The Effect on TSNAs of Cutting and Housing Wet Tobacco

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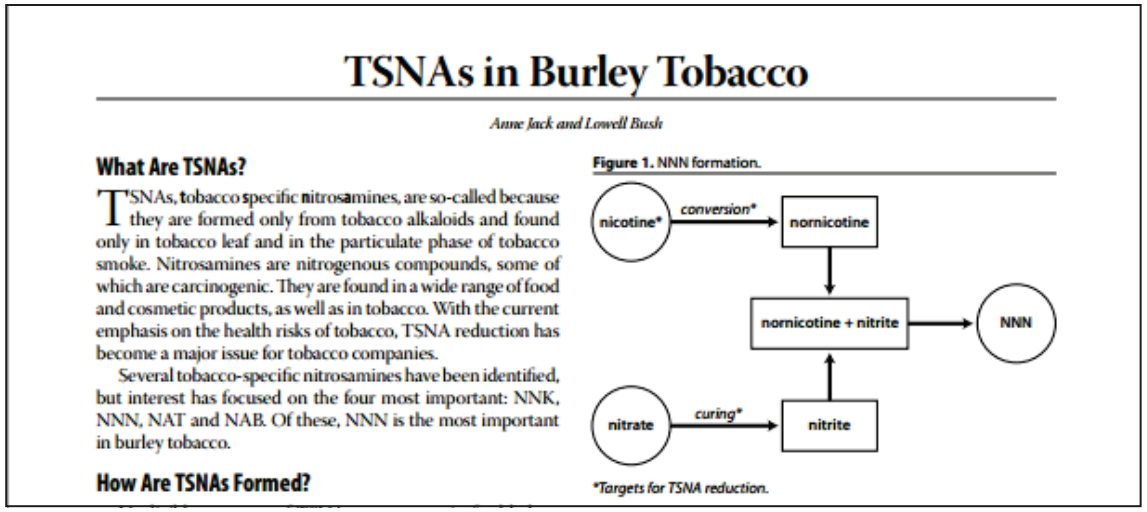
TSNA Relevance to Growers

- 2009 KY & TN Production Guide – chapter on TSNA management
  - Some recommendations tentative (cutting, housing wet)



TSNAs in Burley Tobacco

Anne Jack and Lowell Bush

What Are TSNAs?

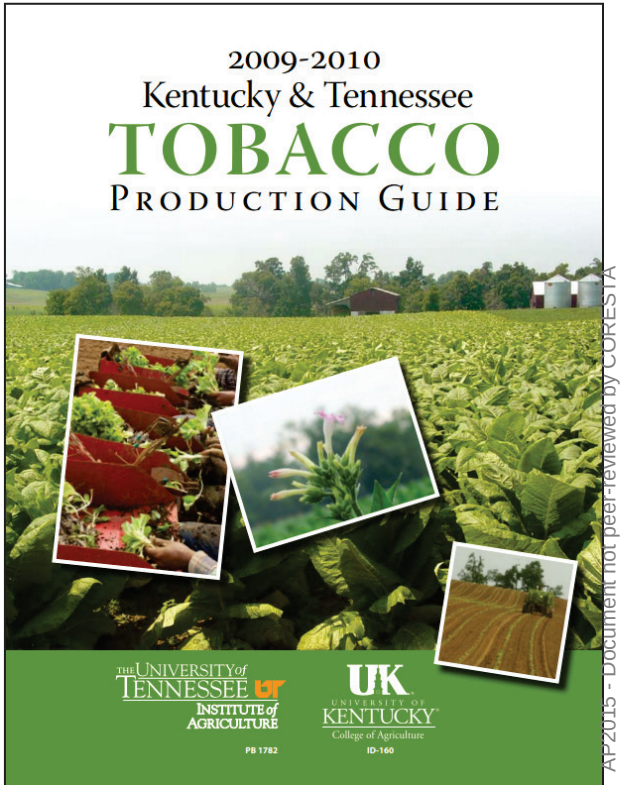
TSNAs, tobacco specific nitrosamines, are so-called because they are formed only from tobacco alkaloids and found only in tobacco leaf and in the particulate phase of tobacco smoke. Nitrosamines are nitrogenous compounds, some of which are carcinogenic. They are found in a wide range of food and cosmetic products, as well as in tobacco. With the current emphasis on the health risks of tobacco, TSNA reduction has become a major issue for tobacco companies.

Several tobacco-specific nitrosamines have been identified, but interest has focused on the four most important: NNK, NNN, NAT and NAB. Of these, NNN is the most important in burley tobacco.

How Are TSNAs Formed?

Figure 1. NNN formation.

*Targets for TSNA reduction.

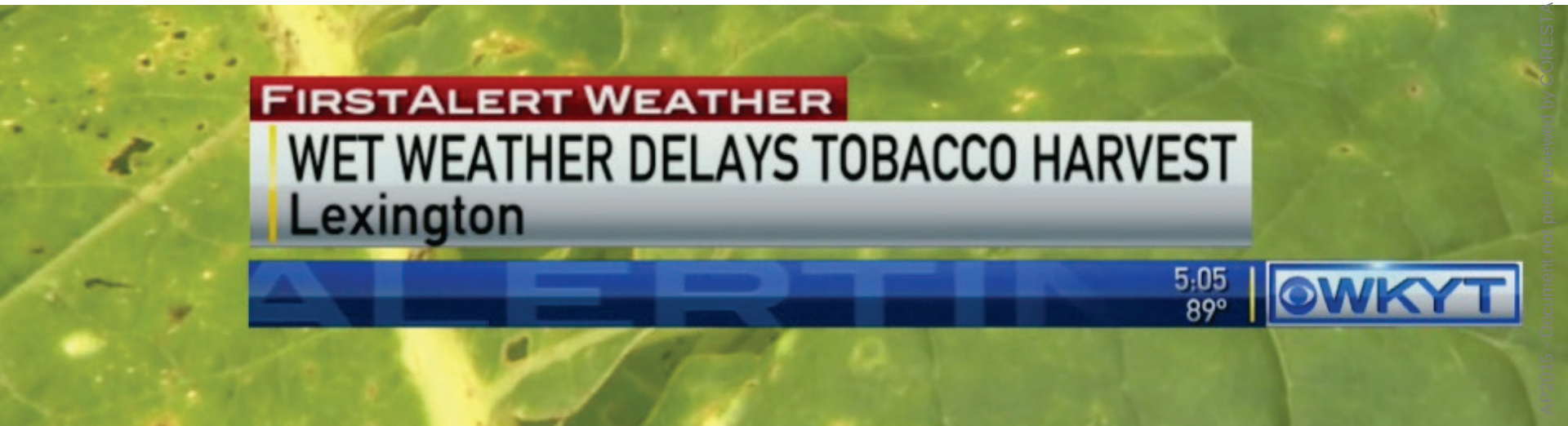


Background

- Previous work: pre-harvest applied anti-oxidants → ↑ TSNAs
  - Water control > unsprayed control
- Possible that wetting leaf ↑ TSNAs
  - Provisionally advised growers not to cut or house wet tobacco
  - Little supporting data
  - Also not advisable because of green tobacco sickness (nicotine poisoning)

Why Cut/House Wet?

- Time running out
  - Other operations
  - Frost
- Labor
  - Contract labor availability



Objectives

- Test tentative recommendations to growers
  - Not to cut wet tobacco
  - Not to house wet tobacco

Procedure

3 year study: 2011, 2012, 2013

Cutting Treatments

Cut dry

Cut wet

200 gallons acre^{-1}

1870 L ha^{-1}

Housing Treatments

Railwagon

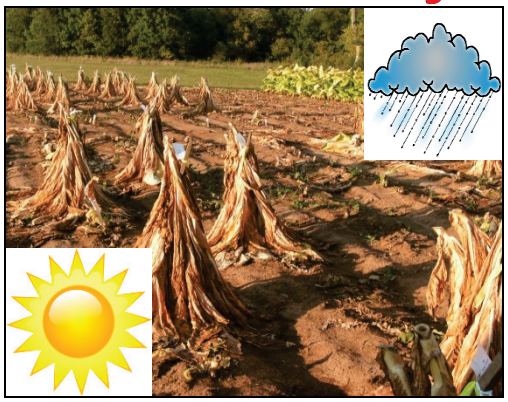
No sun
No rain

Wilted on wagons

Sun
No rain

6 days cutting
to pickup

Field wilted, housed dry



Sun
Rain

Field wilted, housed wet

Varieties

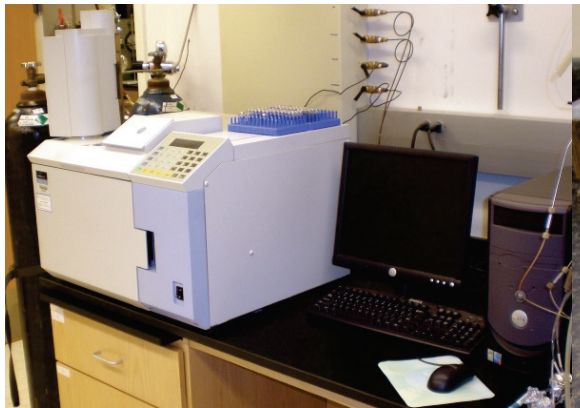
High converter, high TSNA

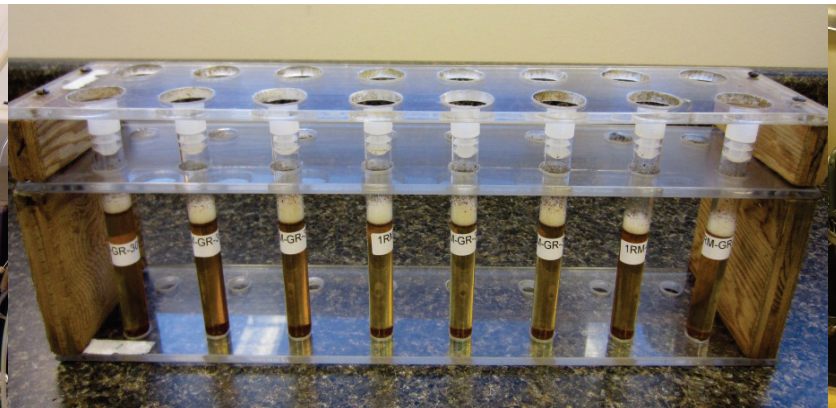
TN 90LC

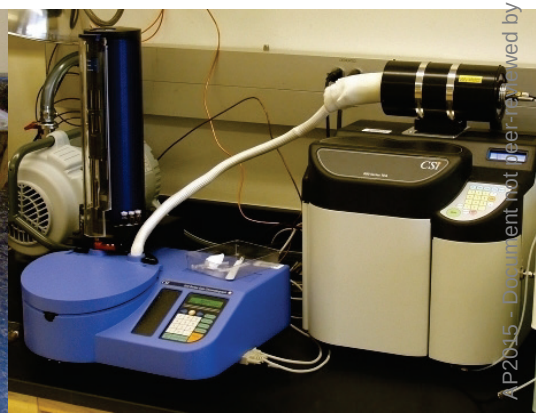
TN 90H

Variables

- Alkaloids
- TSNAs
- NO_2 N
- NO_3 N







Analyses on:

Both lamina & midribs

Weather

2011

- Set late – wet spring
  - Housed late in season
- Continuous rain after cutting
  - “Wilted on wagon” treatment
    - Ineffective because left indoors
- Unfavorable curing
  - Humid but cold
  - Low TSNAs
    - 3-4 ppm in high converter

2012

- Set on time
  - Housed early in season
- Extended drought
  - Drip irrigation
- Less favorable curing
  - Warm, fairly dry
  - Higher TSNAs
    - 10-11 ppm in high converter
      - vs 3-4 ppm in 2011

2013

- Set on time
  - Housed early in season
- VERY wet early in season
  - Small root system
- Despite favorable curing
  - Warm & humid
  - Low TSNAs, similar to 2011
    - 3-4 ppm in high converter
      - vs 10-11 ppm in 2012

Results

Cutting: All Variables

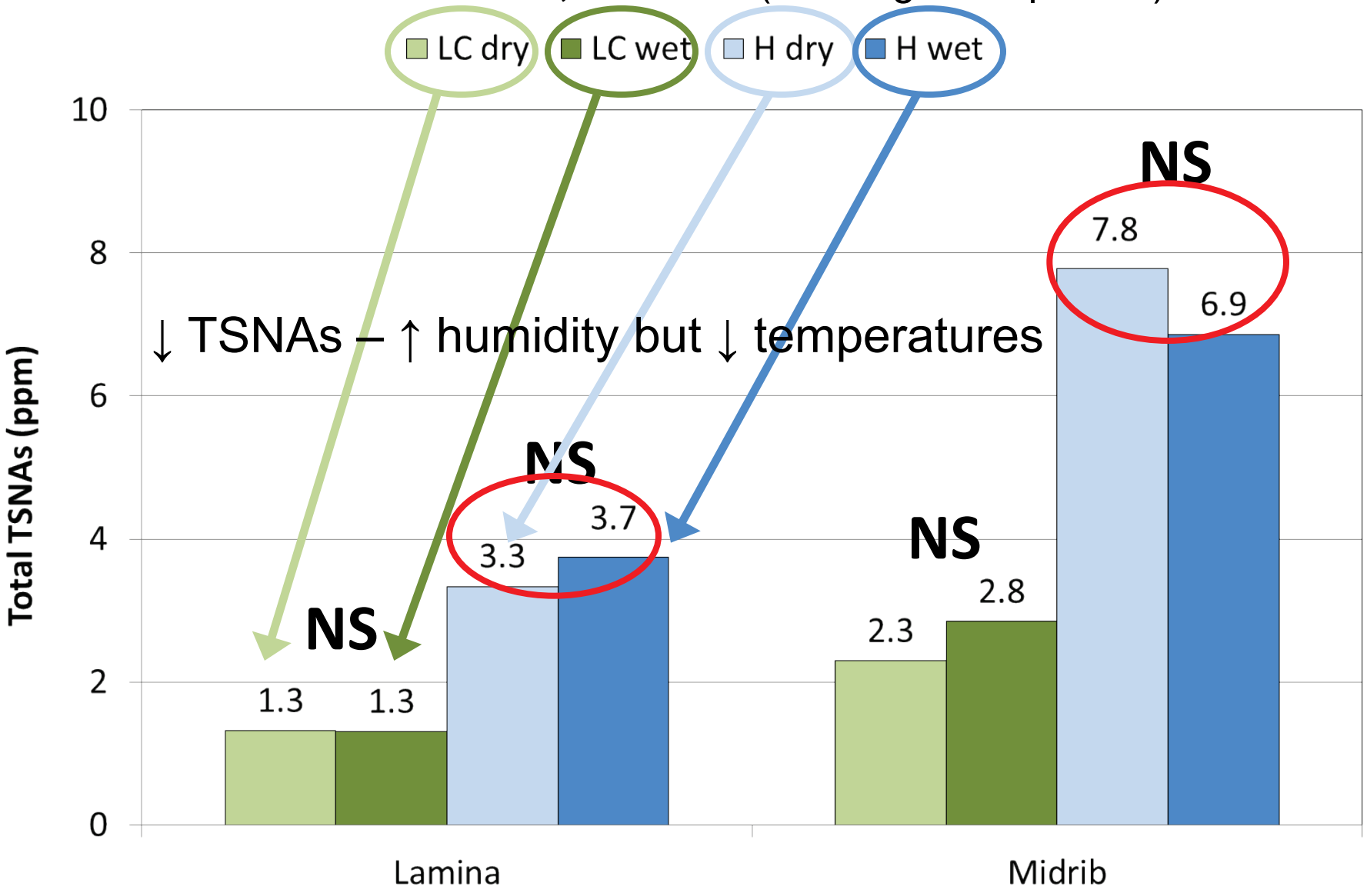
Both Varieties, Lamina & Midrib

2011	NS
2012	NS
2013	NS
Combined	NS

P>0.05

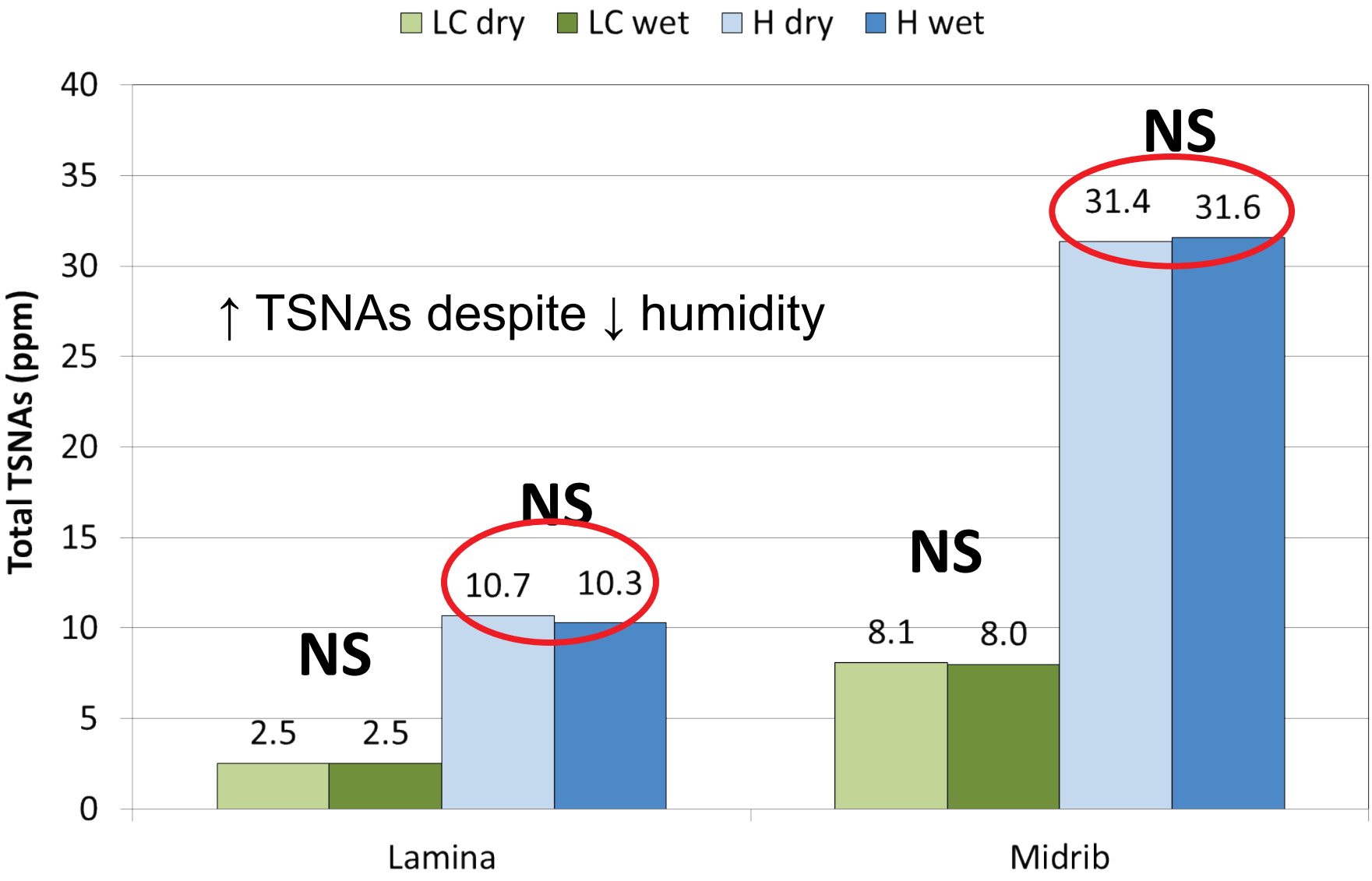
Total TSNAs 2011: Cutting Treatments

Lamina & Midrib, LC & H (housing trmts pooled)



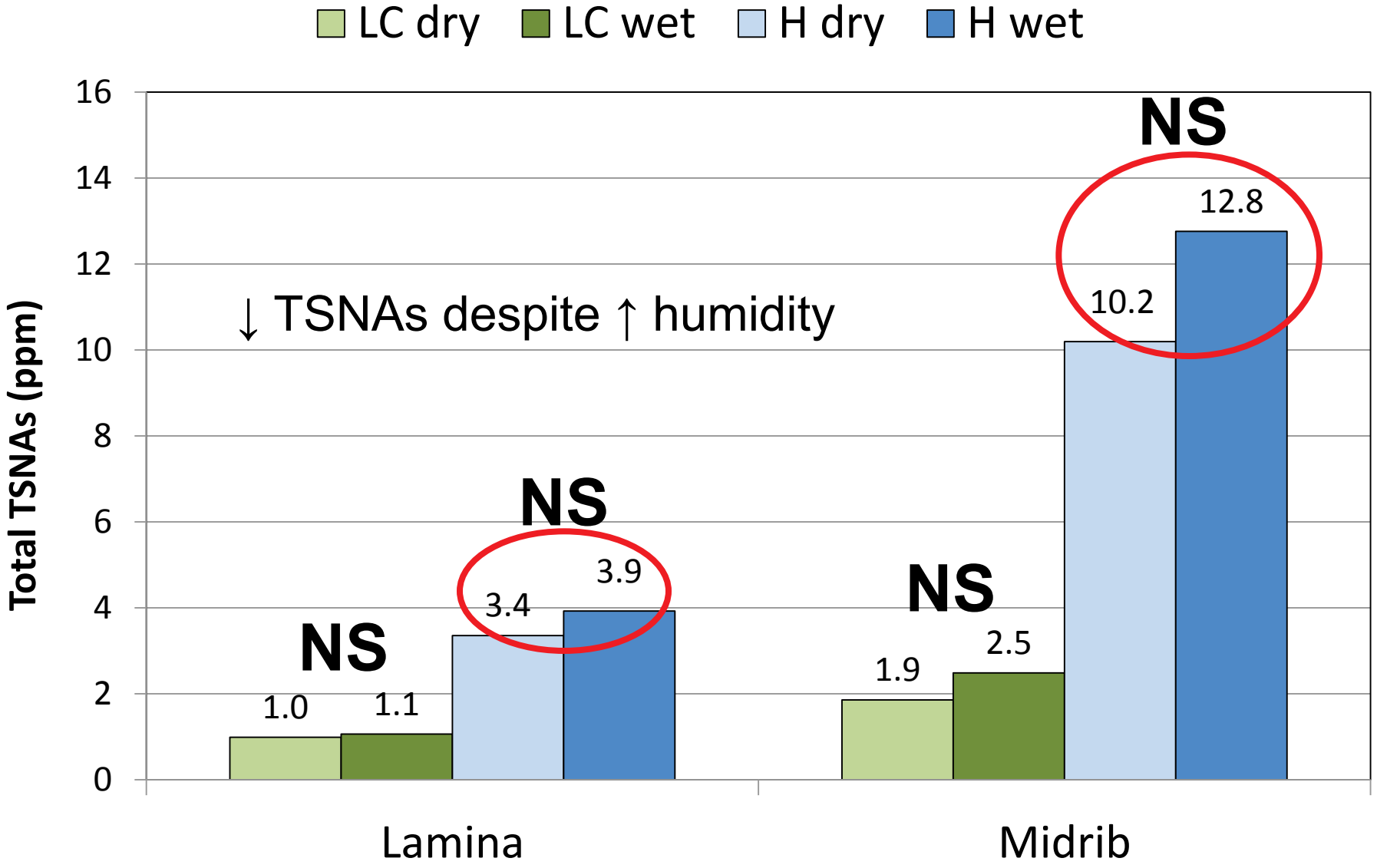
TOTAL TSNAs 2012: Cutting Treatments

Lamina & Midrib, LC & H (housing trmts pooled)



TOTAL TSNAs 2013: Cutting Treatments

Lamina & Midrib, LC & H (housing trmts pooled)



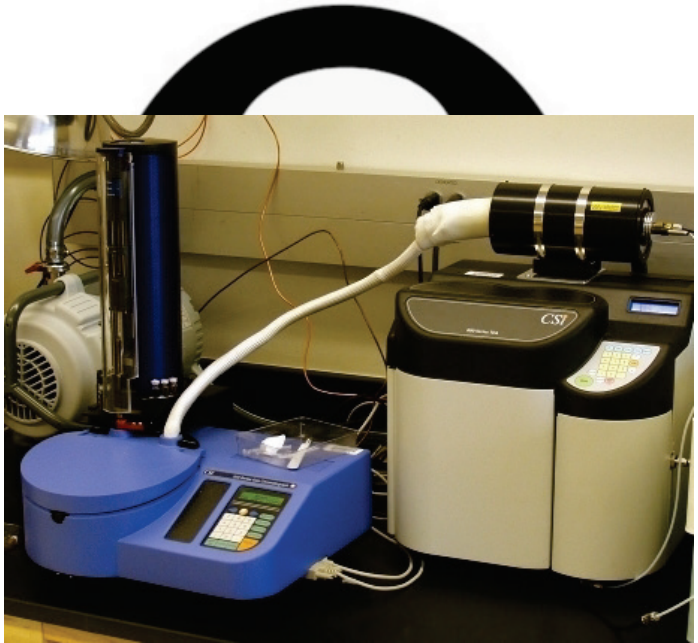
2011 Housing Treatments

Both Varieties, Lamina & Midrib

All variables NS P>0.05

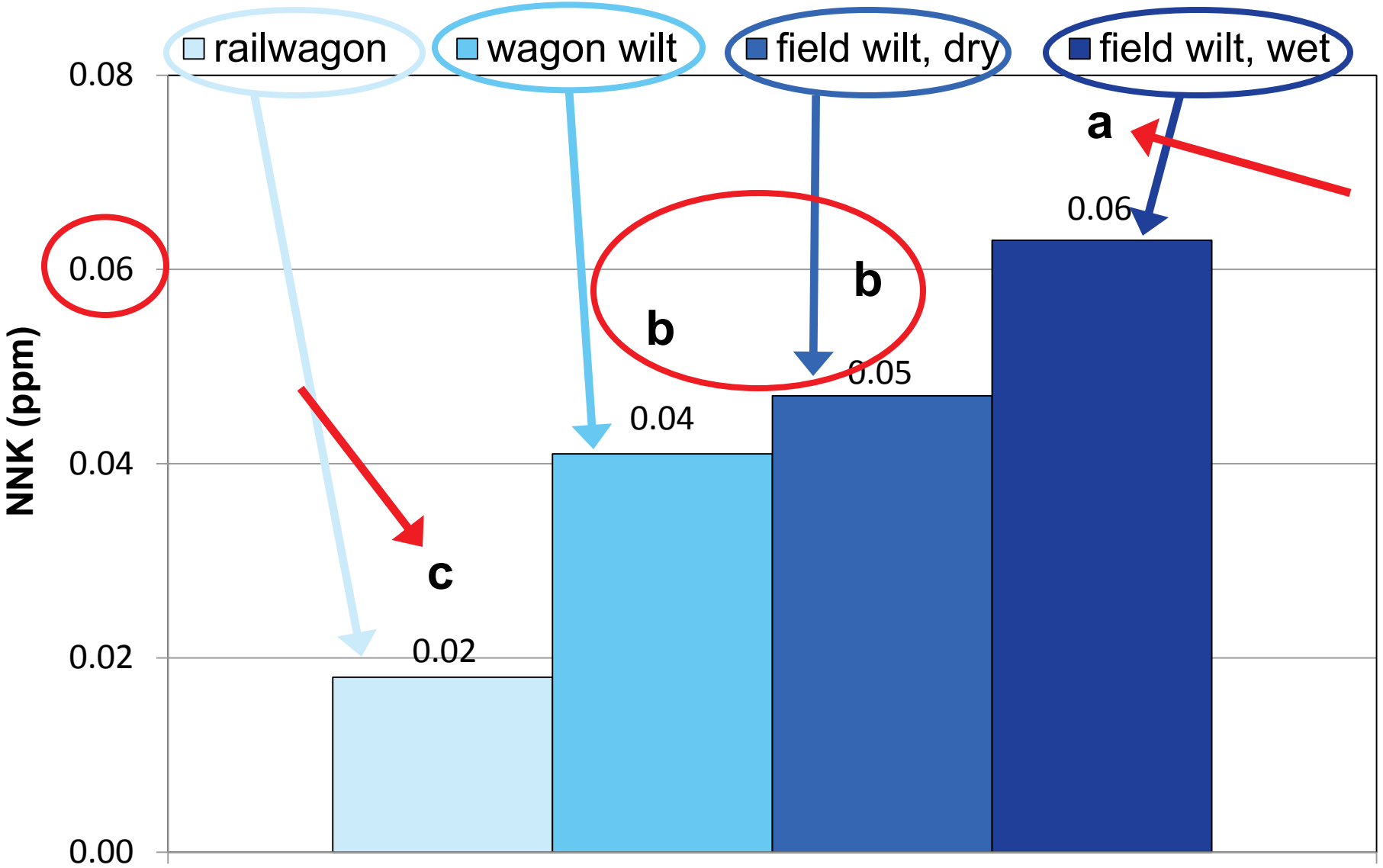
Data presented only for 2013, 2014

NNK



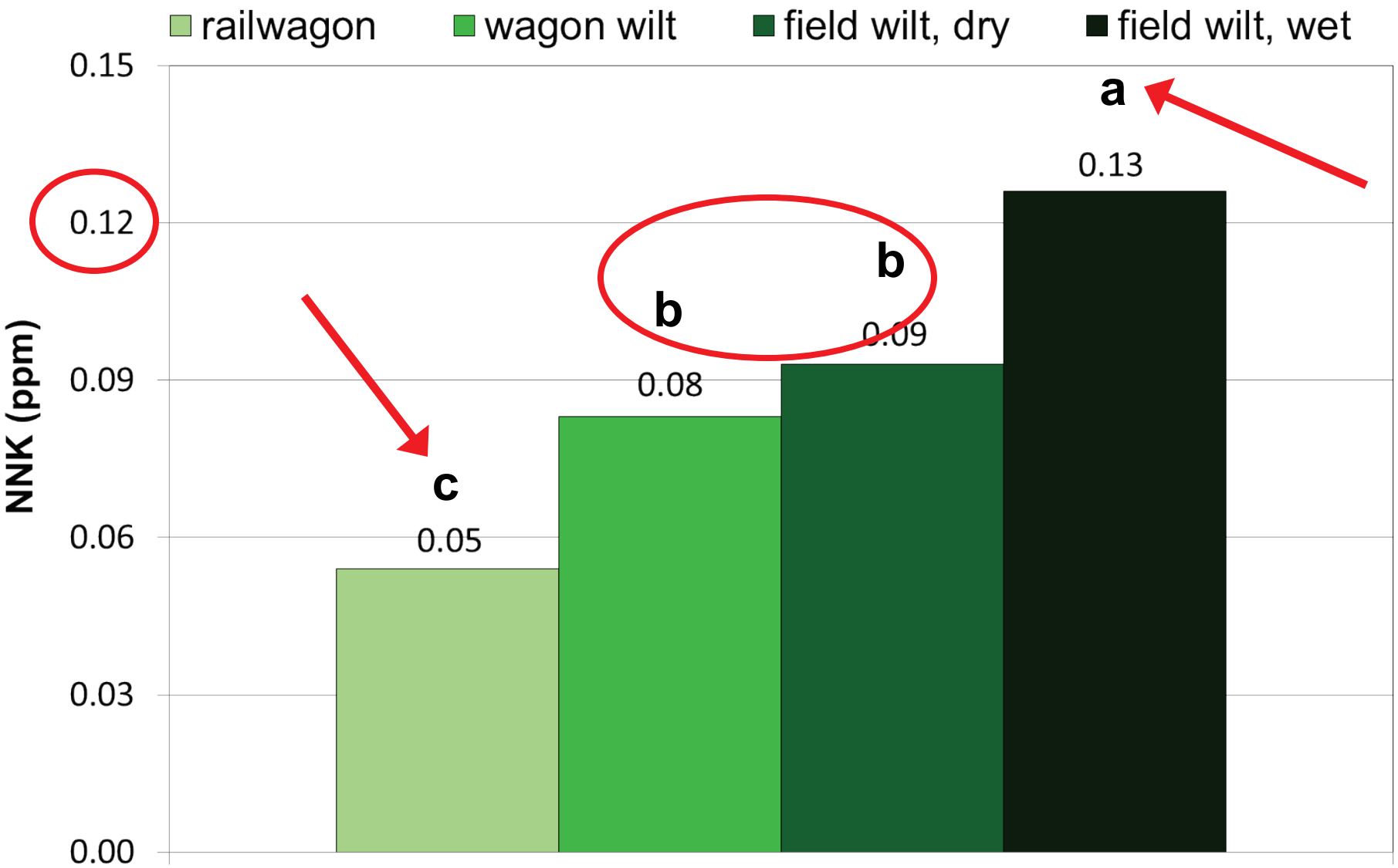
NNK 2012: Housing Treatments

High Converter: Lamina (cutting trmts pooled)



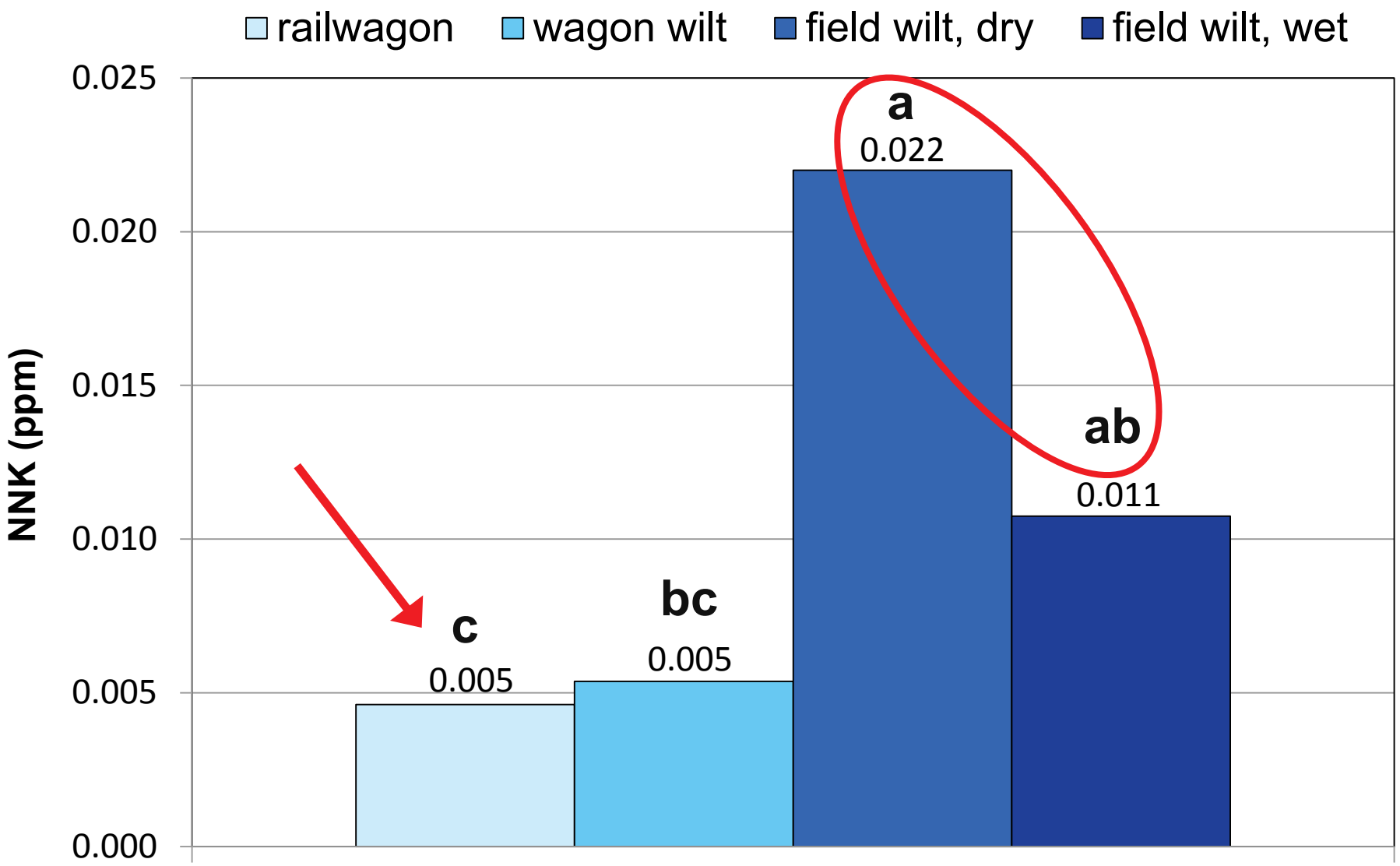
NNK 2012: Housing Treatments

Low Converter: Lamina (cutting trmts pooled)



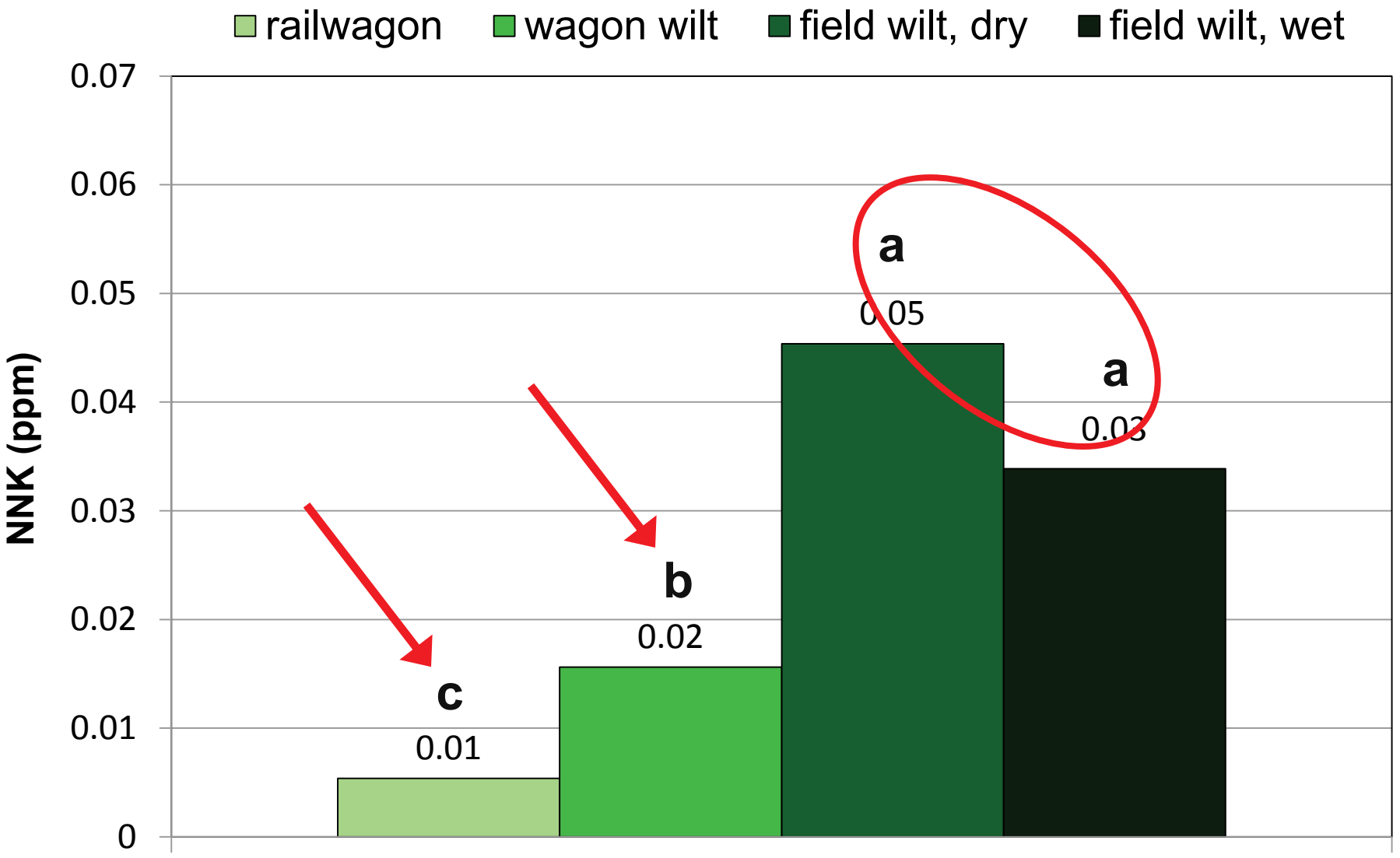
NNK 2013: Housing Treatments

High Converter: Lamina (cutting trmts pooled)



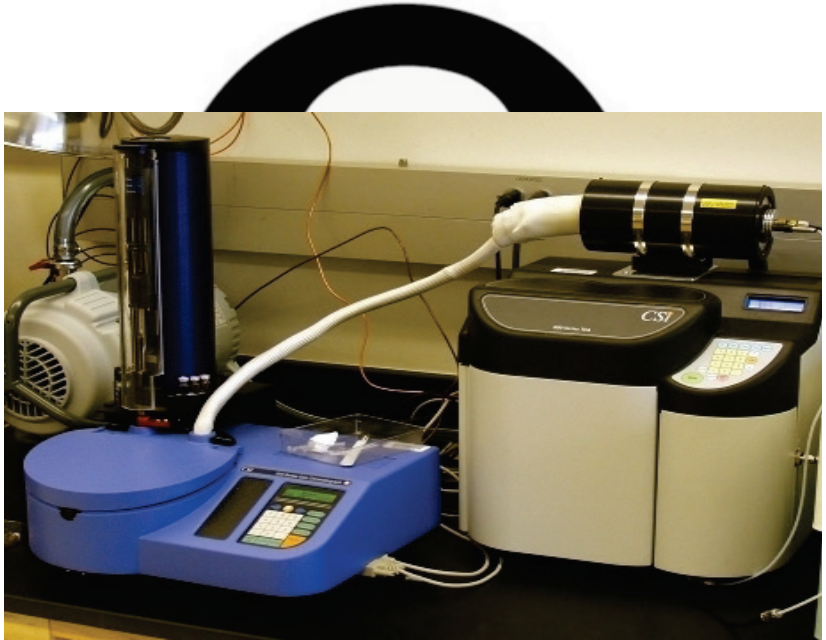
NNK 2013: Housing Treatments

Low Converter: Lamina (cutting trmts pooled)



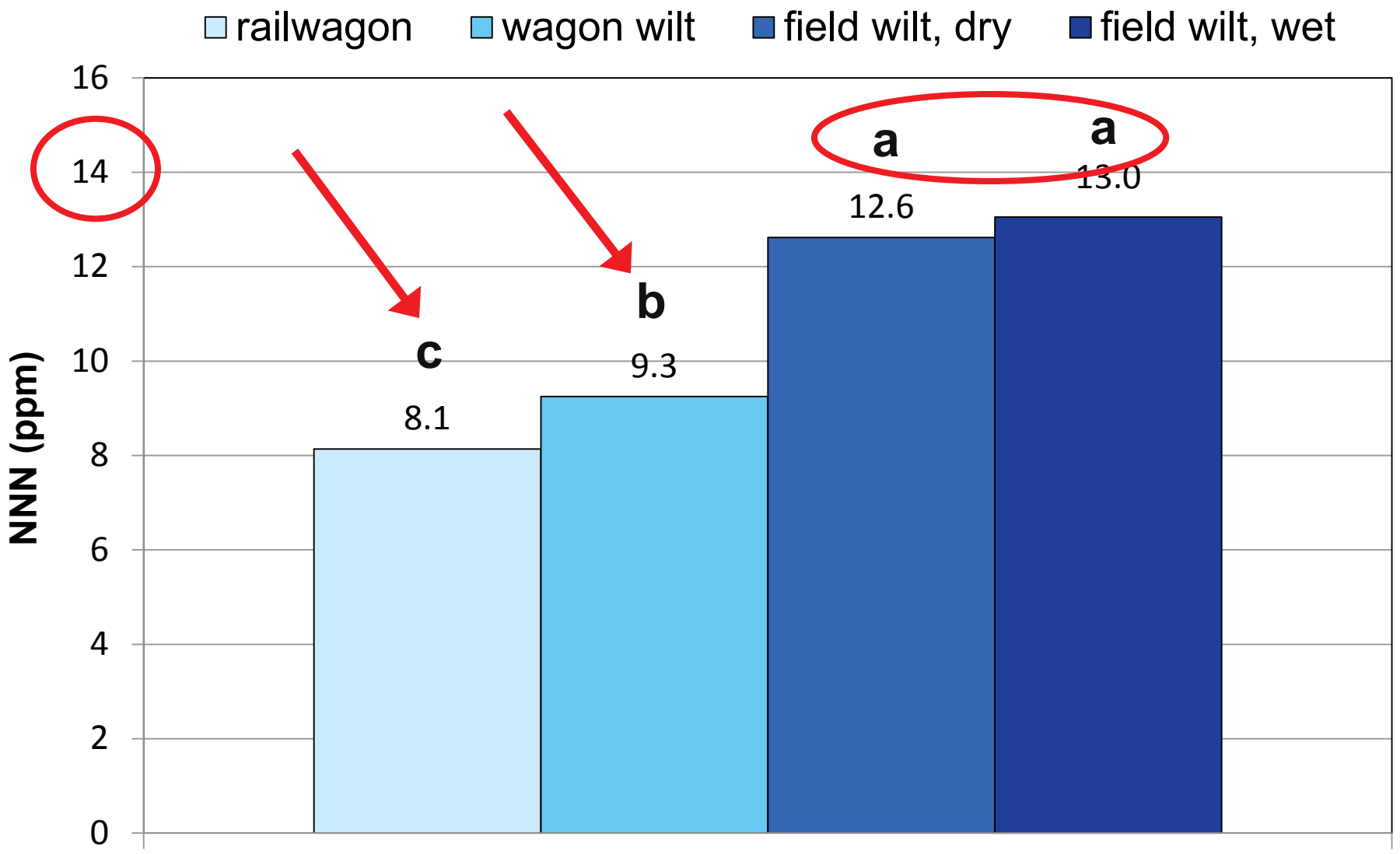
NNK: Years combined: not valid, Housing x Year interaction

NNN



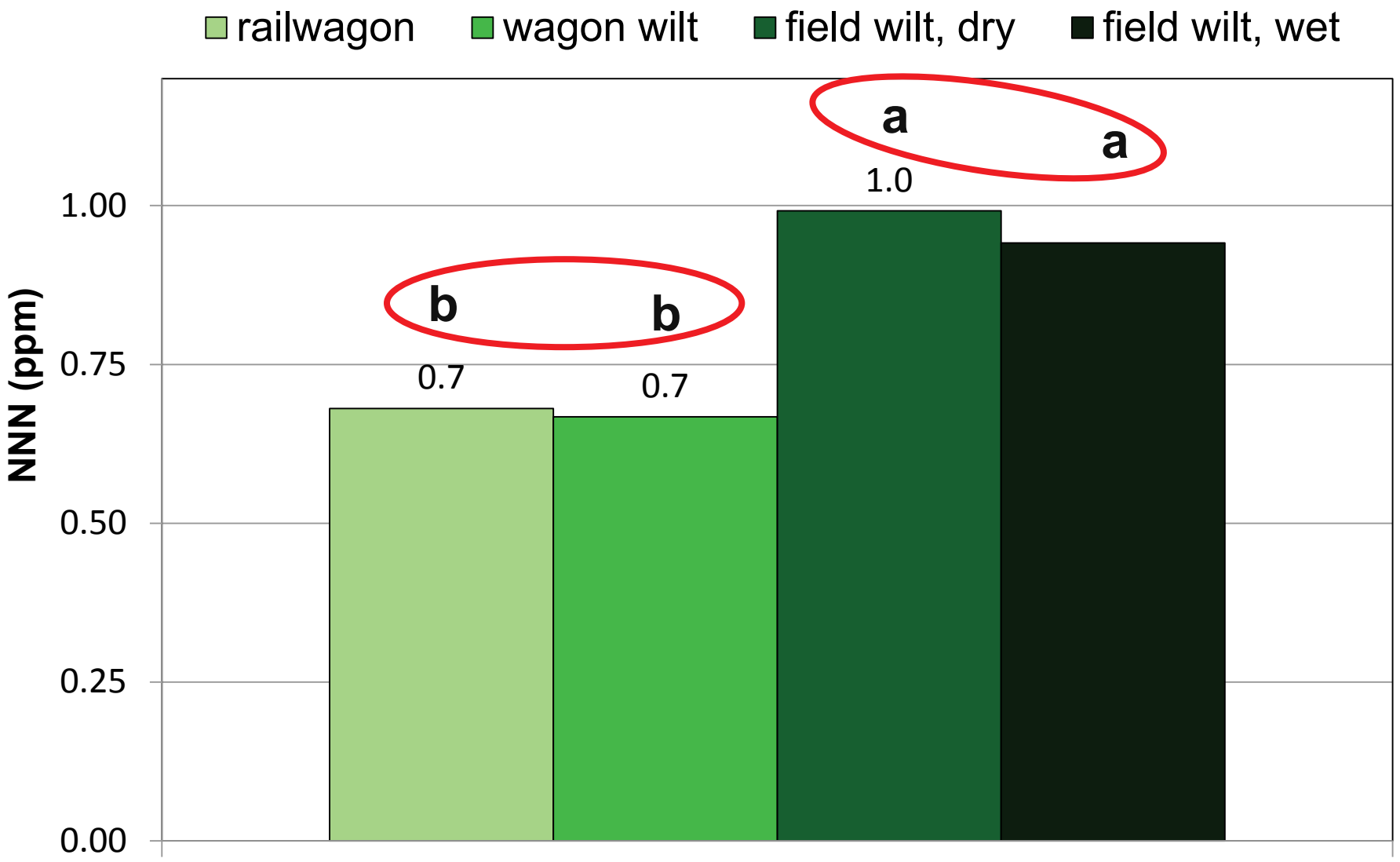
NNN 2013: Housing Treatments

High Converter Midrib (cutting trmts pooled)

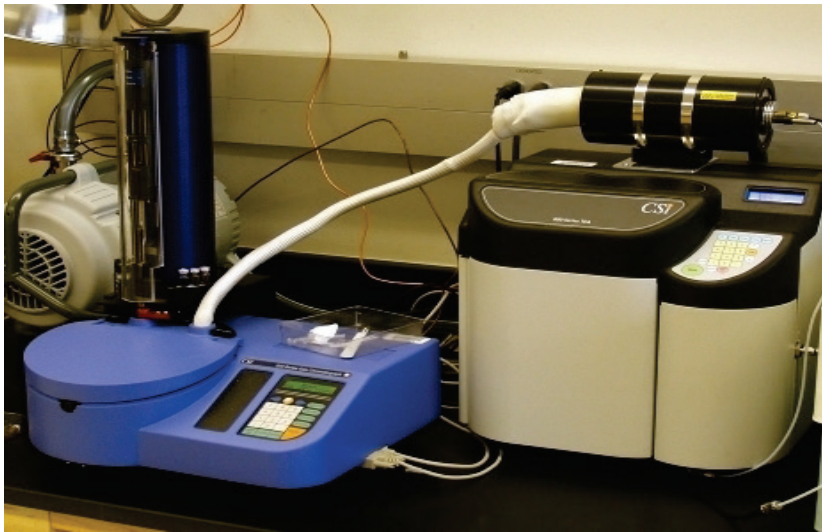


NNN Years Combined: Housing Treatments

Low Converter: Lamina (cutting trmts pooled)

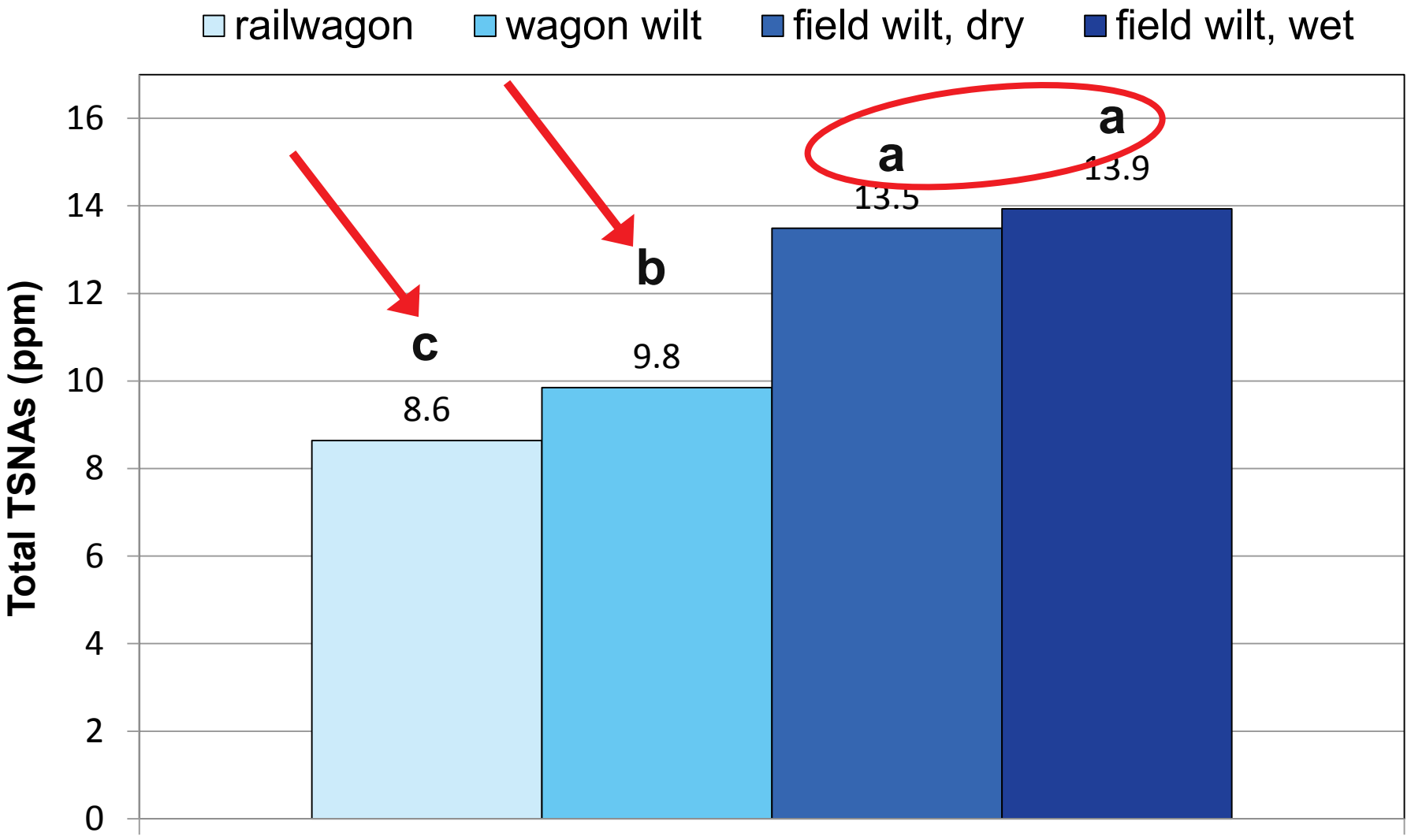


Total TSNAs

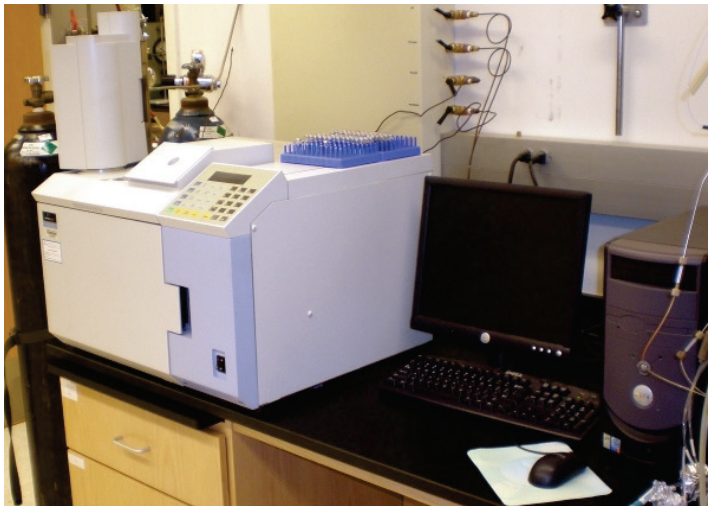


Total TSNAs 2013: Housing Treatments

High Converter: Midrib (cutting trmts pooled)

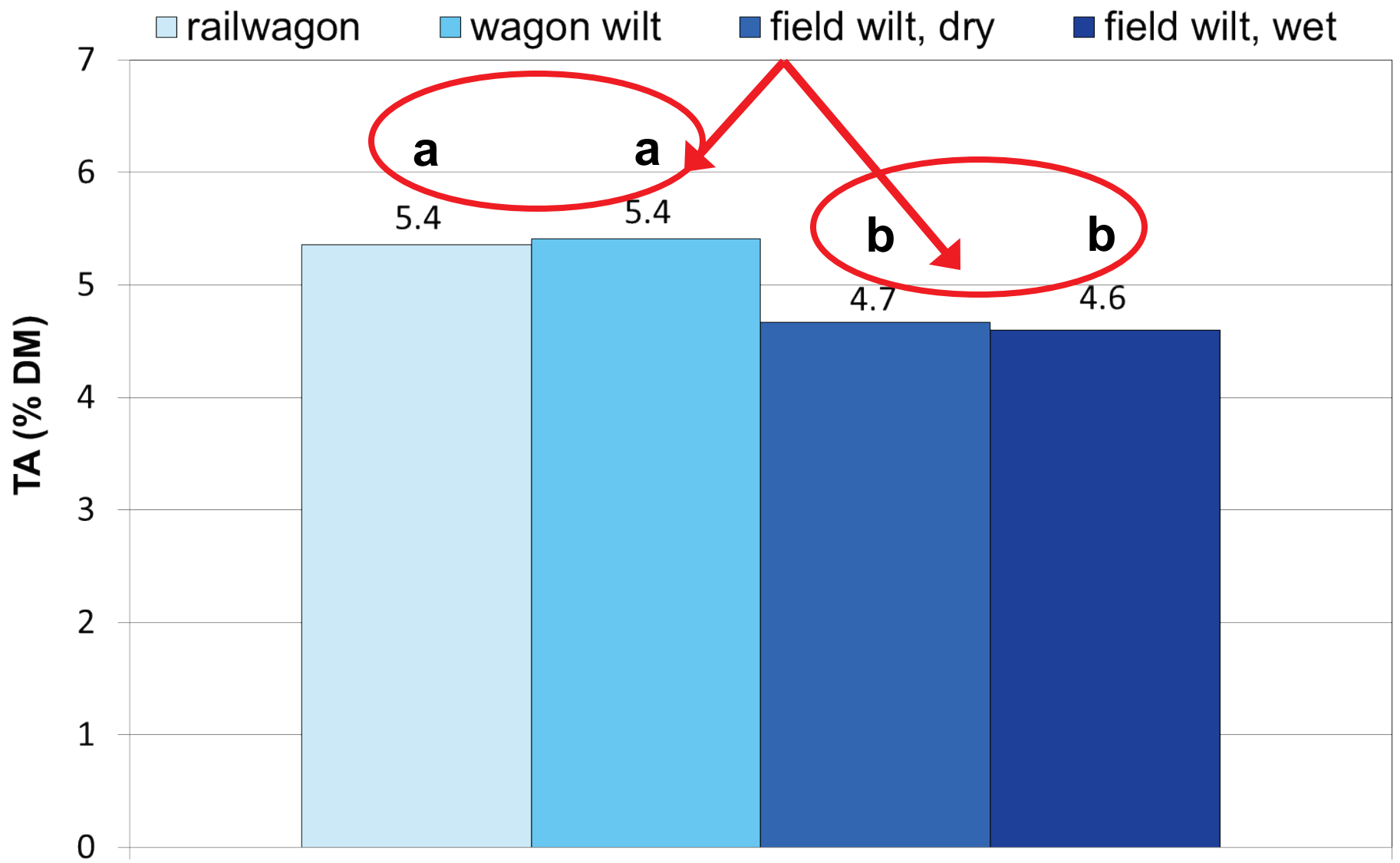


Total Alkaloids



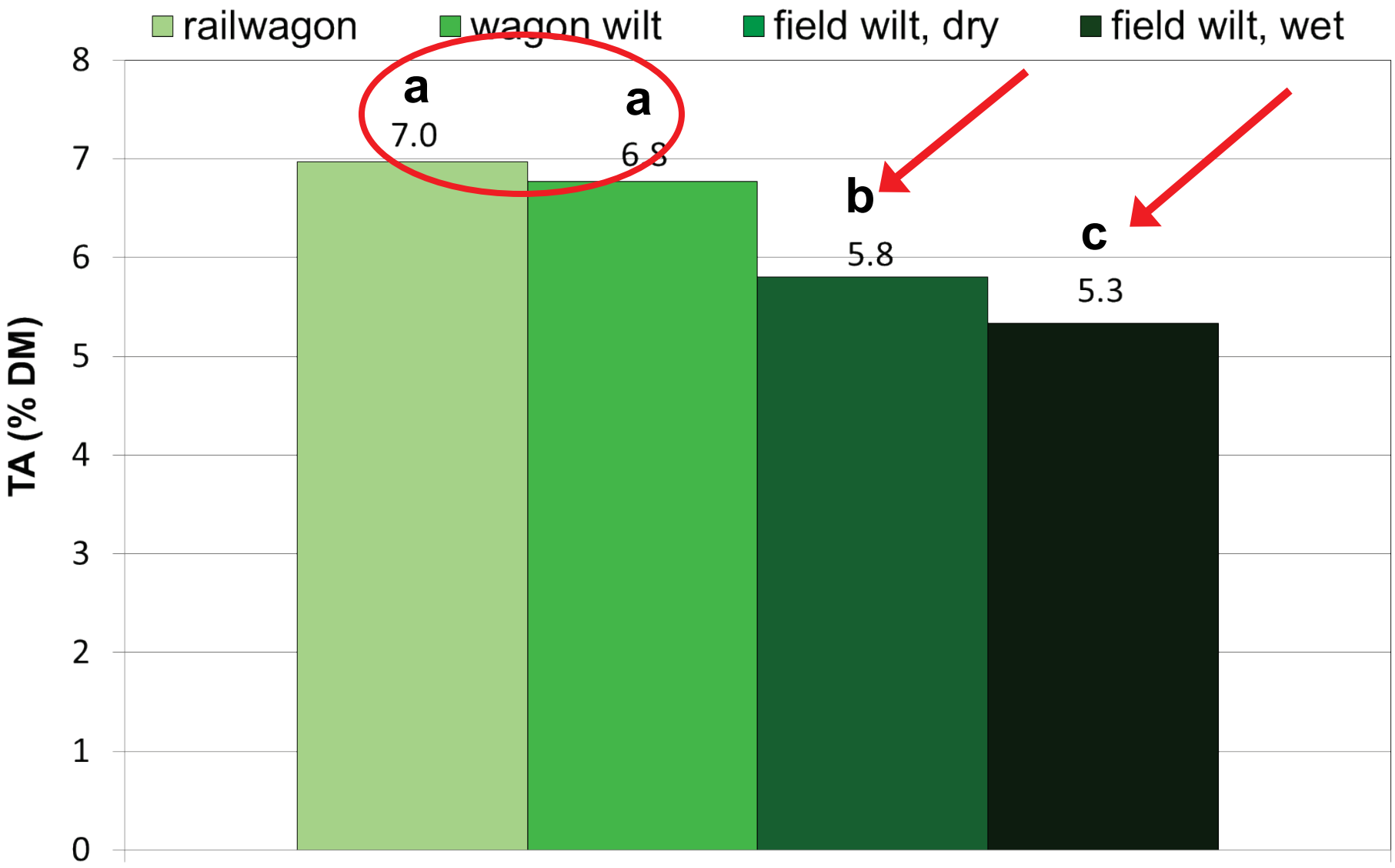
Total Alkaloids 2012: Housing Treatments

High Converter: Lamina (cutting trmts pooled)



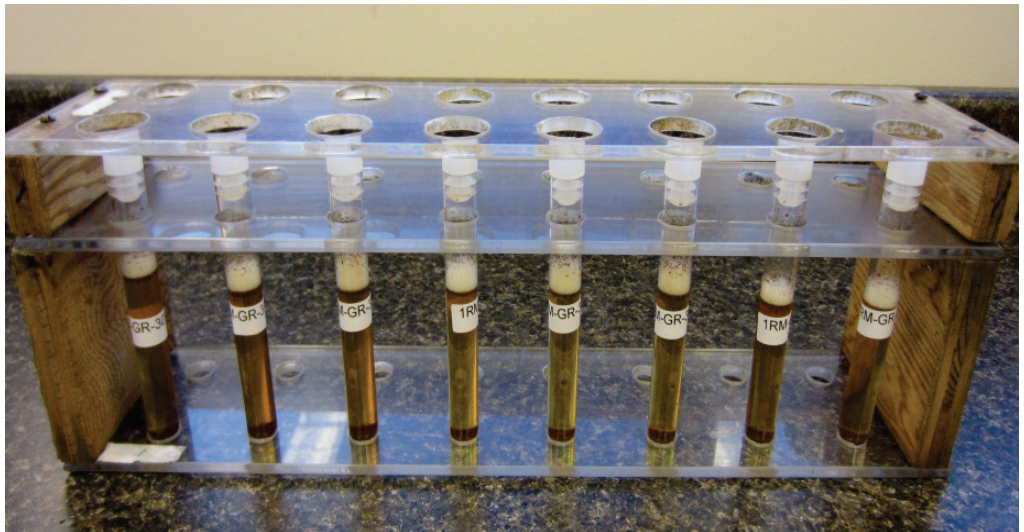
Total Alkaloids 2012: Housing Treatments

Low Converter: Lamina (cutting trmts pooled)



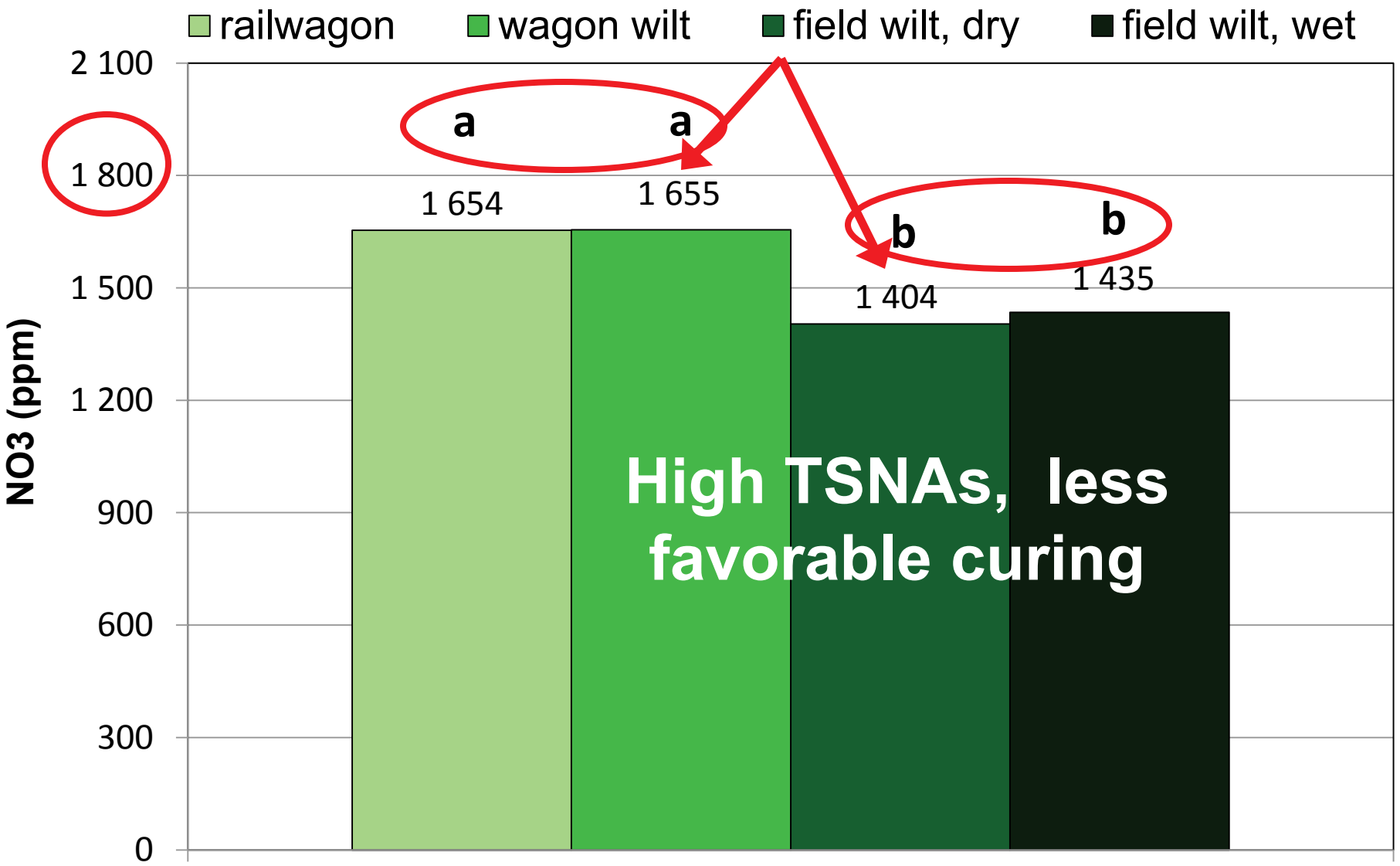
NO_3 N

LC shown, HC similar



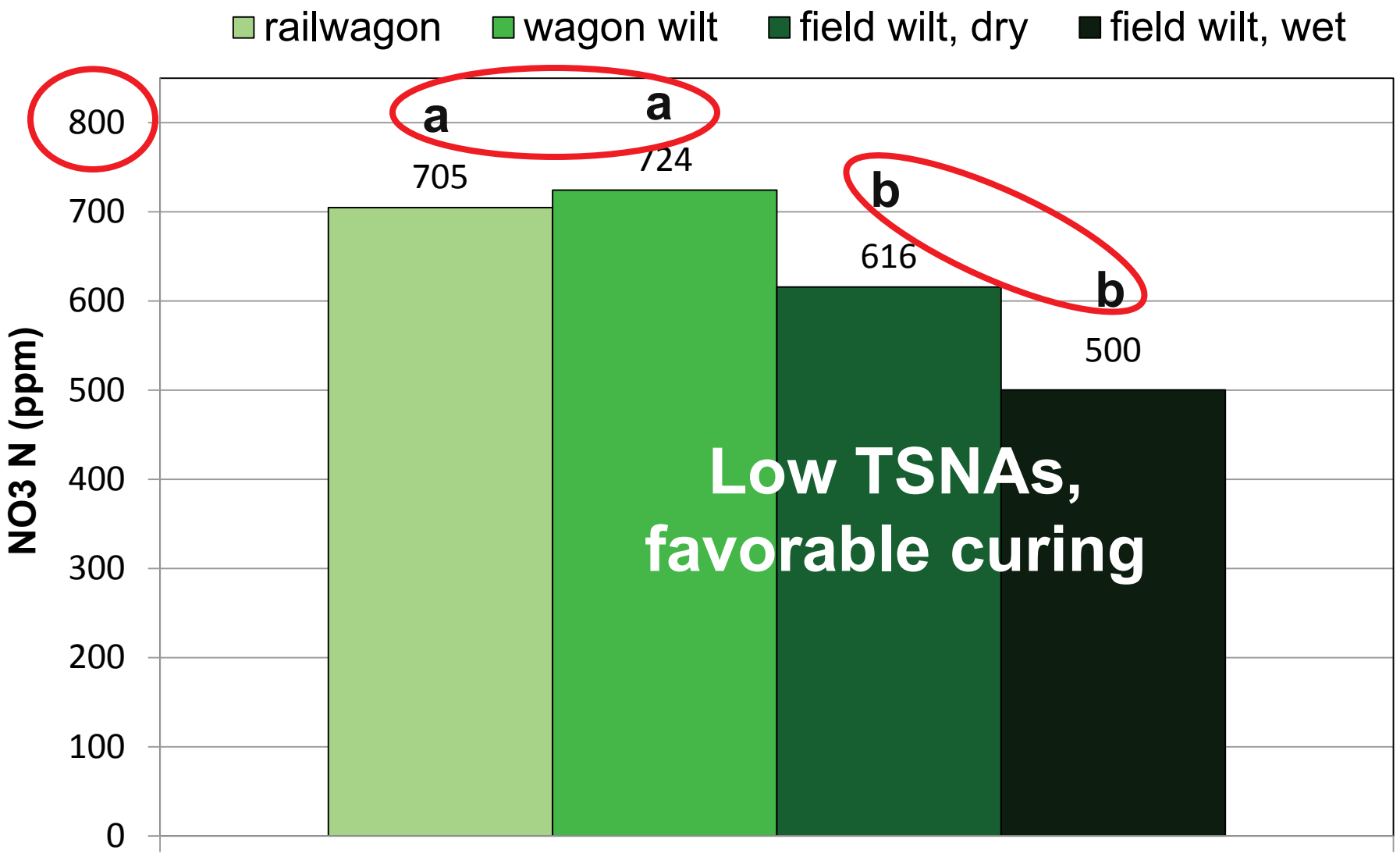
NO_3 N 2012: Housing Treatments

Low Converter: Lamina (cutting trmts pooled)



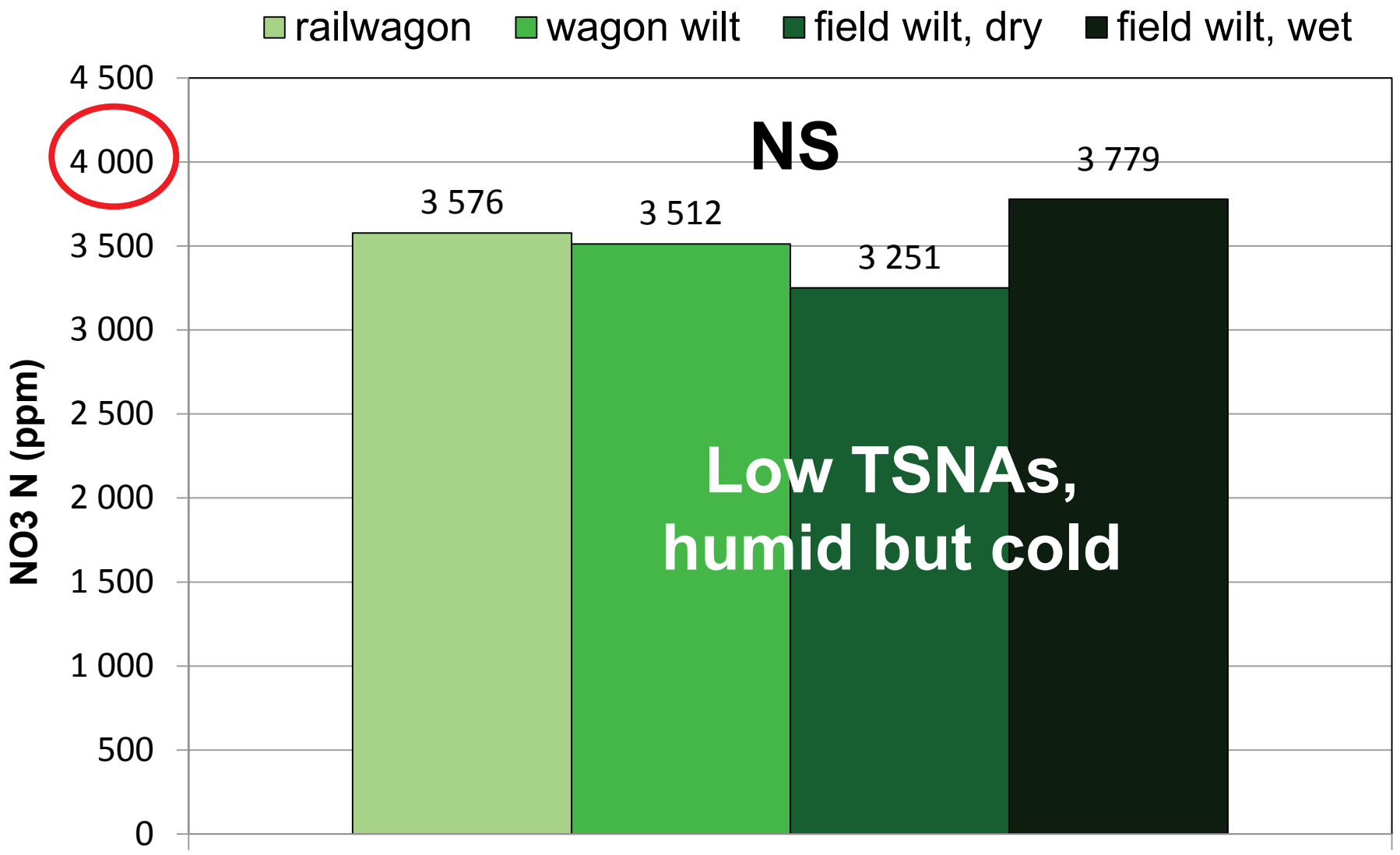
NO_3 N 2013: Housing Treatments

Low Converter: Lamina (cutting trmts pooled)



NO_3 N 2011: Housing Treatments

Low Converter: Lamina (cutting trmts pooled)



Summary

Overall

- 2011
  - Nothing significant
- 2012, 2013, years combined
  - Cutting treatments not significant
  - Housing treatments significant
    - All variables except nitrite
    - Not wholly consistent
      - H, LC, lamina, midrib

TSNAs

- Years
  - 2011, 2013 low; 2012 higher
- Cutting wet vs dry
  - No effect
- Housing
  - Only consistent differences (years, varieties) in NNK lamina
  - Generally – railwagon lowest, field wilt (housed wet) – highest

TSNAs – Implications

- Railwagon – lowest TSNAs
  - Protected from heat & moisture
  - Suggest both heat & moisture play a role
- Field wilted – high TSNAs
  - Suggests rain on cut tobacco a factor
- Field wilted housed wet – highest
  - Suggests housing wet further ↑ TSNAs

Total Alkaloids

- Years
  - Similar
    - 2012 drip – no excessively high alkaloids
    - 2013 early rain – slightly lower alkaloids
- Cutting wet vs dry
  - No effect
- Housing
  - Both field wilted treatments ↓
    - Alkaloids on leaf surface dissolved off by rain?

NO_3 N

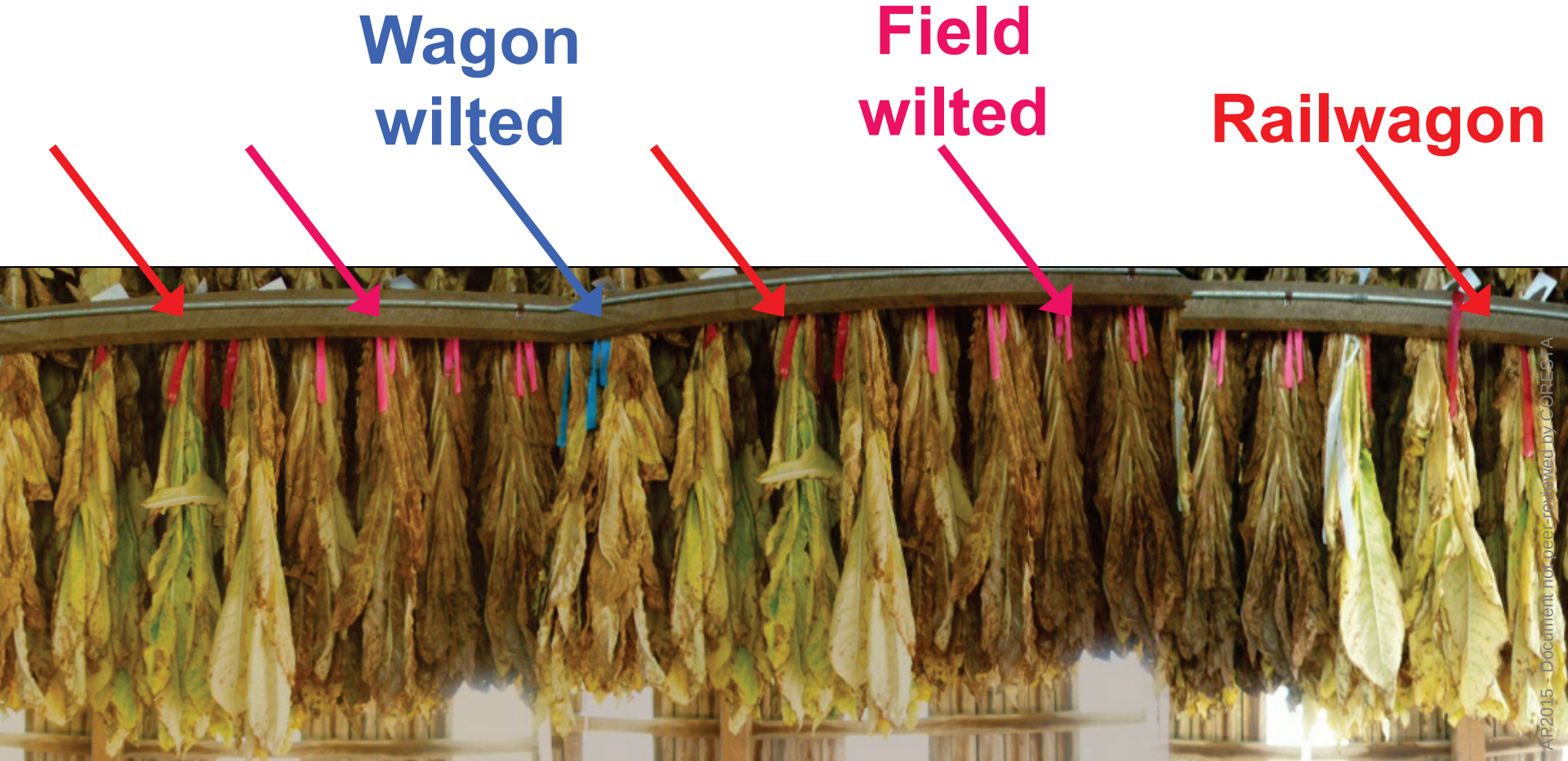
- Years
  - 2011>2012>2013, lamina & midrib
    - Early rain 2013 – low NO_3 N
    - 2011 high NO3 N???
- Cutting wet vs dry
  - No effect
- Housing
  - Same pattern as alkaloids
    - Both field wilted treatments ↓ – leaching?

NO_3 N & TSNAs

- Years
  - 2011>2012>2013 NO_3 N
  - 2012>2011=2013 TSNAs
- NO_3 N, Alkaloids, TSNAs across yrs
  - 2011
    - NO_3 N 3,000s; alkaloids 6; TSNAs 3-4
  - **2012**
    - **NO_3 N 1,000s; alkaloids 6; TSNAs 10-11**
  - 2013
    - NO_3 N 700s ; alkaloids 5-6; TSNAs 3-4

Quality

- Rain on field wilted tobacco
  - Impacts quality



Conclusions

- Cutting & housing wet tobacco
  - Less effect on TSNAs than anticipated
    - Cutting no effect?
    - Not enough data to determine trend?
      - TSNAs too low in these seasons?
- Recommendation altered
  - No reference to cutting wet
  - Advise not housing wet tobacco
  - Advise minimal field wilting

Acknowledgements

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