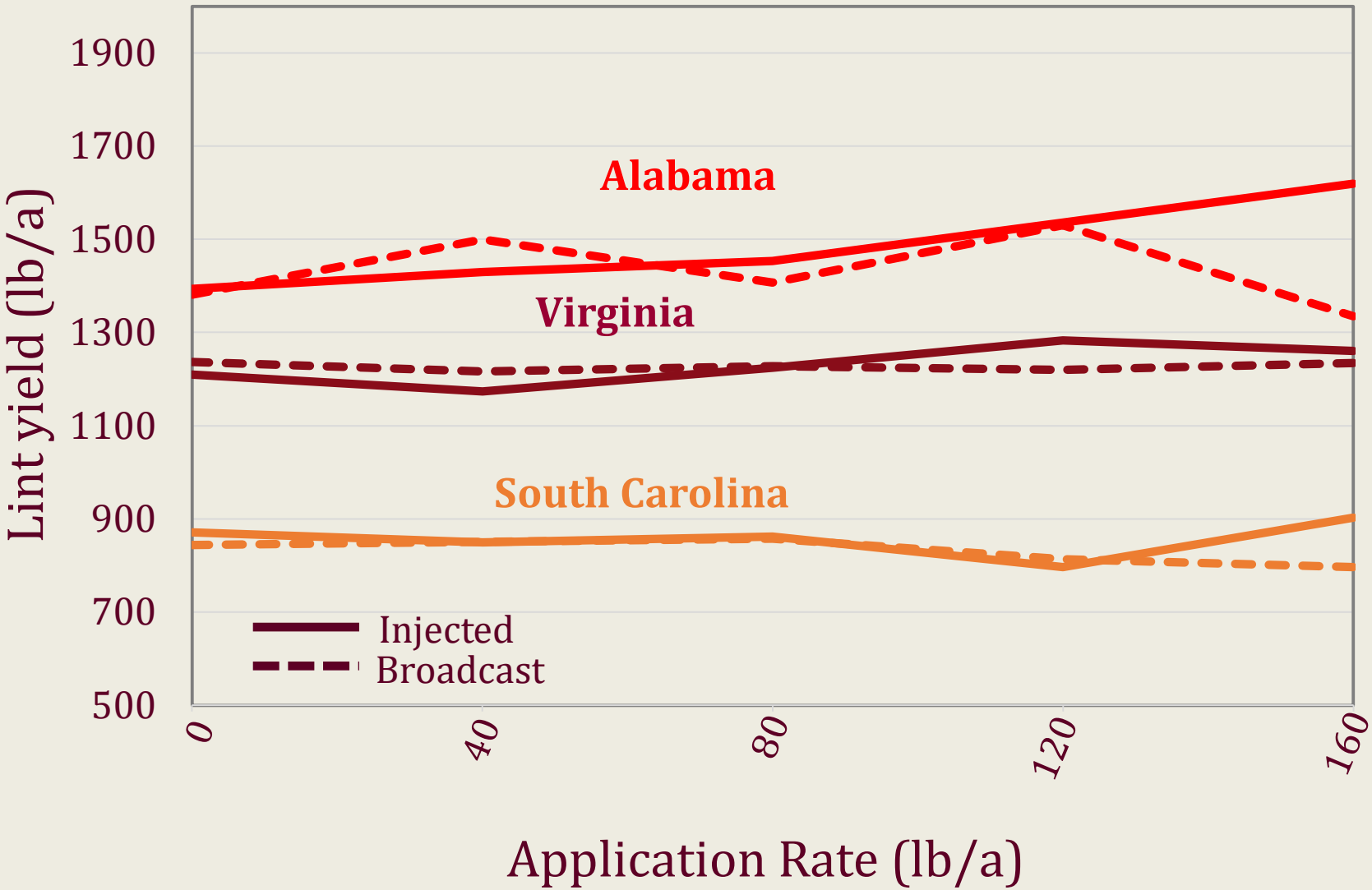
Lint Yield: Delta Region, 2015



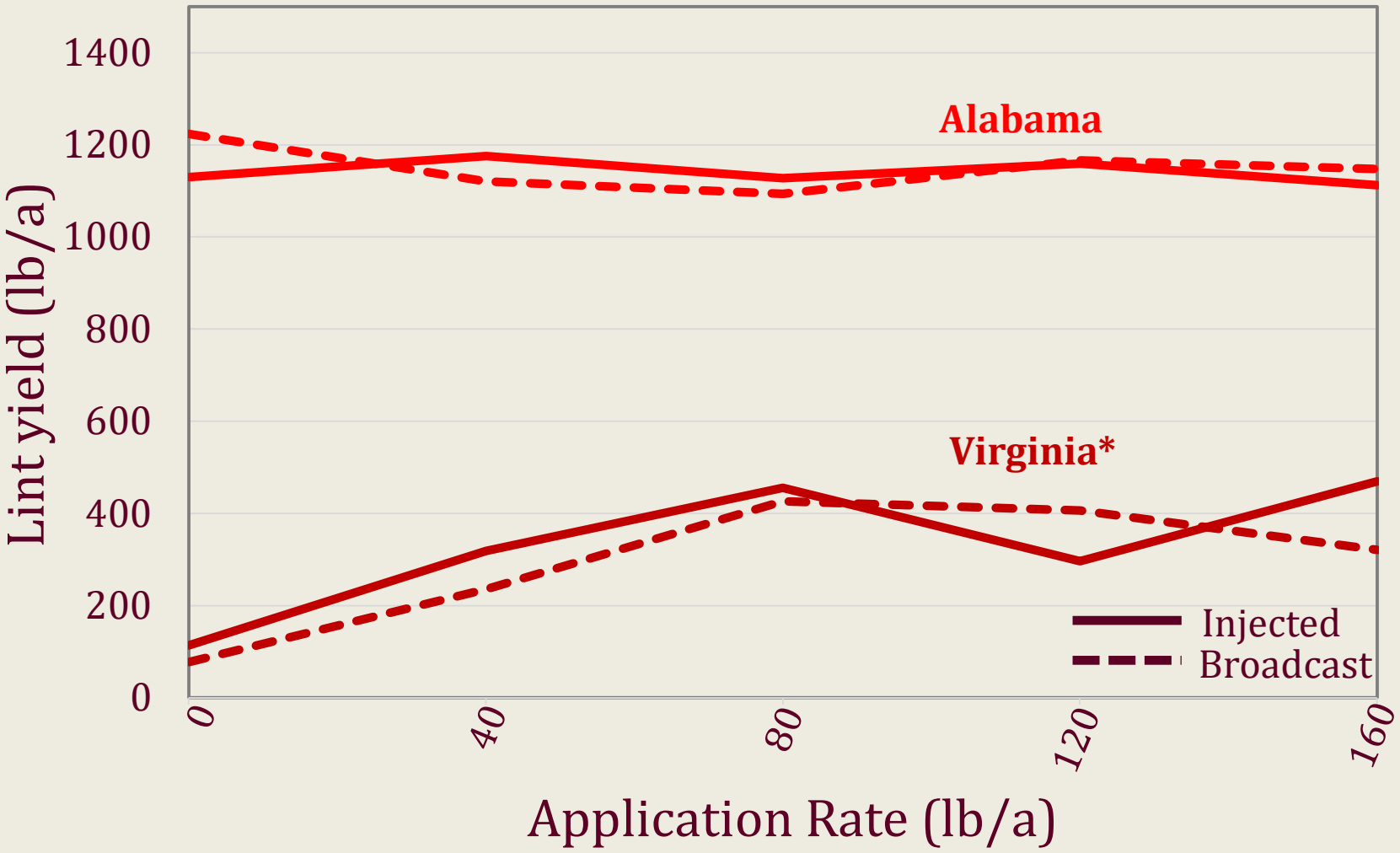
Lint Yield: Delta Region, 2016



Lint Yield: Eastern Region, 2015



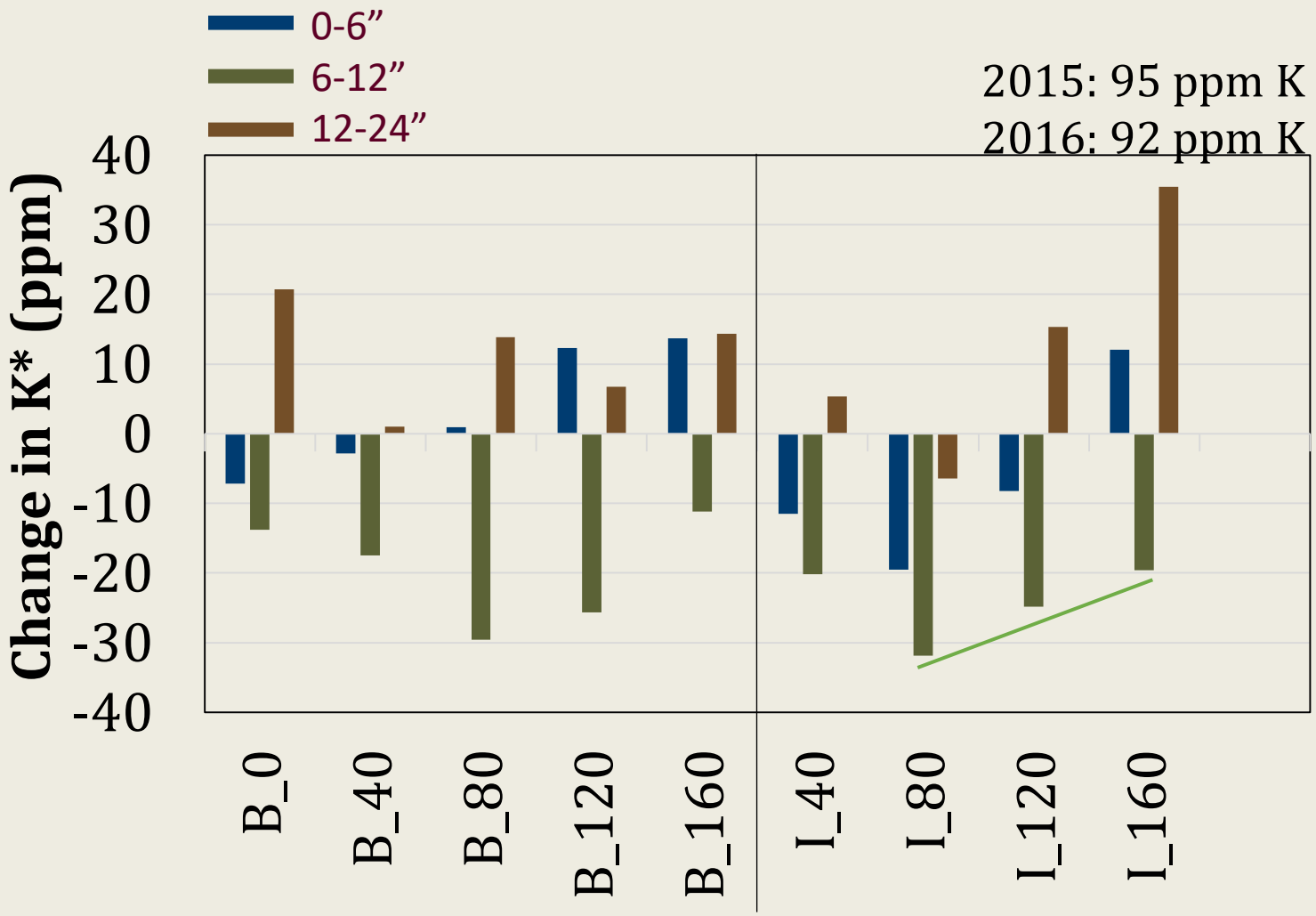
Lint Yield: Eastern Region, 2016



***Significant yield response (*P*<0.05)**

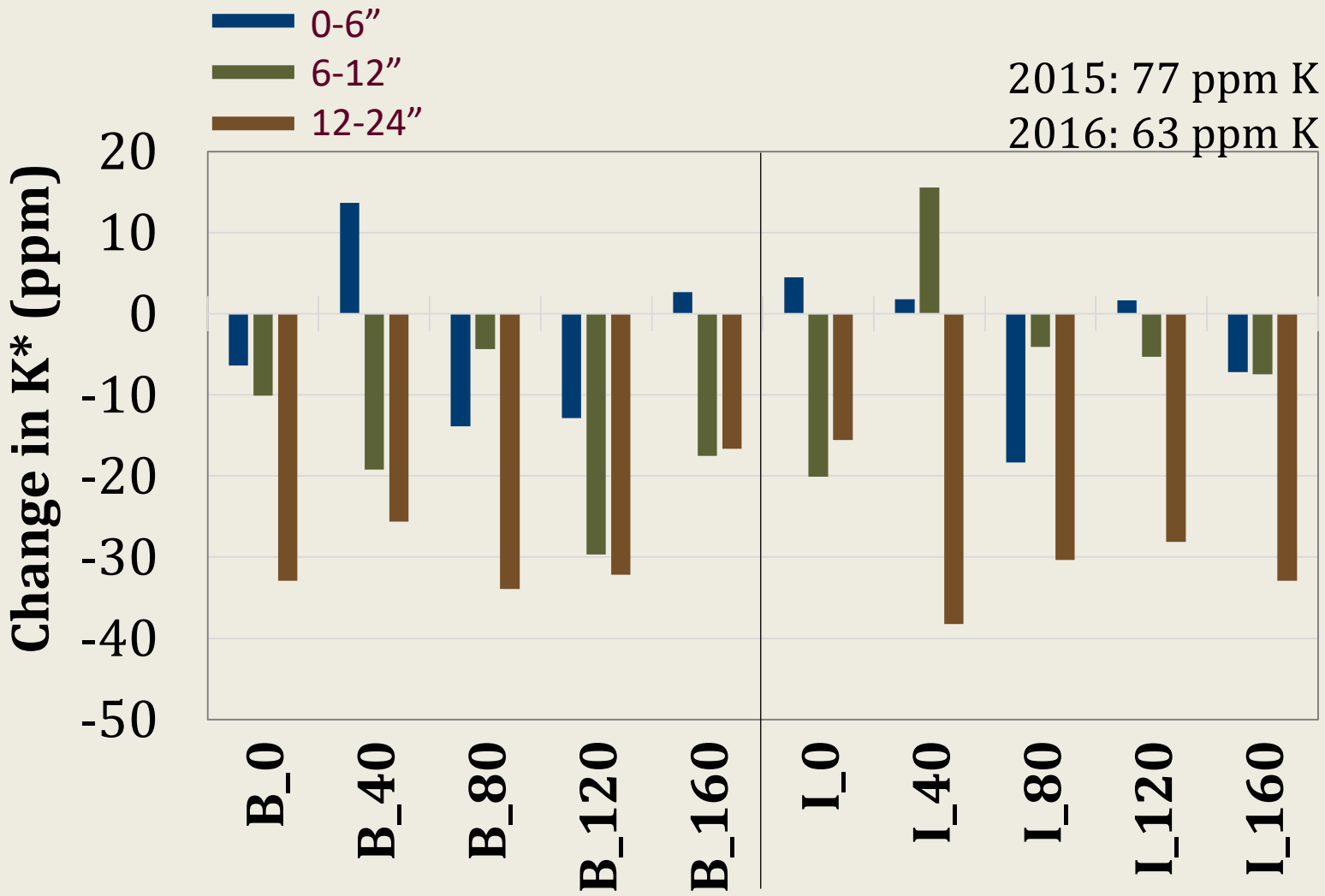
Results: Multi-Year Sites

Virginia: Change in Soil Test K Levels



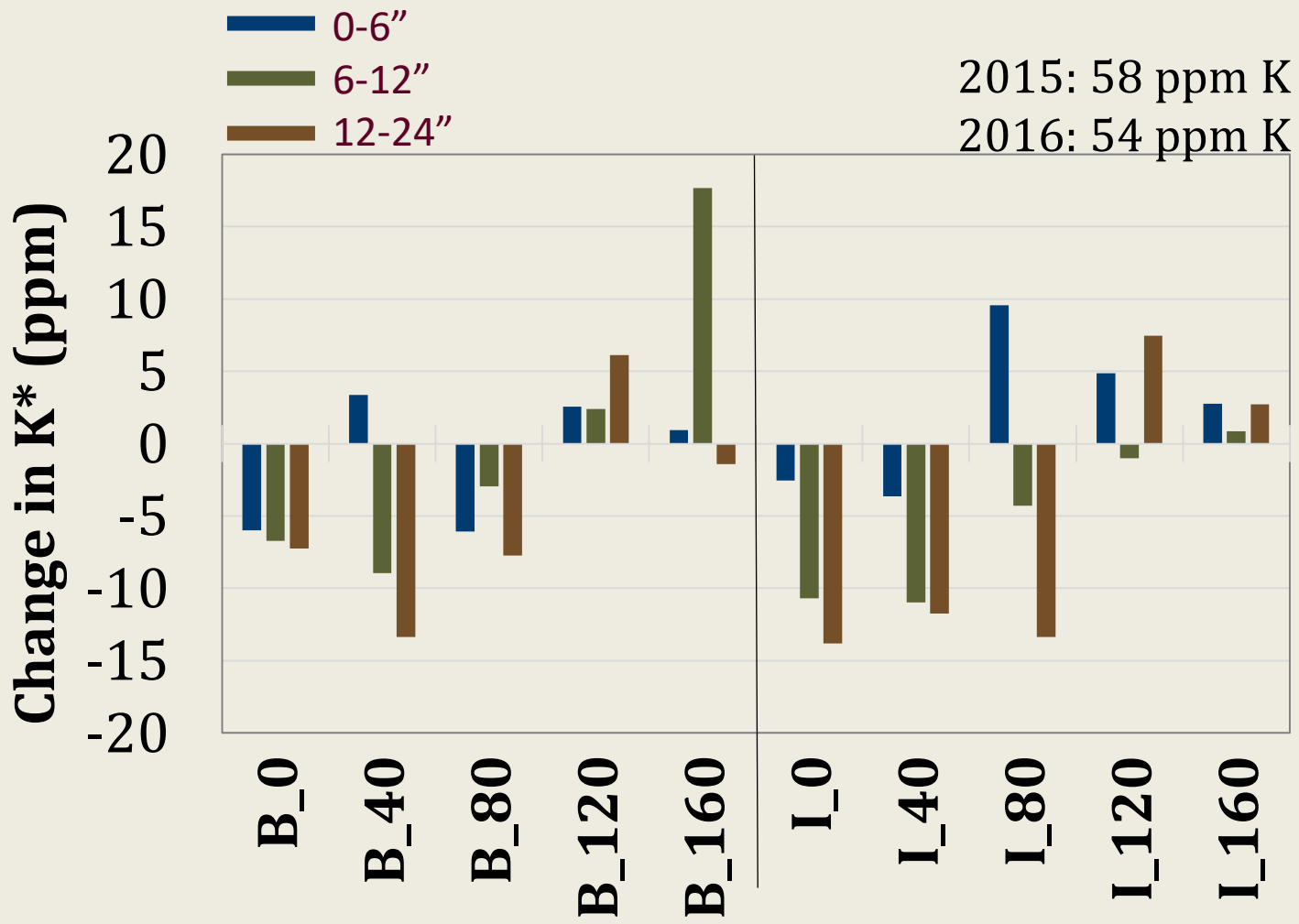
*Difference between 2015 and 2016

South Carolina: Change in Soil Test K Levels



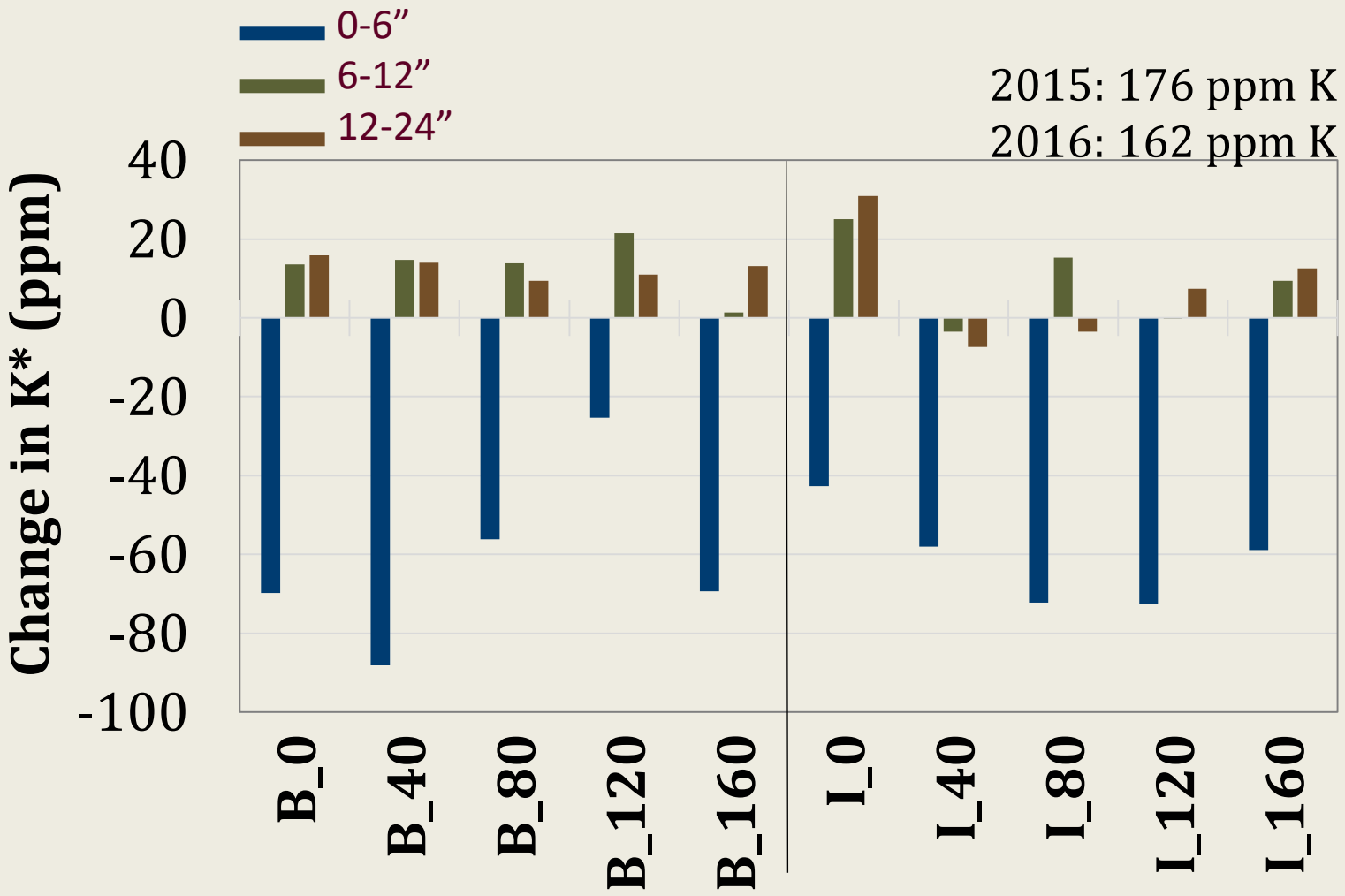
*Difference between 2015 and 2016

Tennessee: Change in Soil Test K Levels



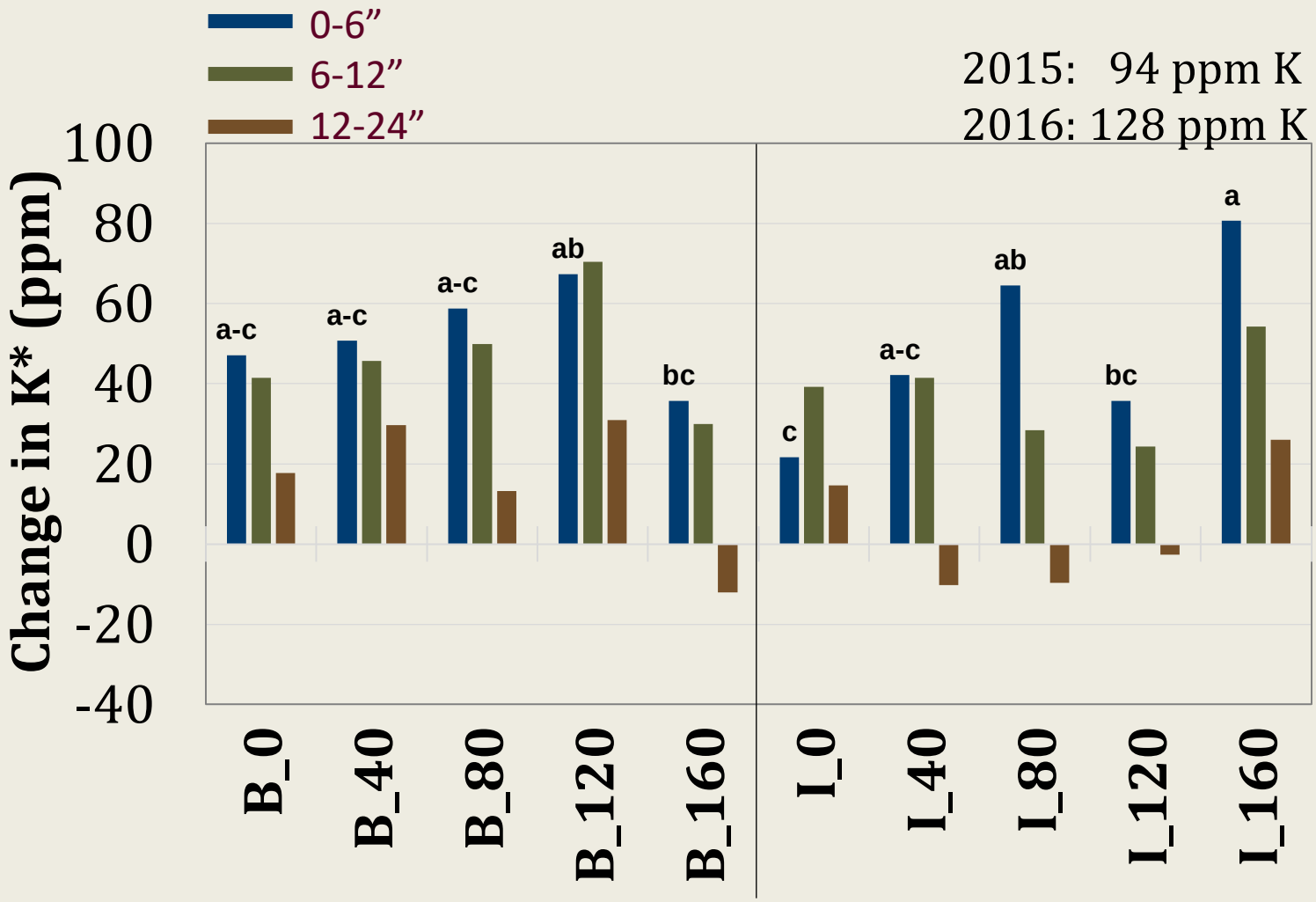
*Difference between 2015 and 2016

Arkansas: Change in Soil Test K Levels



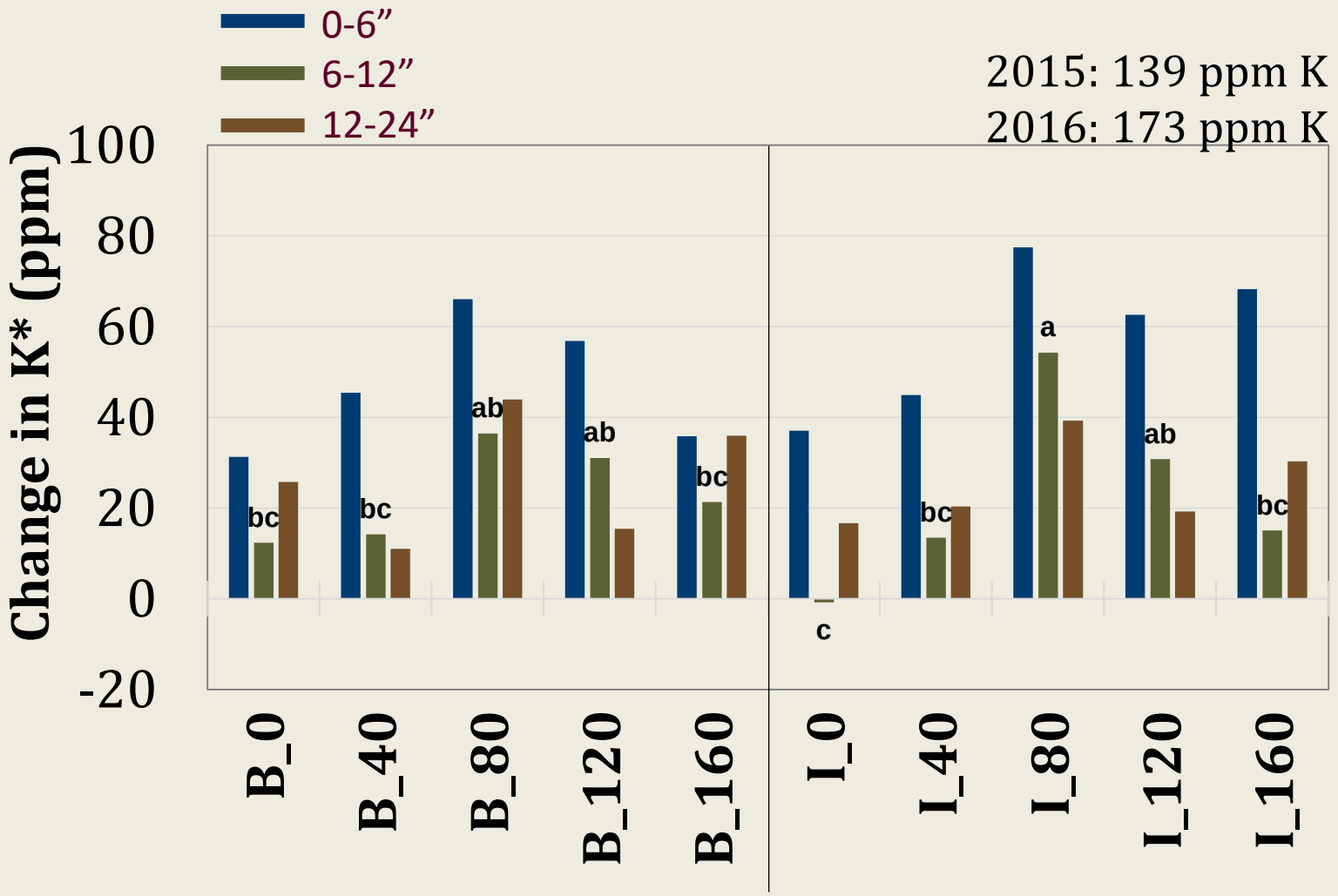
*Difference between 2015 and 2016

Missouri: Change in Soil Test K Levels



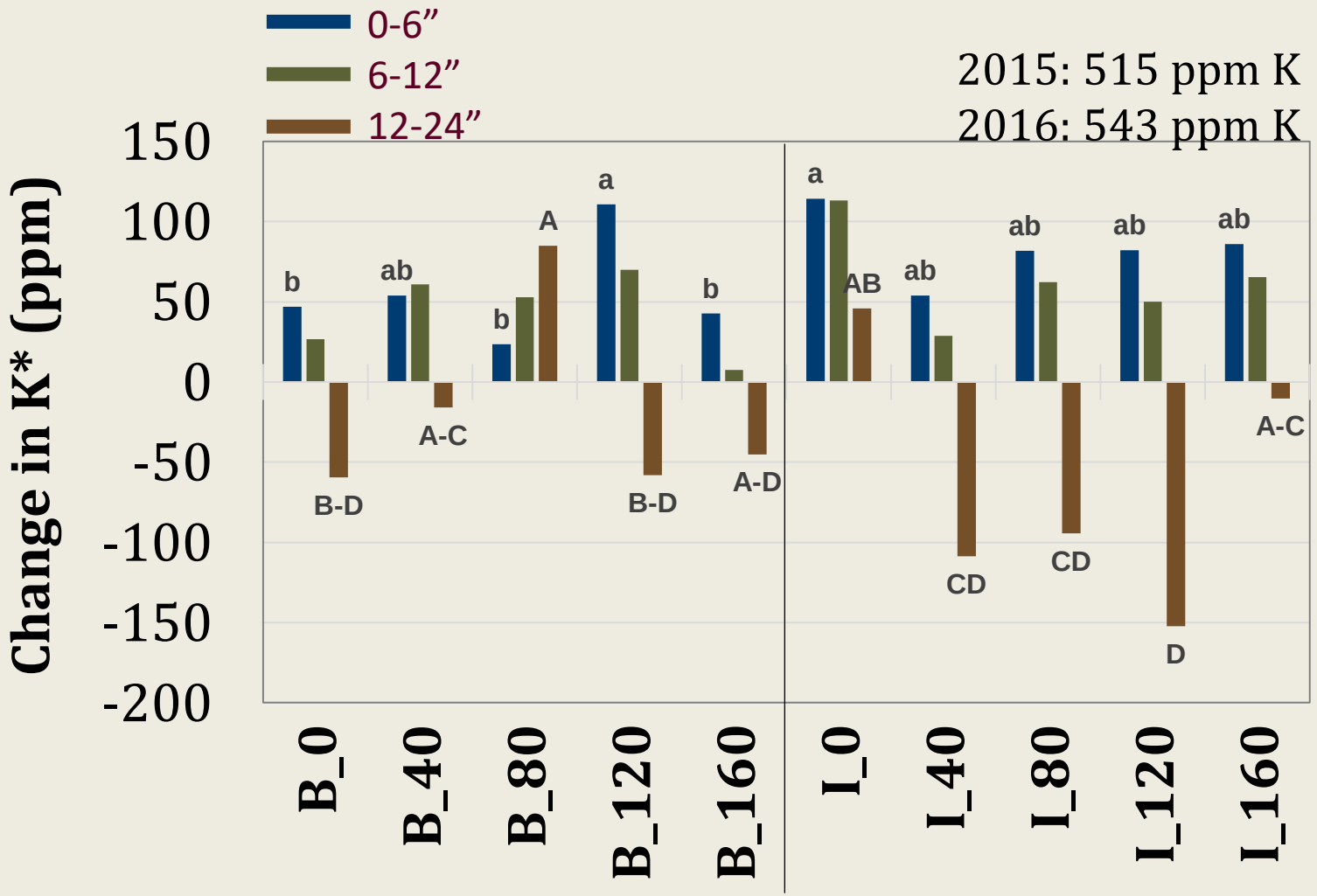
*Difference between 2015 and 2016

Mississippi: Change in Soil Test K Levels



*Difference between 2015 and 2016

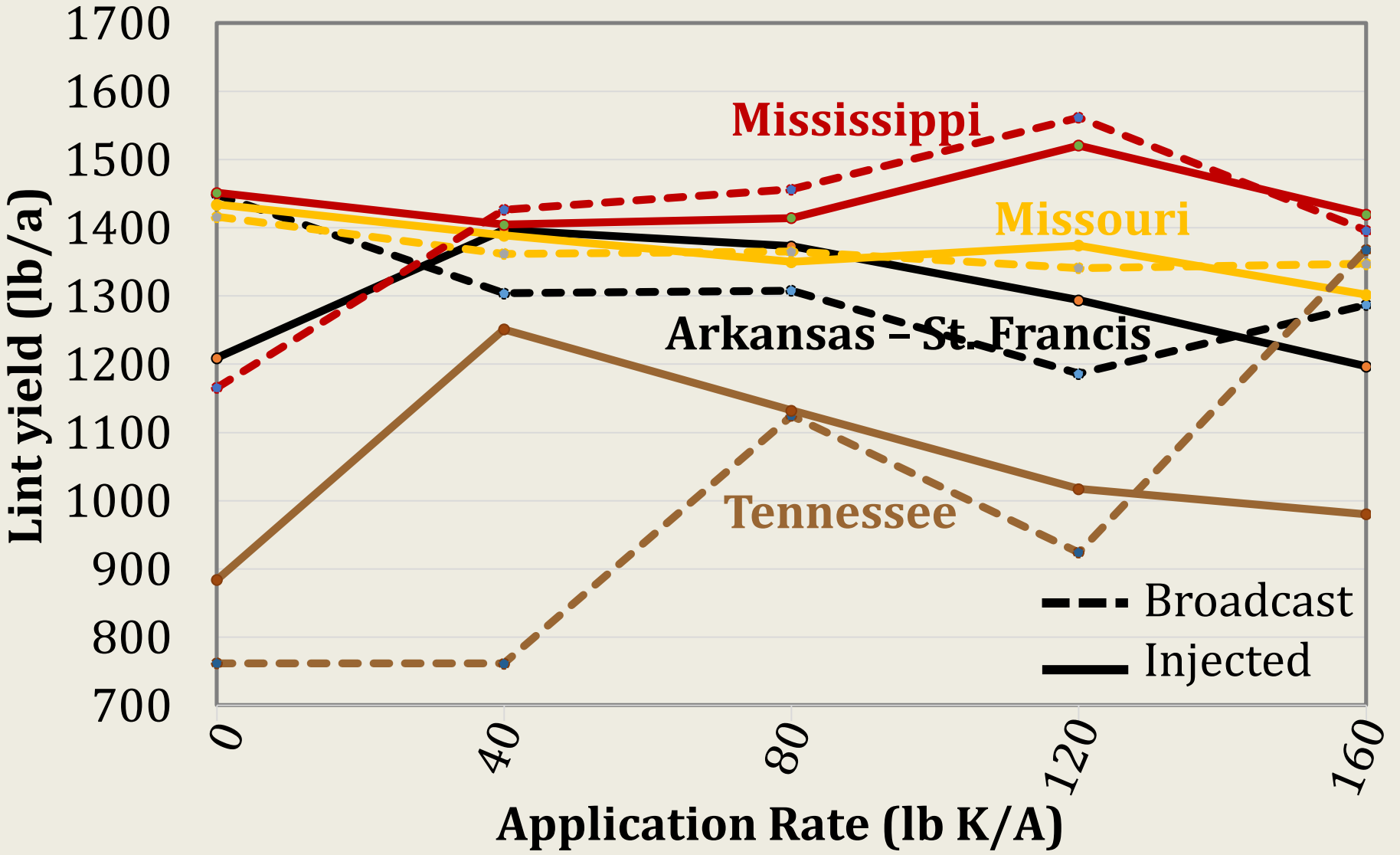
Arizona: Change in Soil Test K Levels



*Difference between 2015 and 2016

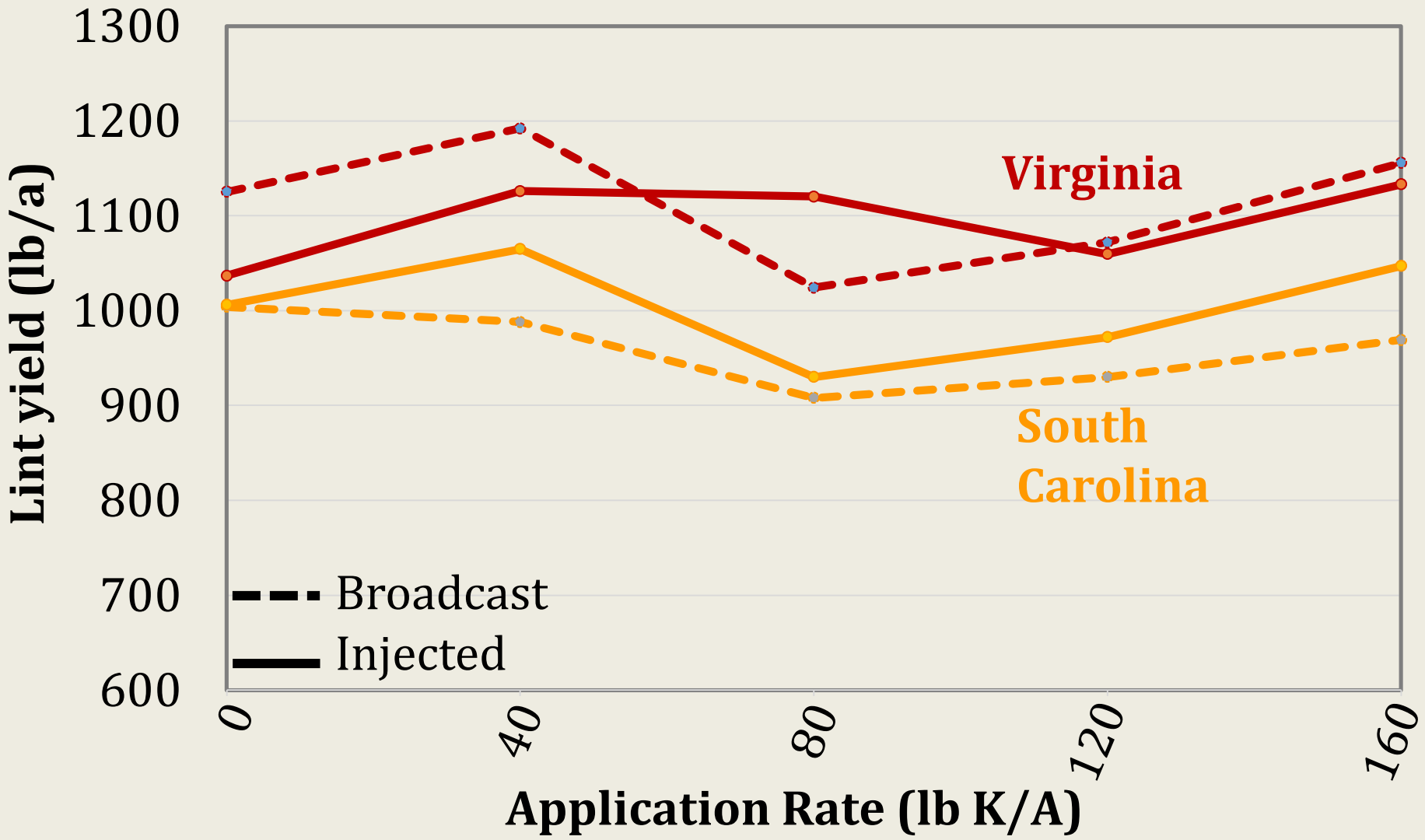
Delta Region, 2016

AR = 162 ppm K
MS = 173 ppm K
MO = 128 ppm K
TN = 54 ppm K

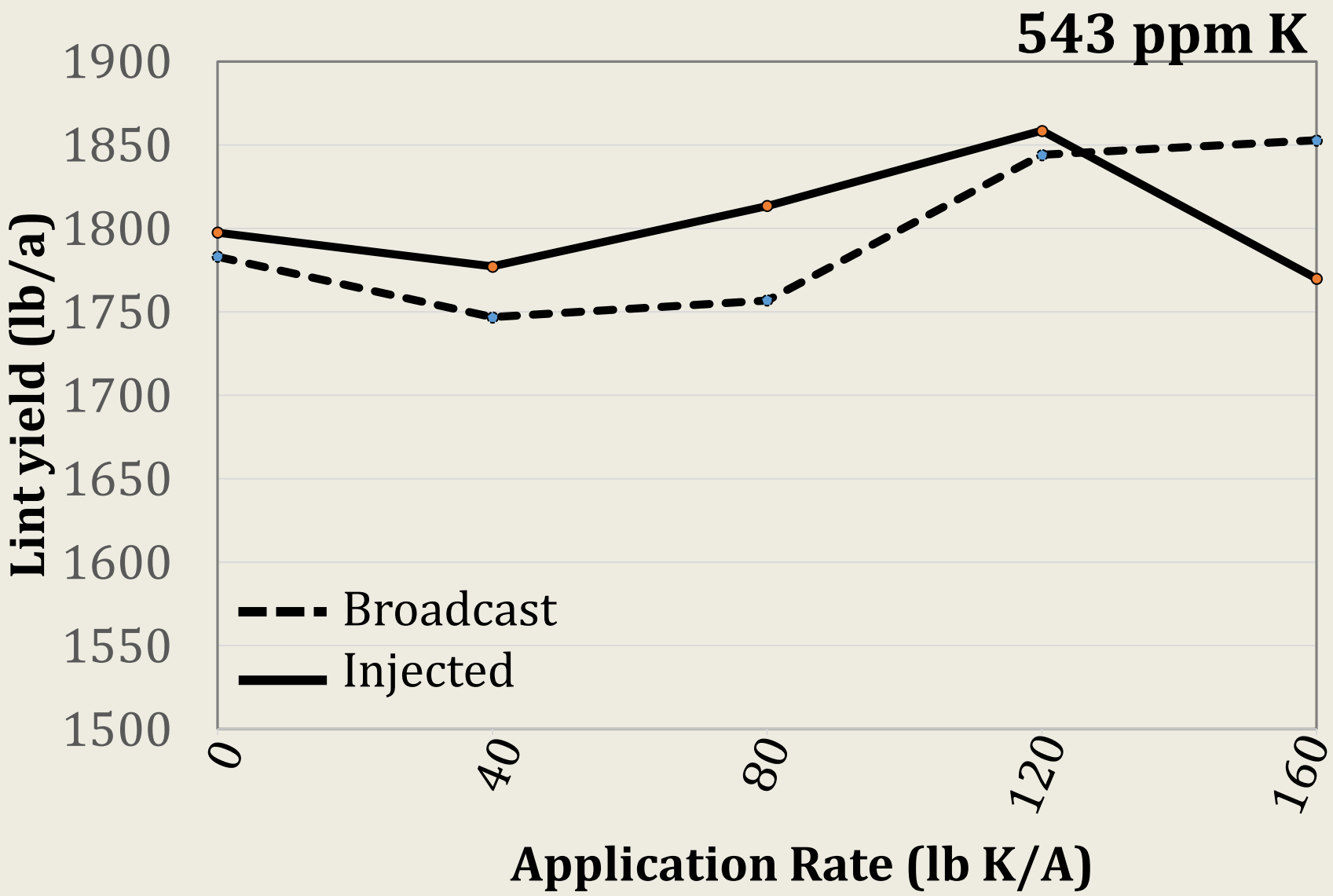


Southeast, 2016

VA = 91 ppm K SC = 63 ppm K



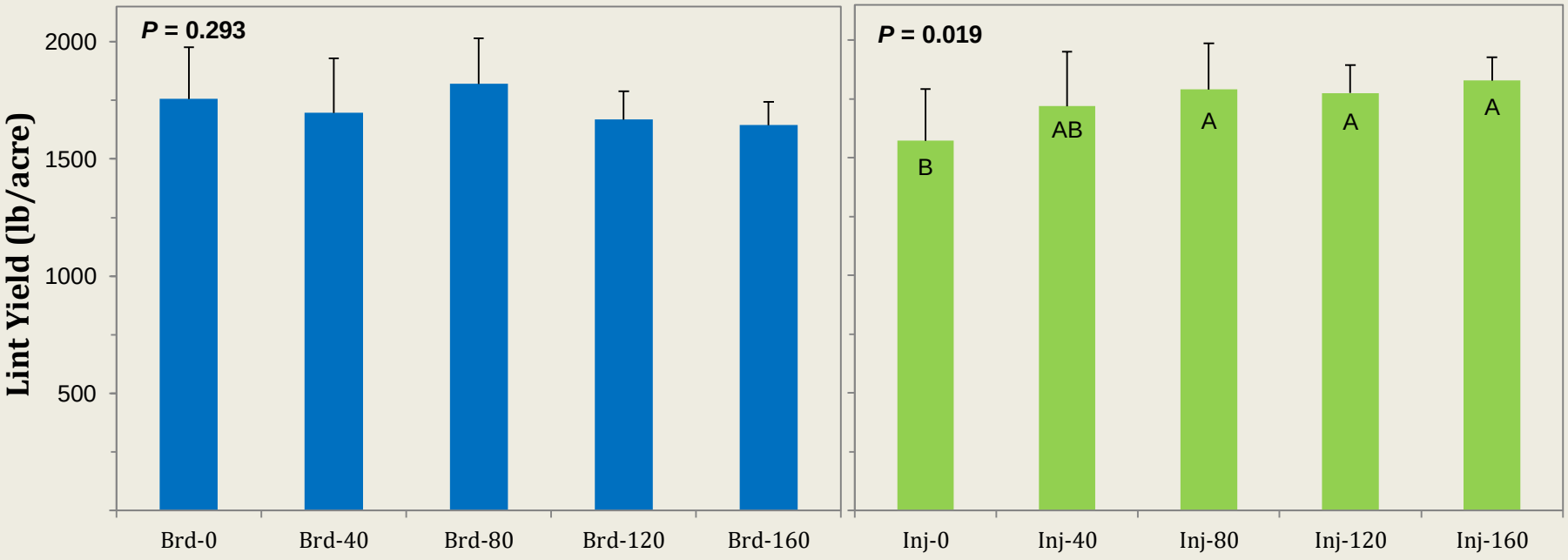
Lint Yield: Arizona, 2016



Data Analysis: Combined Years

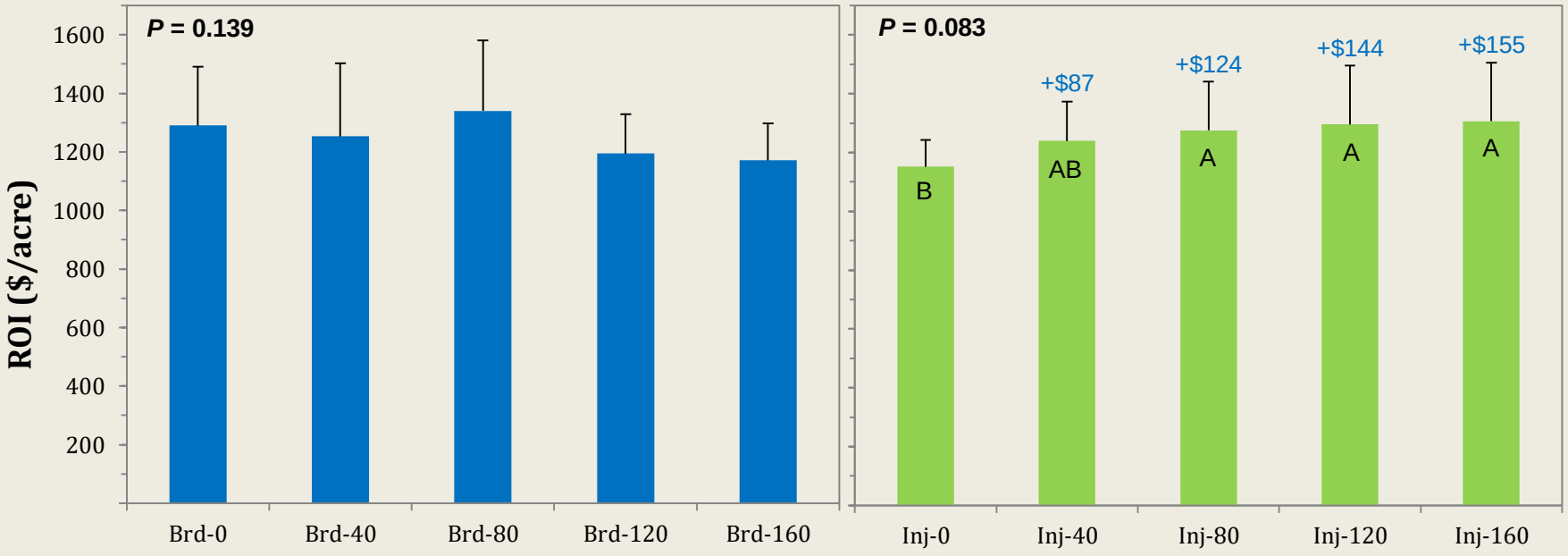
Lubbock: lint yield combined, 2015 and 2016

	Soil K (mg/kg)	
Depth	2015	2016
0-6"	392	287
6-12"	294	270
12-24"	252	240



Data Analysis: Combined Years

Lubbock: ROI combined, 2015 and 2016



Conclusions: Single-Year Sites

- **Application method comparisons**
  - **Injected had a more consistent yield response**
  - **Injected increase K use efficiency (lint/unit of K)**
- **At responsive sites (less than 150 ppm)**
  - **Micronaire increased as K levels increased**
  - **Strength increased at some sites as K levels increased**
- **Current soil analysis thresholds for K may need to be reevaluated**

Conclusions: Multi-Year Sites

- **Despite the sites in Southeast and Delta regions being at or below 125 ppm threshold and high yields for multiple years, no consistent yield response was observed from either application method or rates**
- **The Southwest location was not responsive for yield but did show some removal of K with depth**
- **In previous research, yield lint response has been more consistent in low moisture years. Adequate moisture in most locations in 2016 likely contributed to the lack of response to K applications**

Acknowledgments

- **Funding Sources**
  - **Cotton Incorporated**
  - **Fluid Fertilizer Foundation**
  - **I.P.N.I.**
  - **DeltaPine – seed**

- **Cooperators**

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