TSNA Accumulation in Two Burley Cultivars

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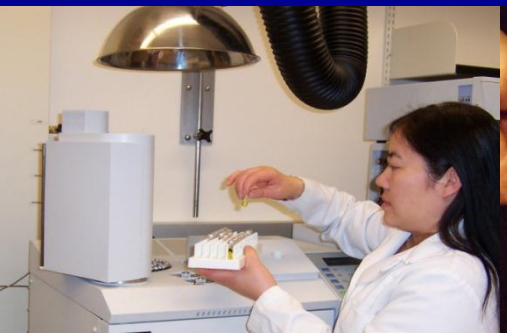
Coresta 2011

Background

- TSNA differences reported between varieties with:
  - similar conversion
  - similar total alkaloids
- Literature
  - speculates differential drying rate during curing
- Previous work (Miller)
  - TSNAs
  - KT 204 < NCBH 129

Objective

- Compare these varieties
- Identify factors causing differential TSNA accumulation



Procedure

Procedure

- 2 varieties
  - KT 204
  - NCBH 129
- 2 years
  - 2009
  - 2010

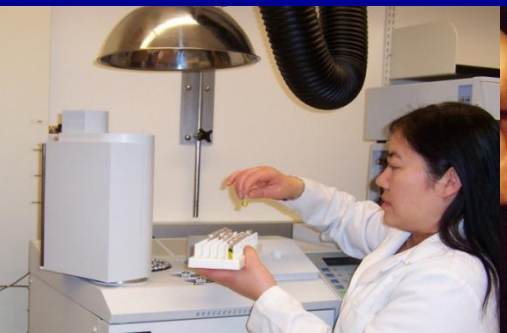
- Normal production practices
  - Cured on railwagon, covered with plastic
  - dataloggers

Variables

- **Sampled throughout cure:**
  - **TSNAs**
  - **NO_2 N**
  - **Leaf moisture**
  - **Duvatrienediols (DVTs)**
    - **effect on leaf moisture loss**

Variables cont

- **Sampled at stripping:**
  - Total alkaloids
  - Total N, NO_3 N
  - Leaf thickness
  - Leaf specific weight
  - TSNAs
  - NO_2 N
  - DVTs



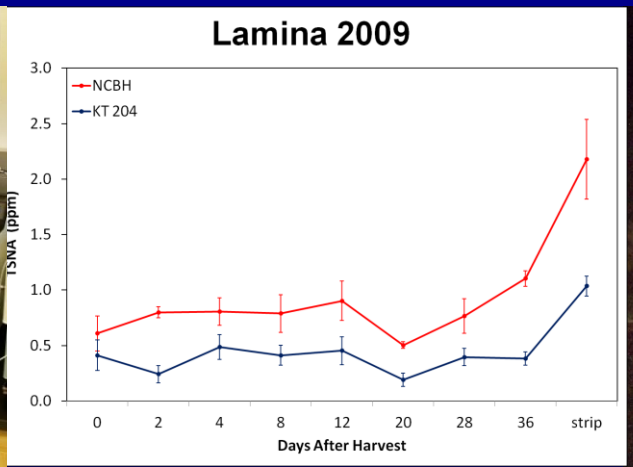


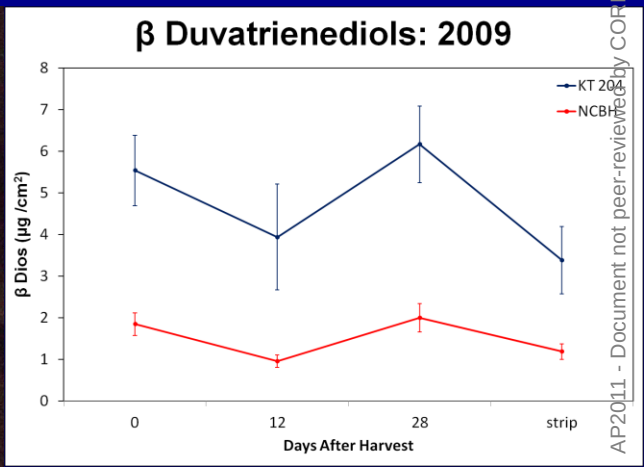
Statistical Analysis

- Time series plots
  - samples through curing
- ANOVA
  - single sample variables (stripping)
  - SAS Proc Mixed
- Verify model assumptions
  - some variables – heteroscedasticity
  - transformations (sq rt, log, log-log, exponential) for means separation
    - untransformed data presented

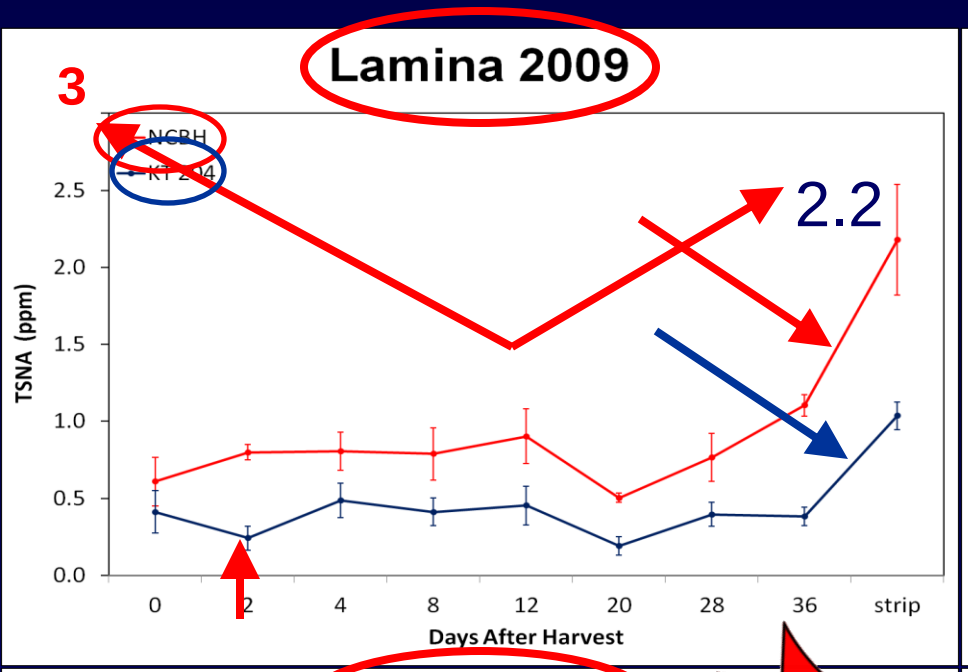
Results

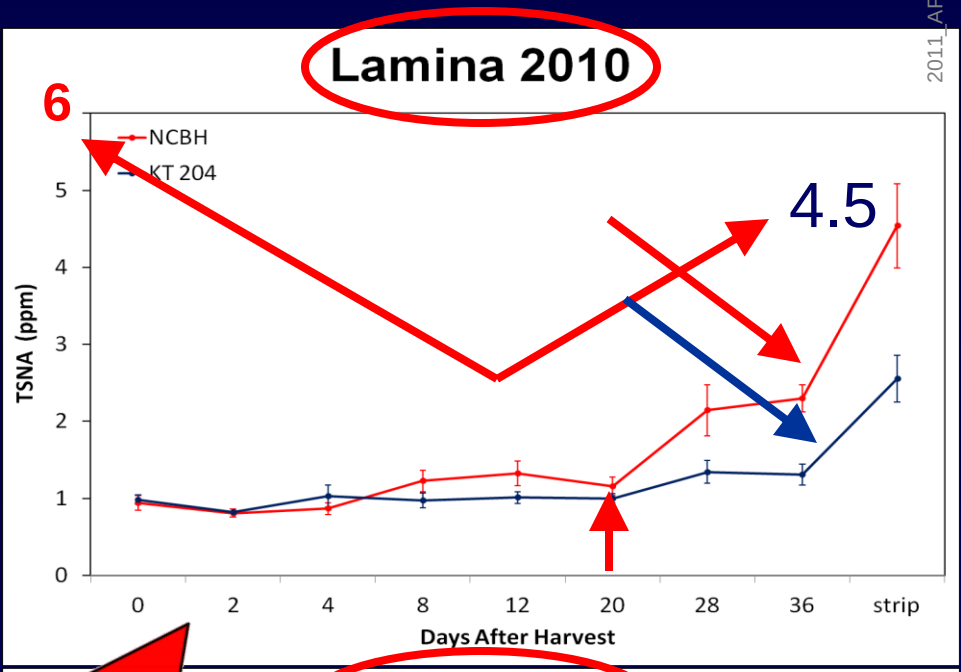
Time Series

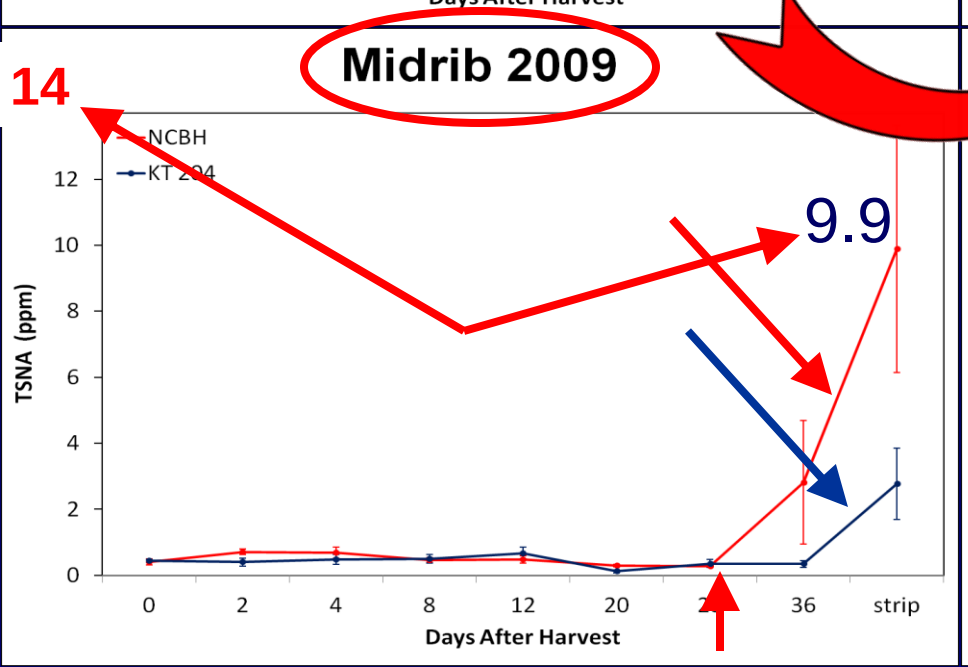


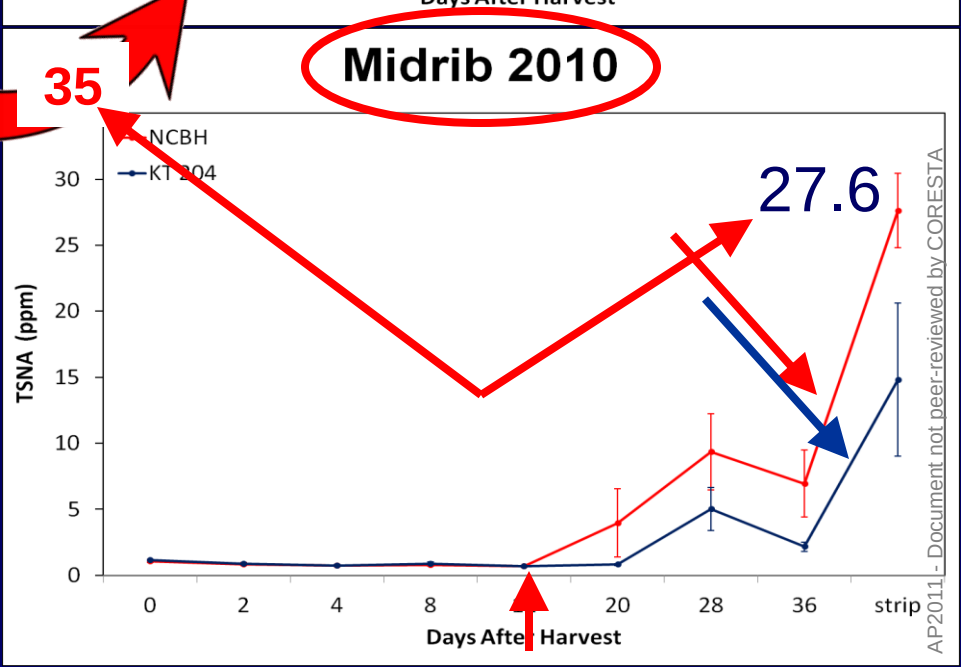


TSNAs

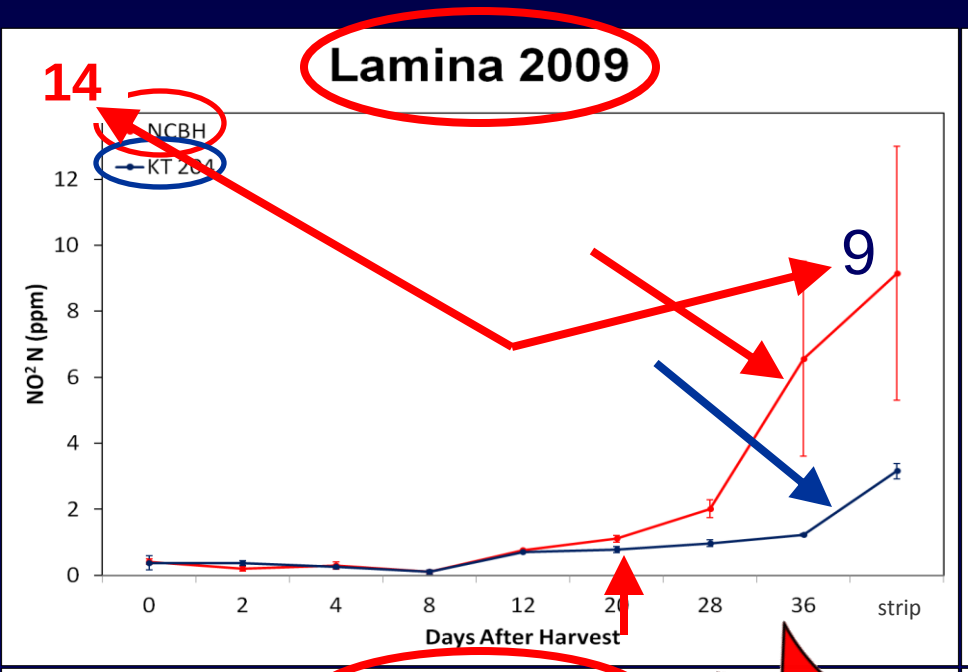


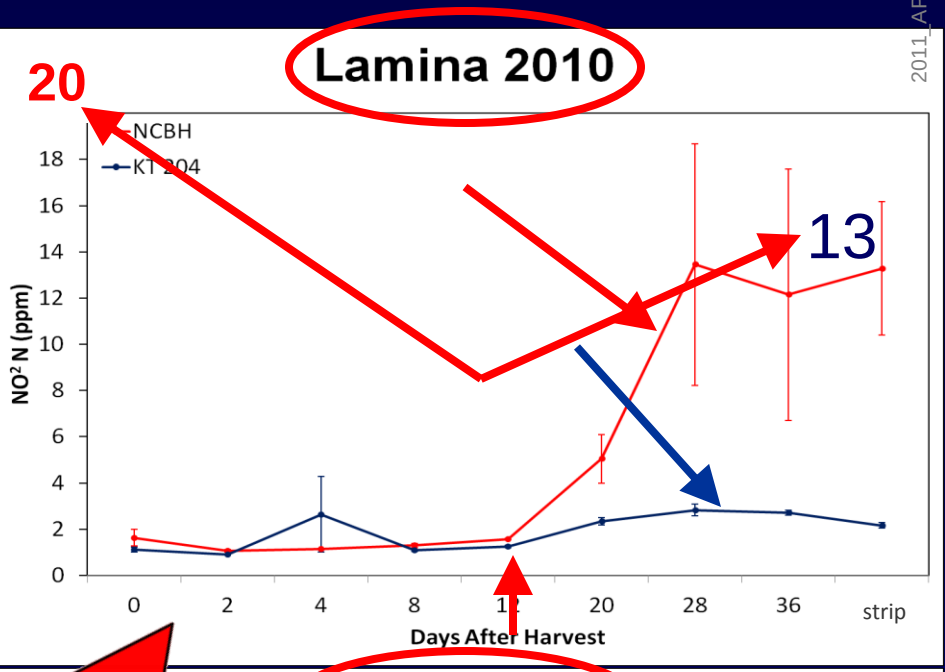


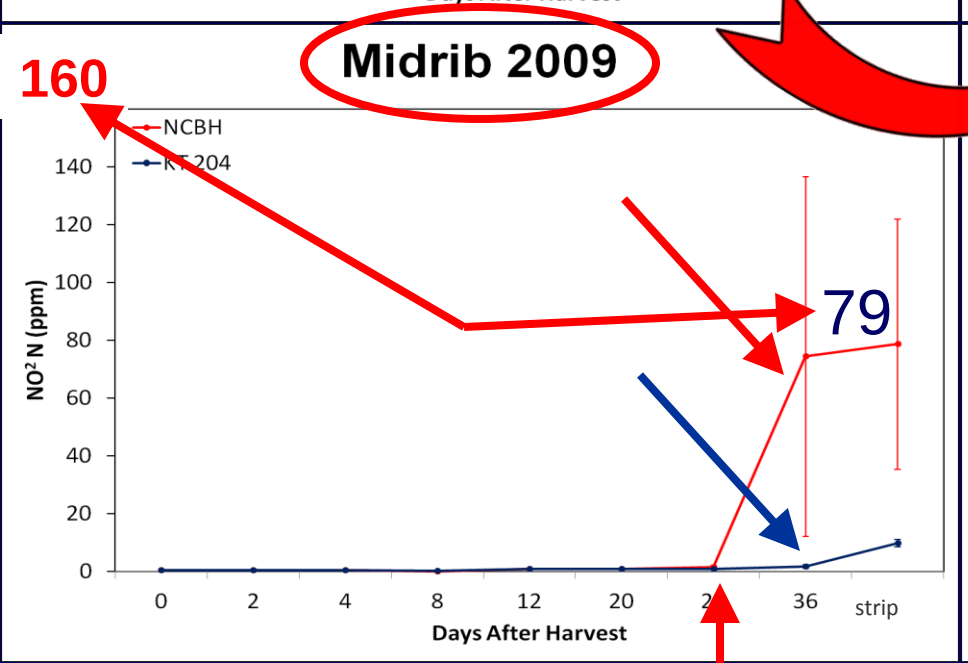


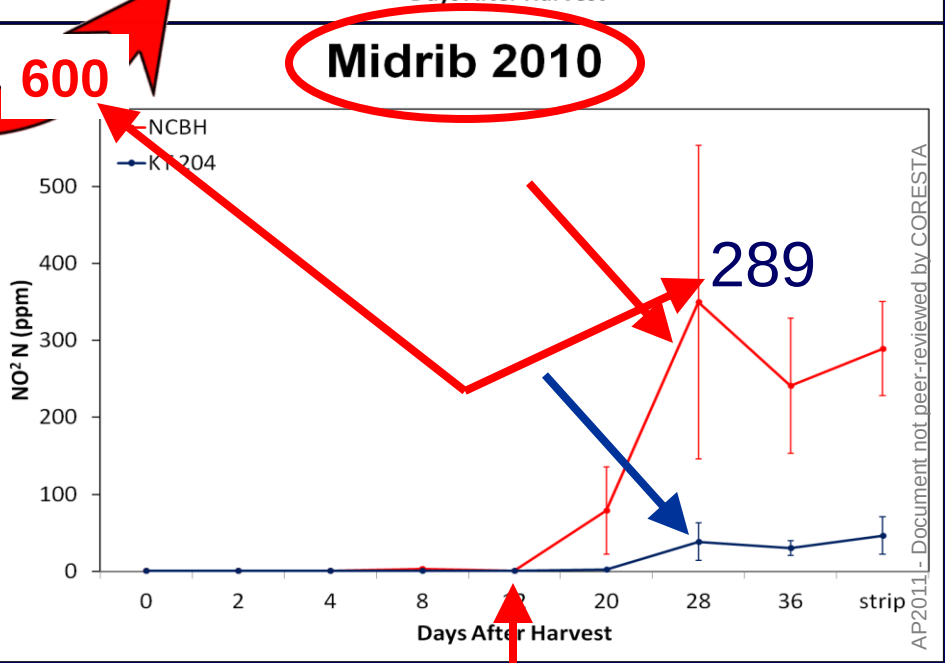


Nitrite N

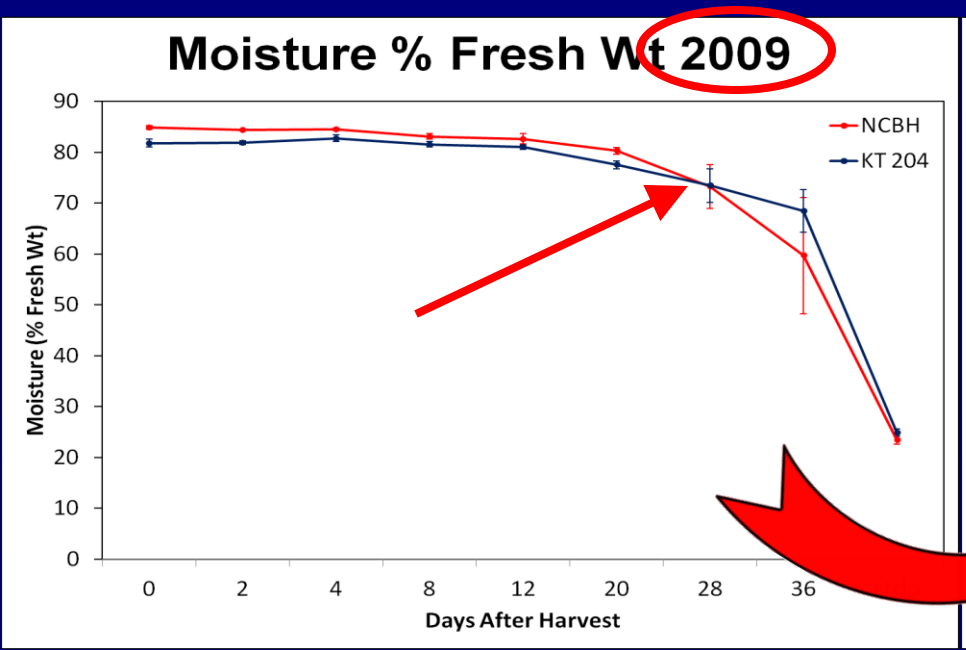


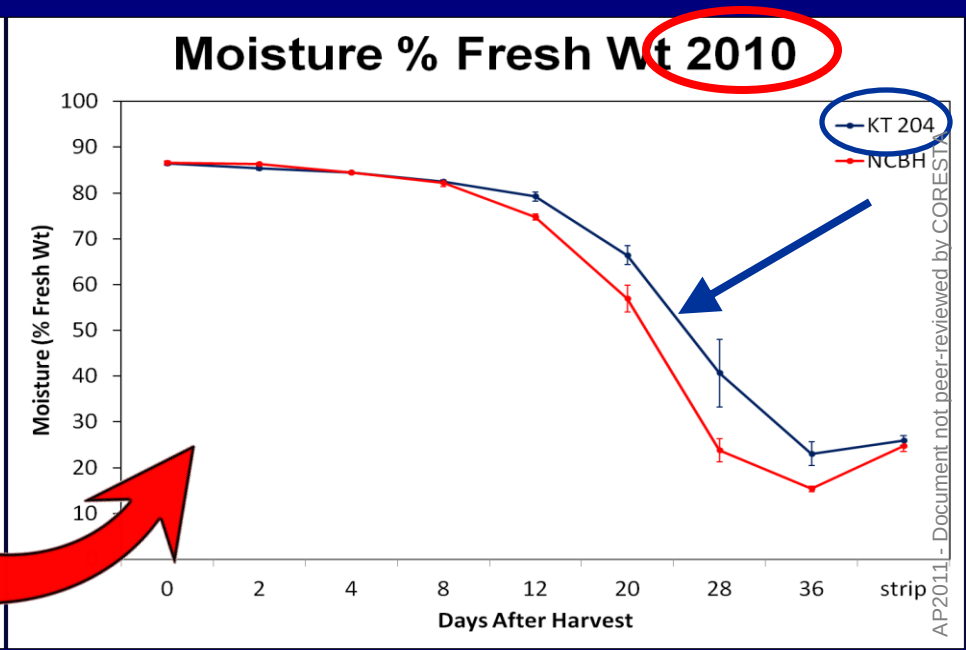




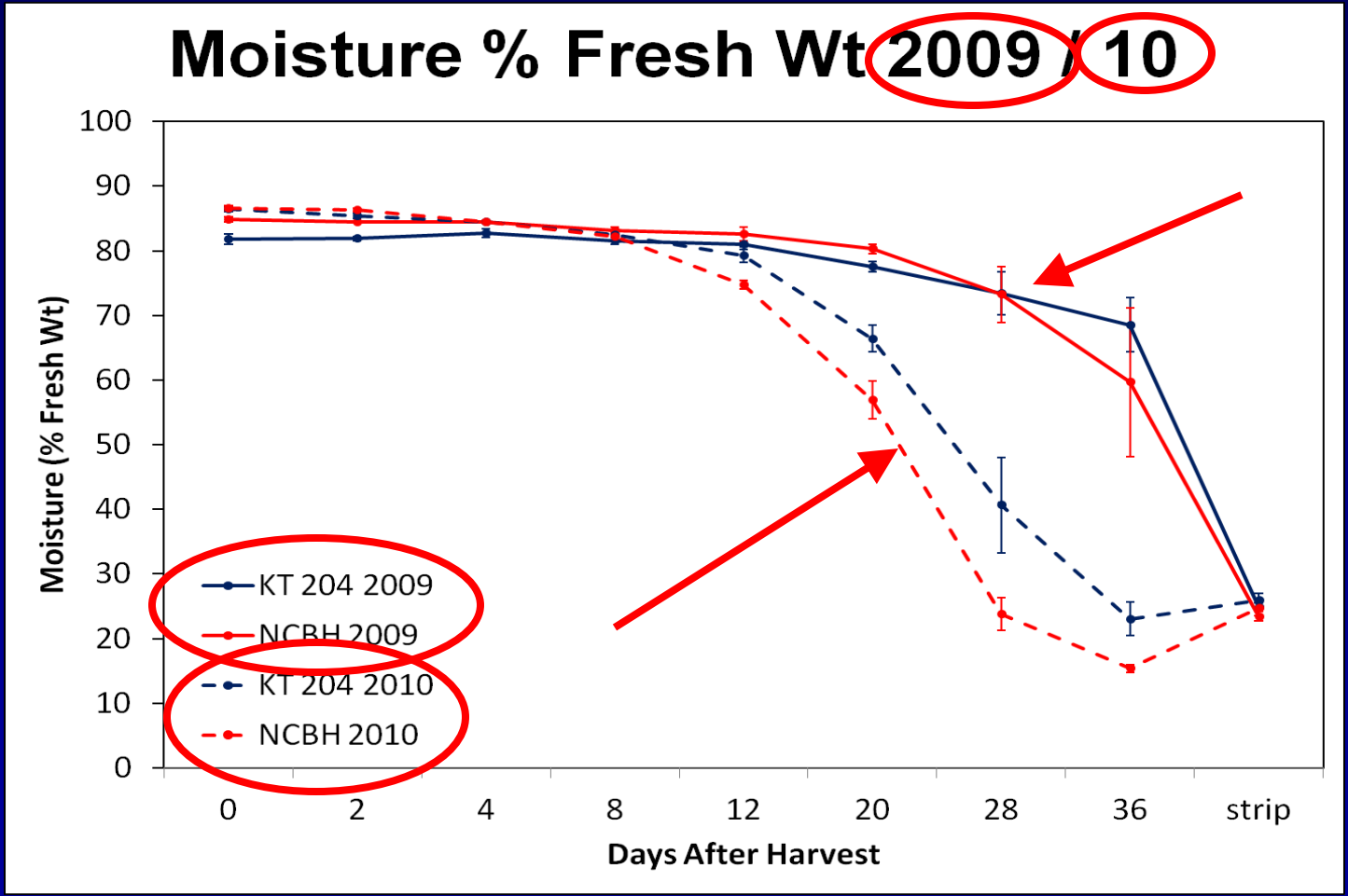


Leaf Moisture

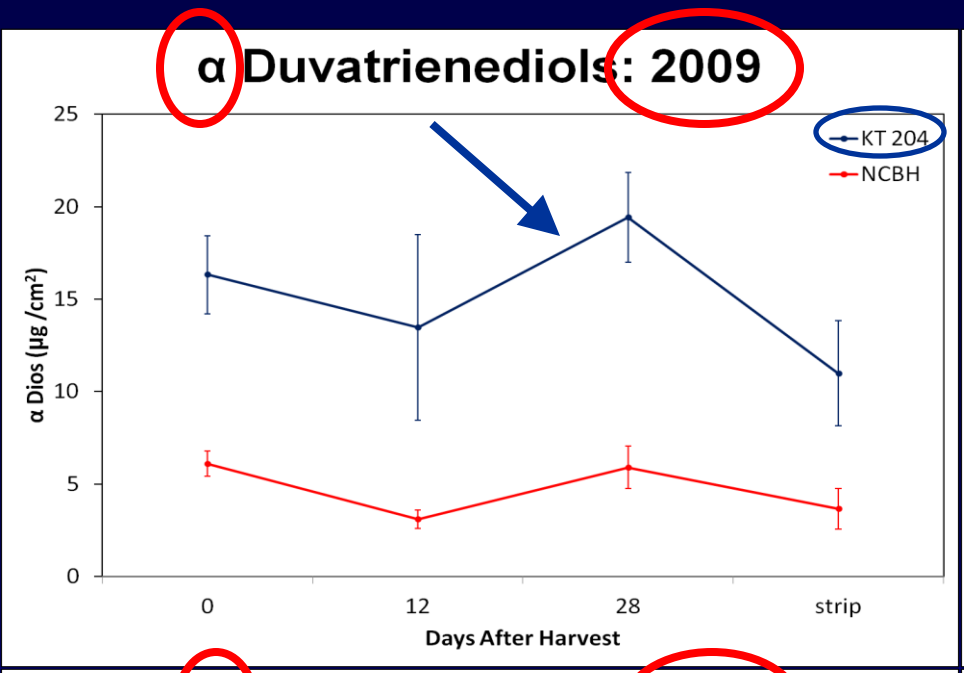


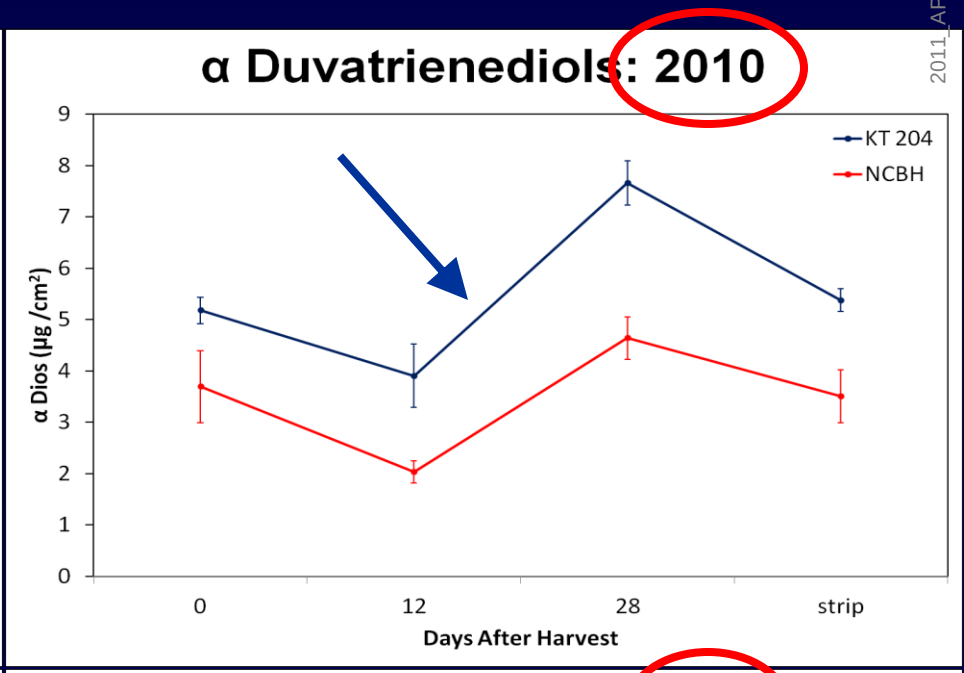


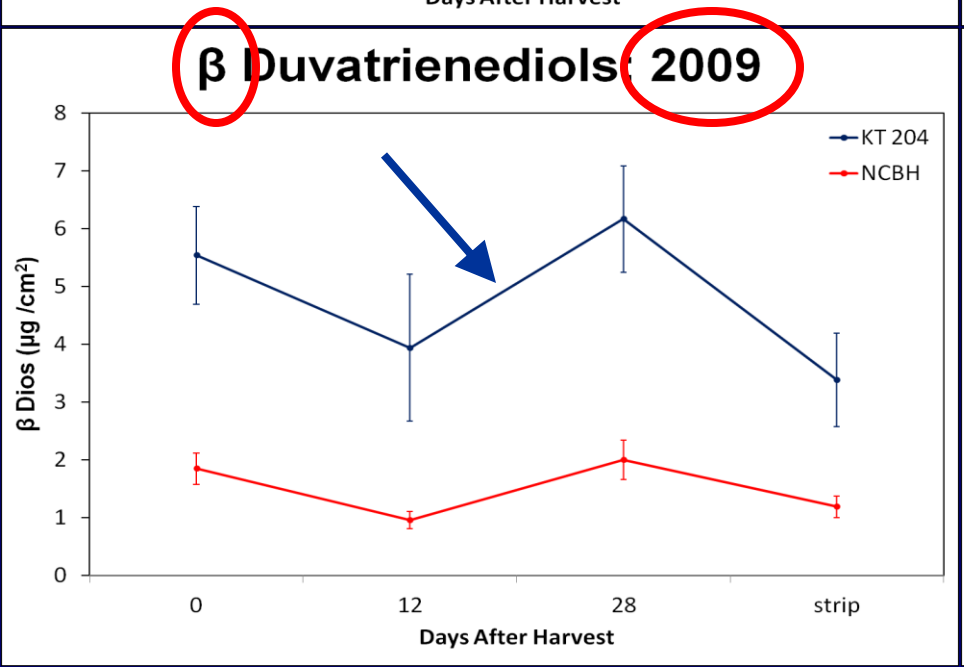
Leaf Moisture

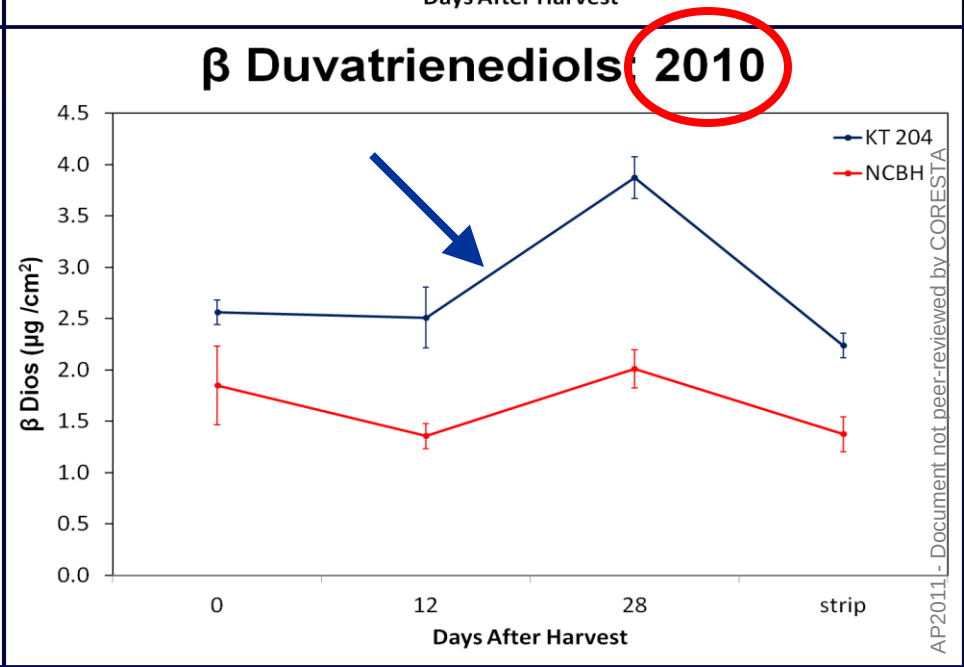


Duvatriendiols



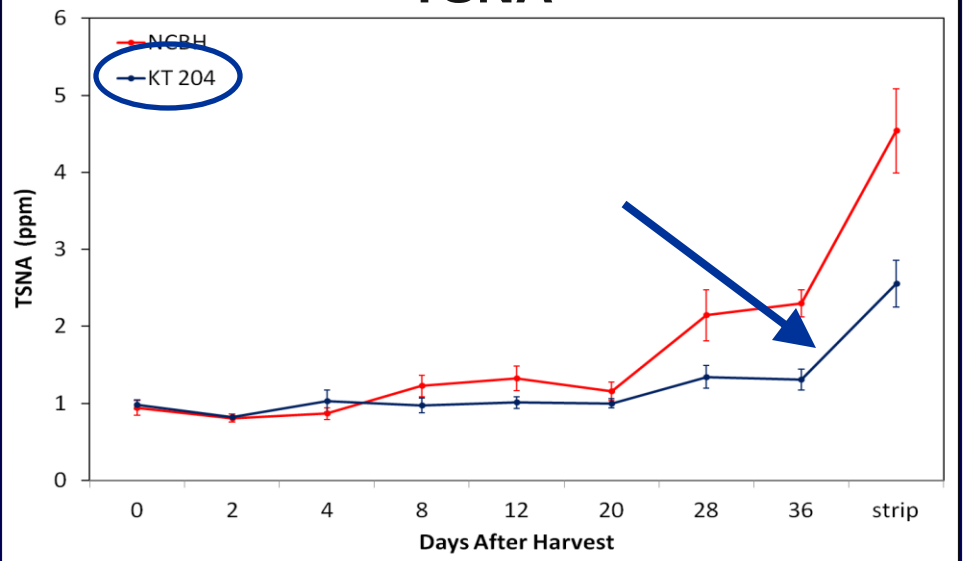




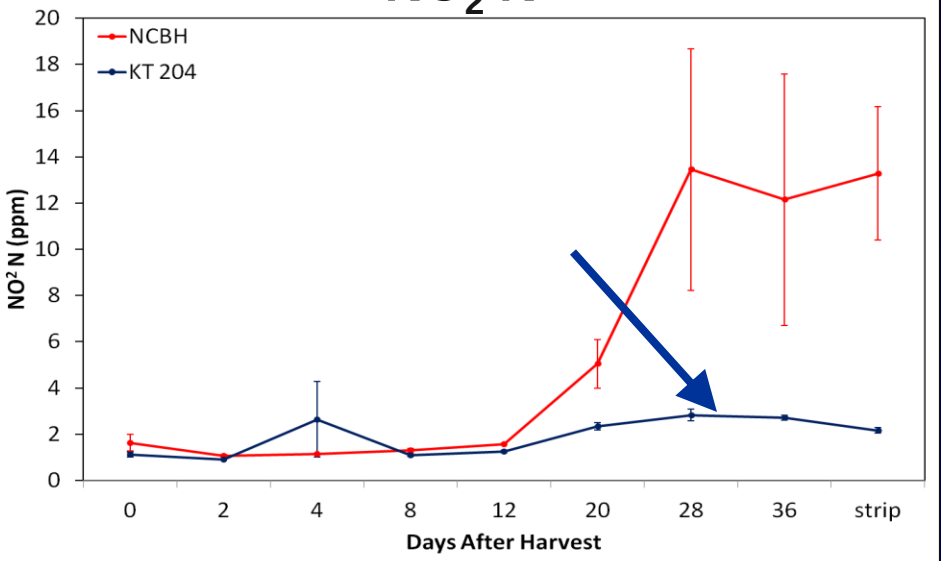


Summary – KT 204

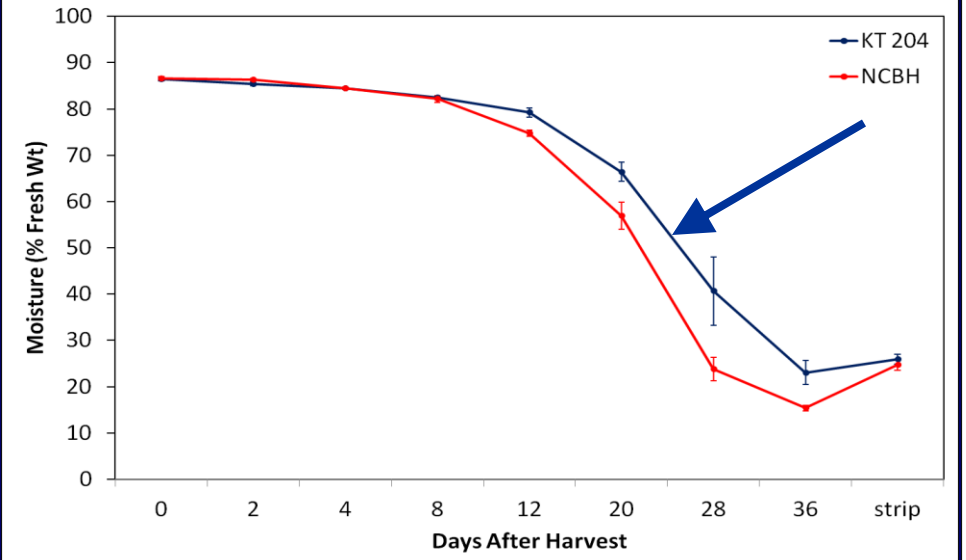
TSNA



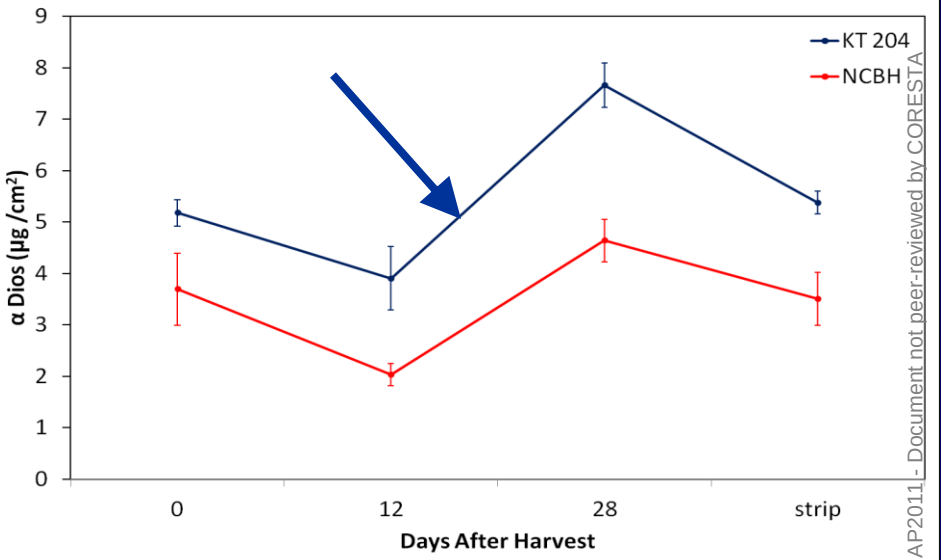
NO_2 N



Moisture % Fresh Wt



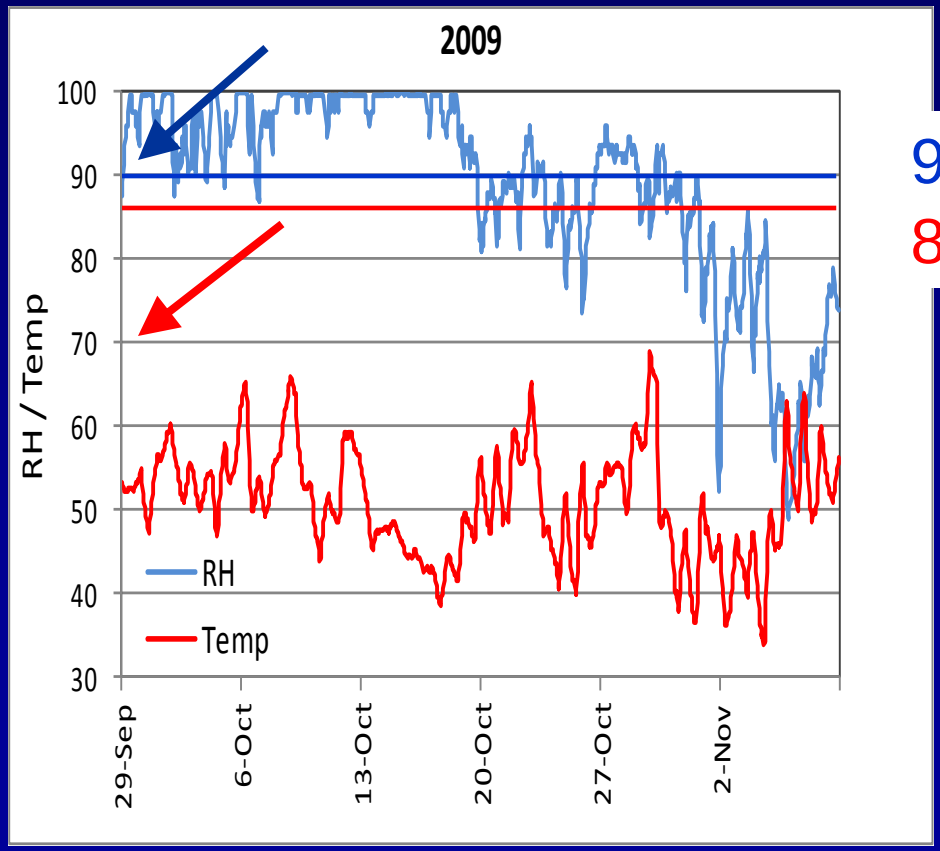
α Duvatrienediols



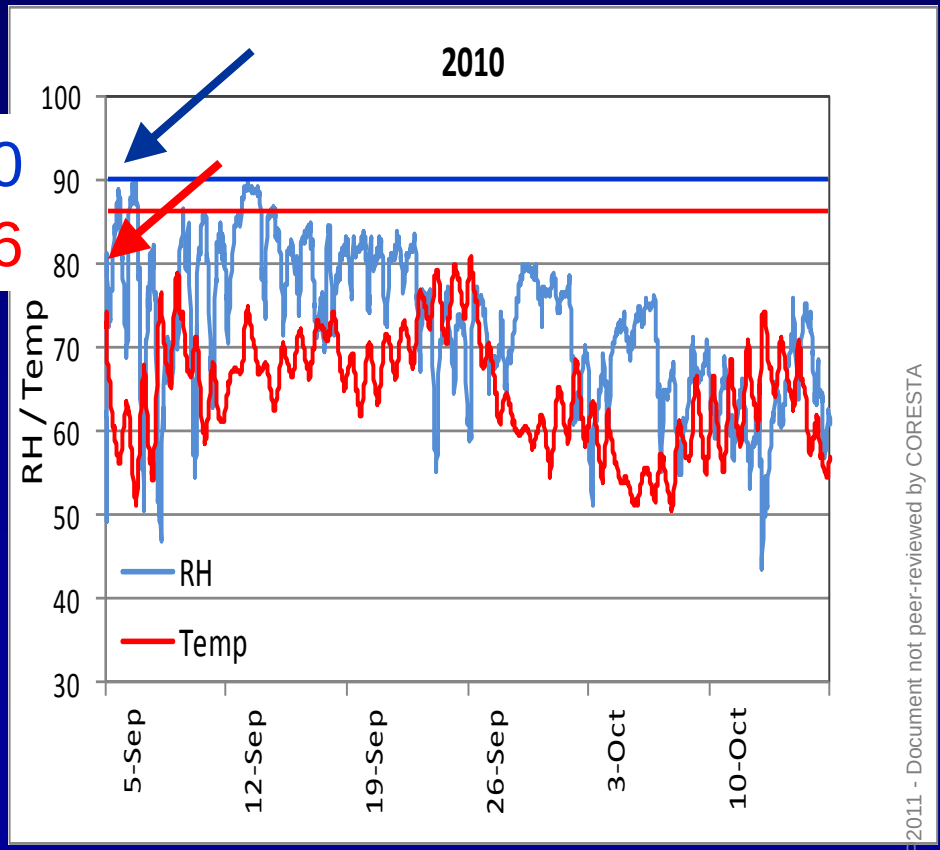
Dataloggers

More humid
Cooler

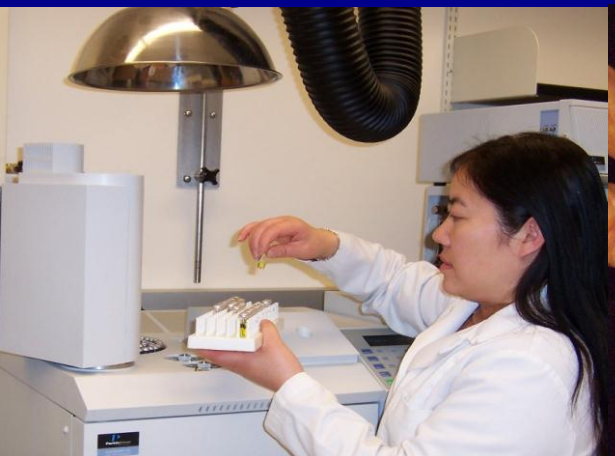
Drier
Warmer



90
86



Samples at Strippping




TSNAs (lamina) : ANOVA

[1] loglog transformed, [2] log transformed

	NNN	NAT[1]	TSNA[2]
Variety	*	**	**
Year	**	***	***
Var x Yr	NS	NS	NS

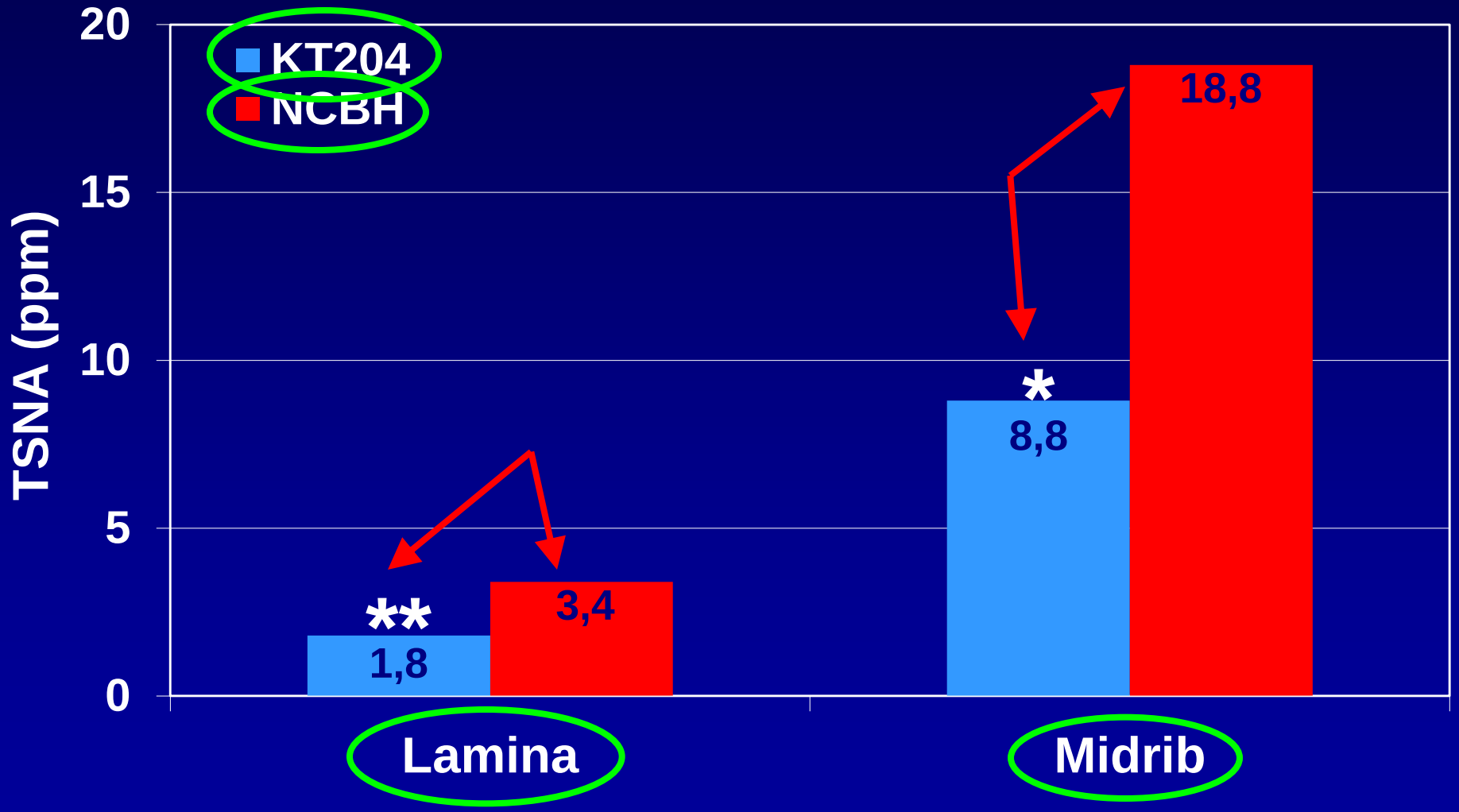
TSNAs (midrib) : ANOVA

[1] log transformed

	NNN[1]	NAT	TSNA[1]
Variety	NS	*	*
Year	**	*	**
Var x Yr	NS	NS	NS

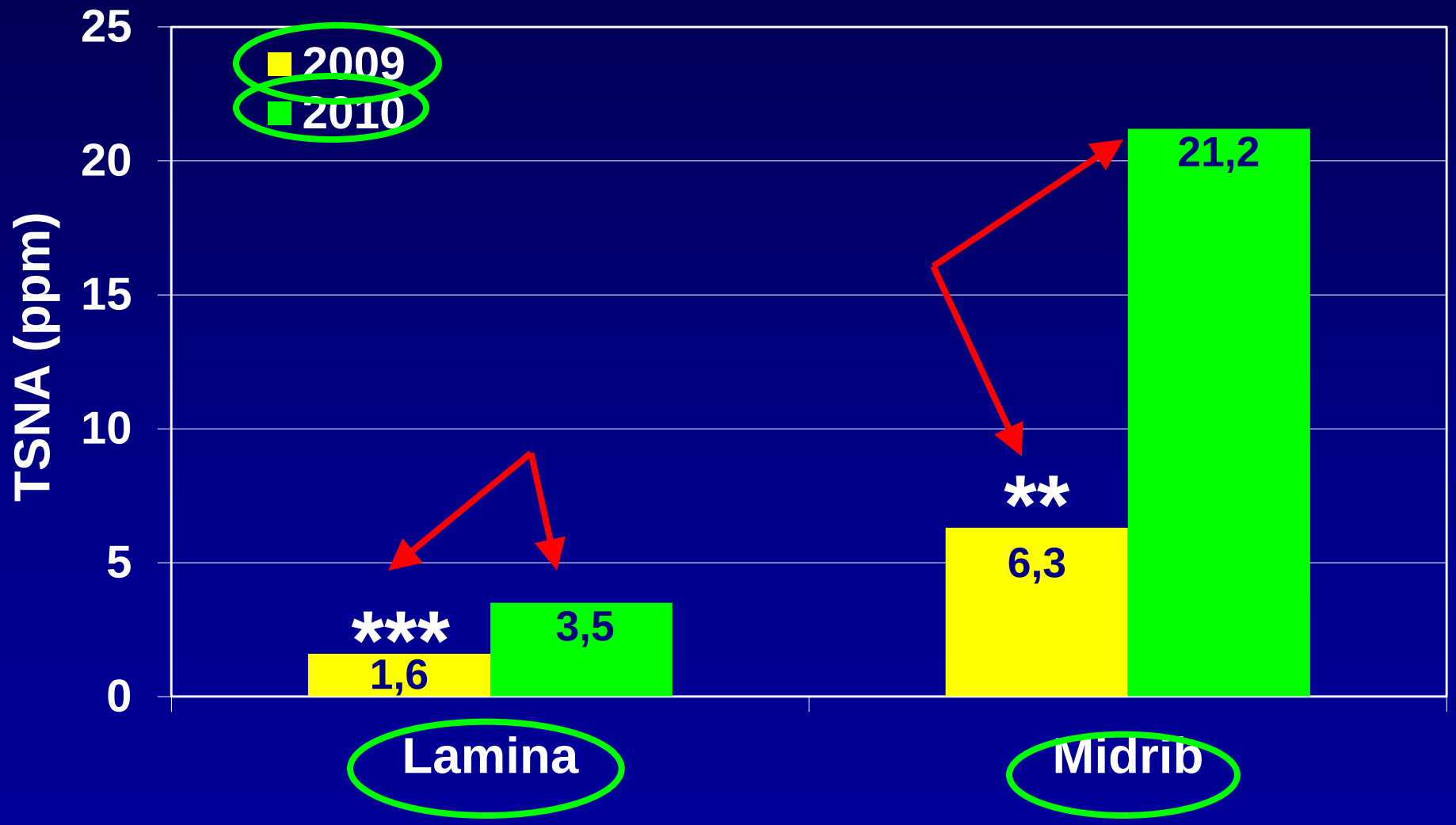
Total TSNAs (ppm)

Variety Effects (pooled over years)



Total TSNAs (ppm)

Year Effects (pooled over varieties)



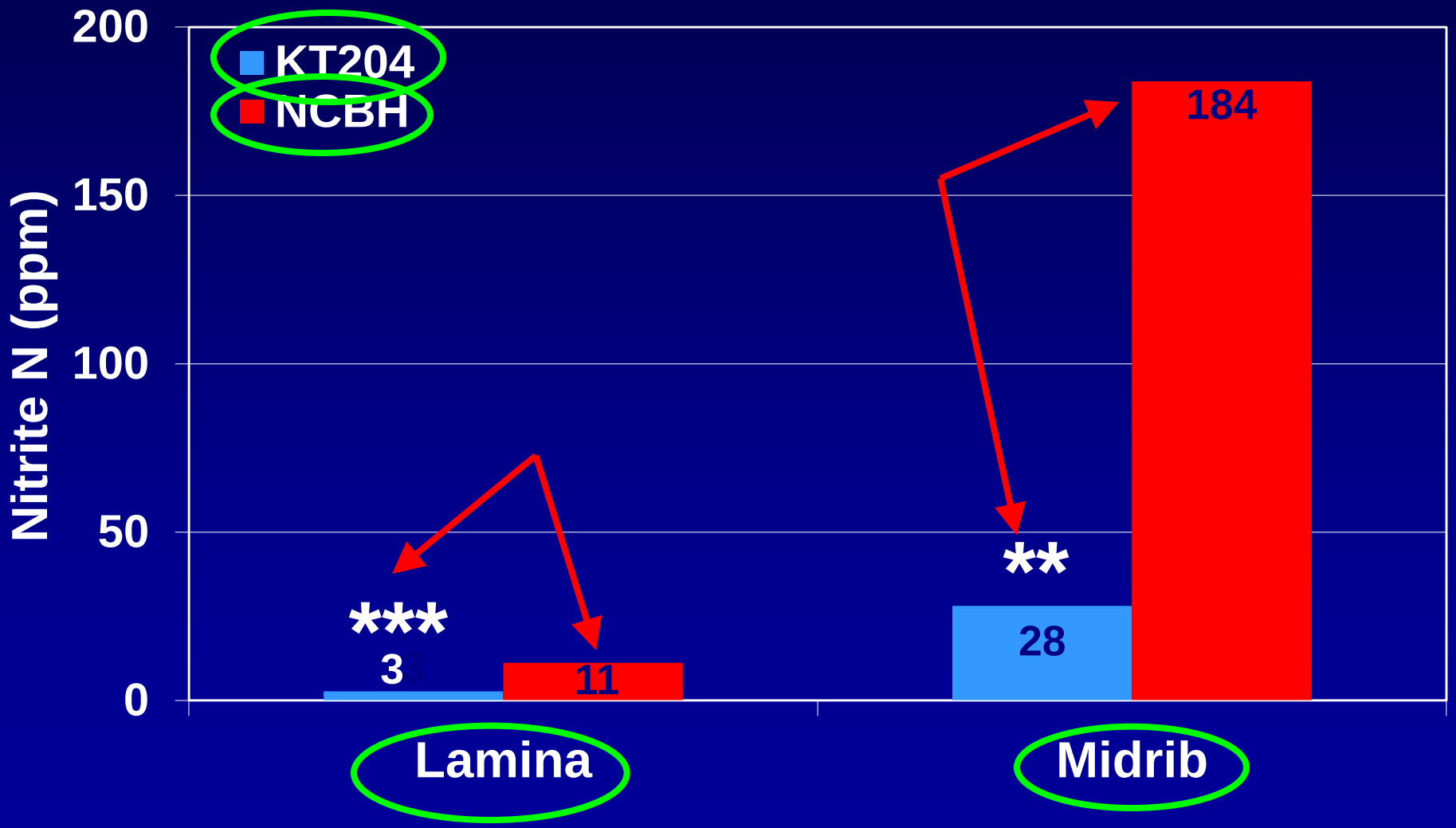
Nitrite N : ANOVA

[1] loglog transformed, [2] sq rt transformed

	Lamina[1]	Midrib[2]
Variety	***	**
Year	NS	*
Var x Yr	NS	NS

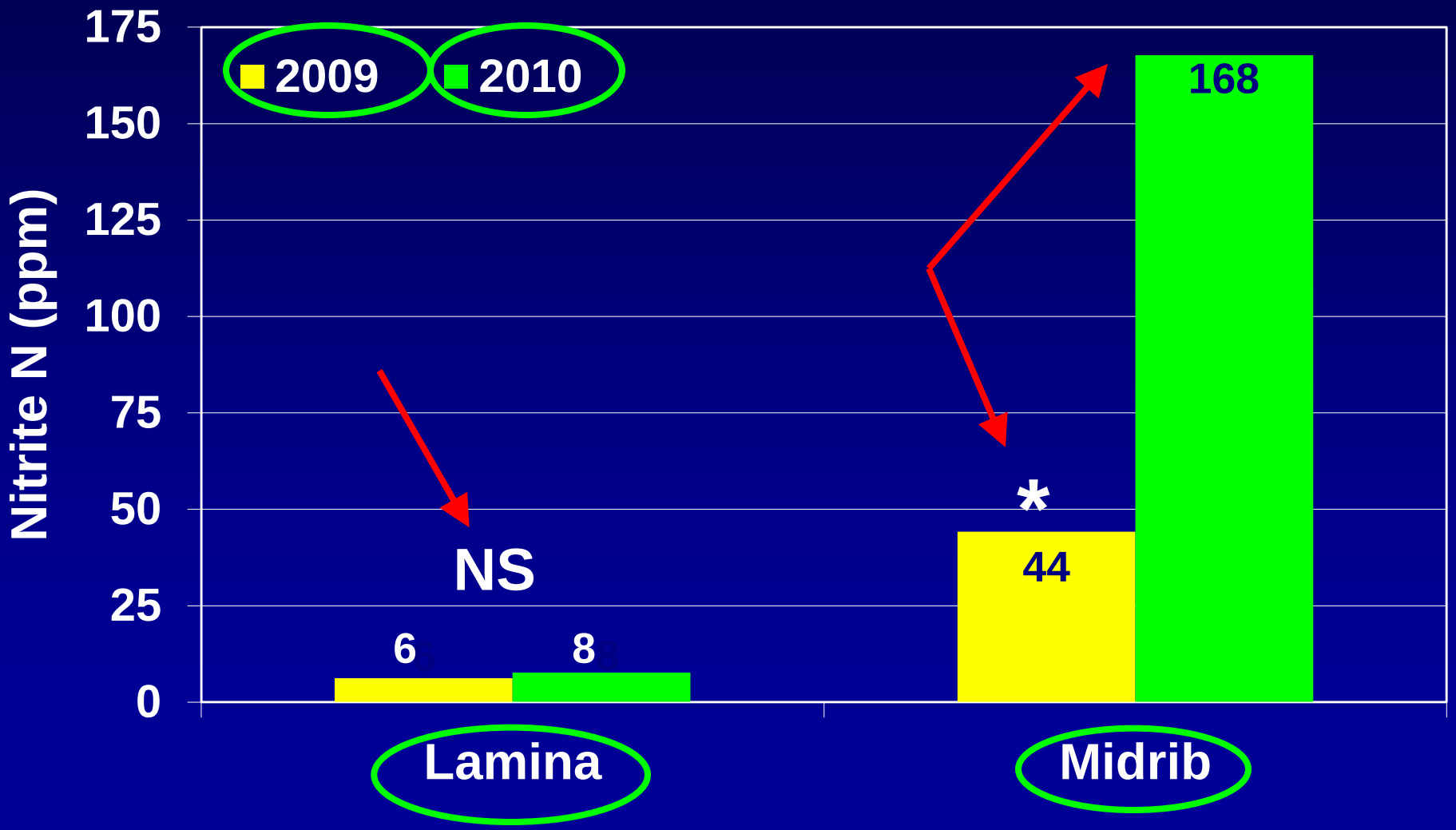
Nitrite N (ppm)

Variety Effects (pooled over years)



Nitrite N (ppm)

Year Effects (pooled over varieties)



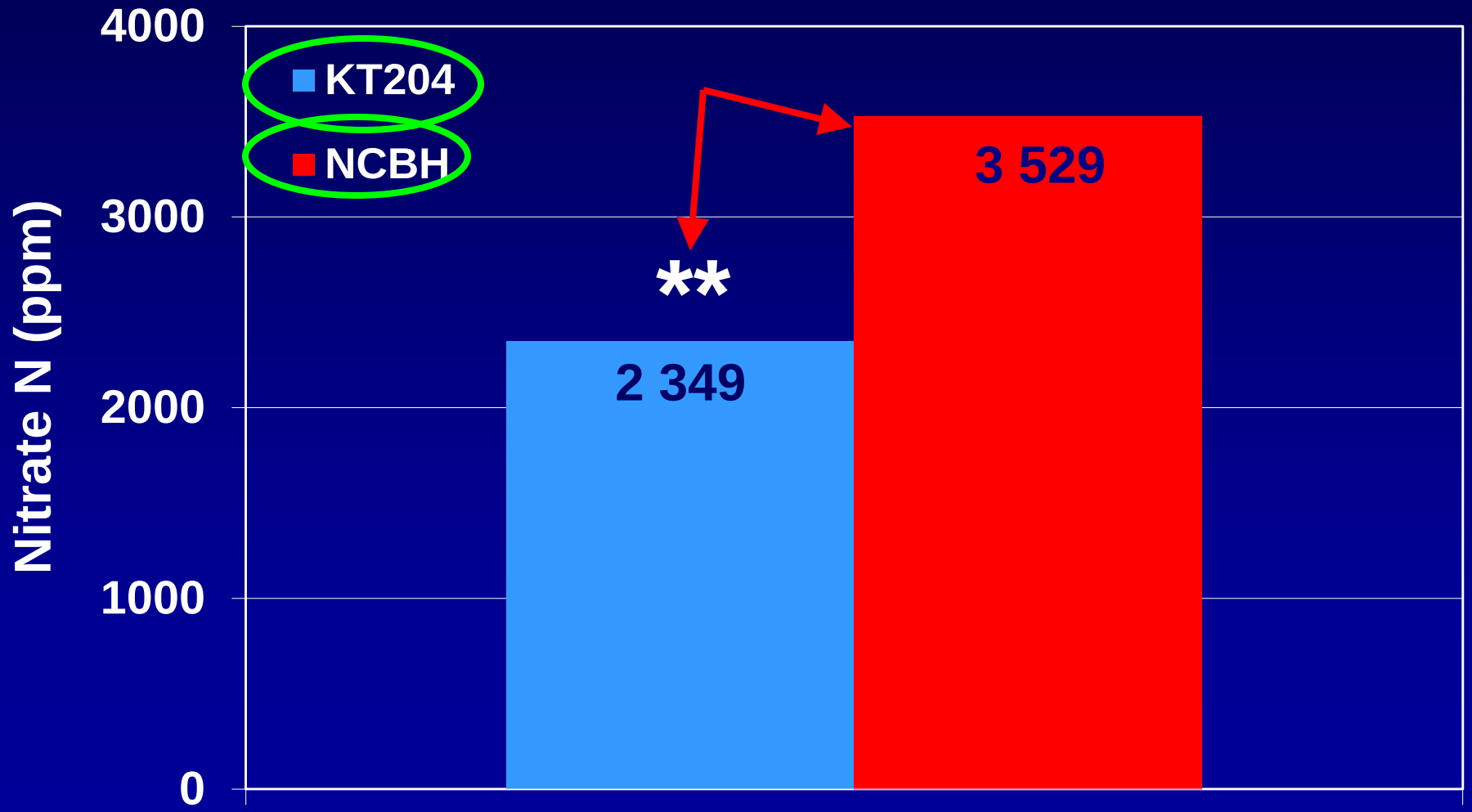
Nitrate N : ANOVA

[1] log transformed

	Nitrate[1]
Variety	**
Year	***
Var x Yr	NS

Nitrate N (ppm)

Variety Effects (pooled over years)



Nitrate N (ppm)

Year Effects (pooled over varieties)

Tot Alk, Tot N : ANOVA

[1] exponential transformed

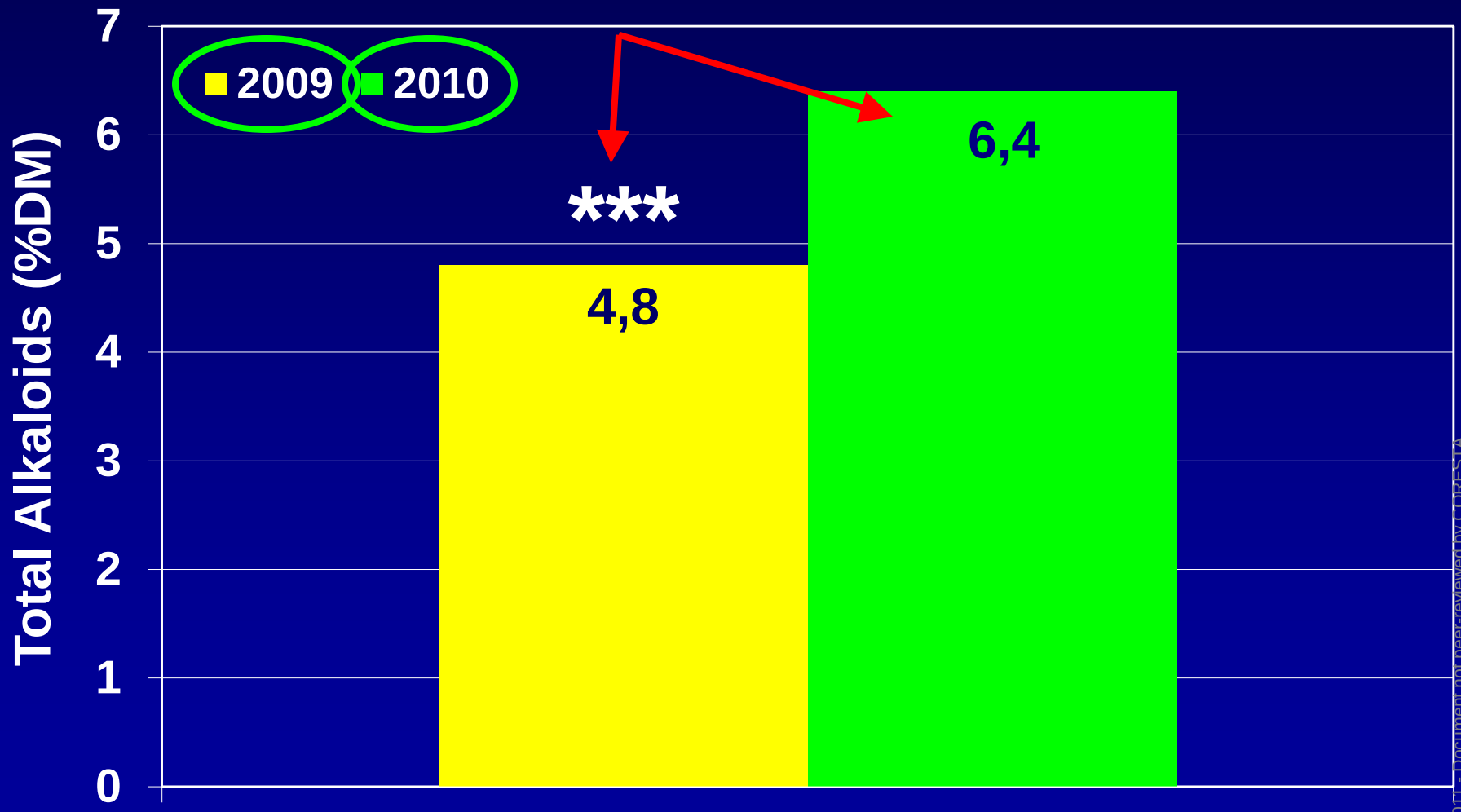
	Tot Alk[1]	Tot N
Variety	**	**
Year	***	**
Var x Yr	***	*

Total Alkaloids, Total N (% DM)

Variety Effects (2010)

Total Alkaloids (%DM)

Year Effects (pooled over varieties)



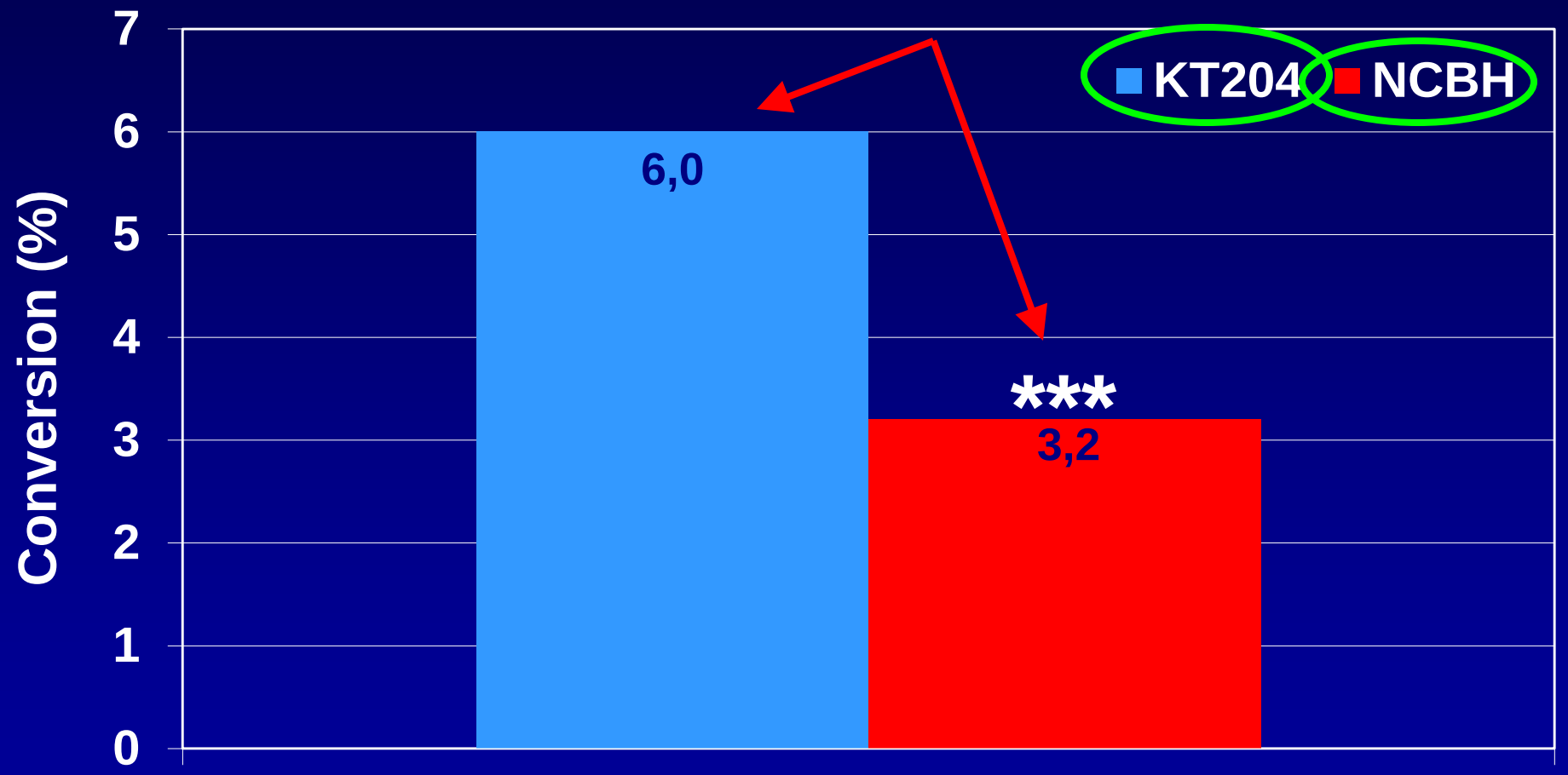
Nornic, Conversion : ANOVA

[1] log transformed

	Nornic[1]	Conv[1]
Variety	**	***
Year	*	*
Var x Yr	NS	NS

Conversion (%)

Variety Effects (pooled over years)



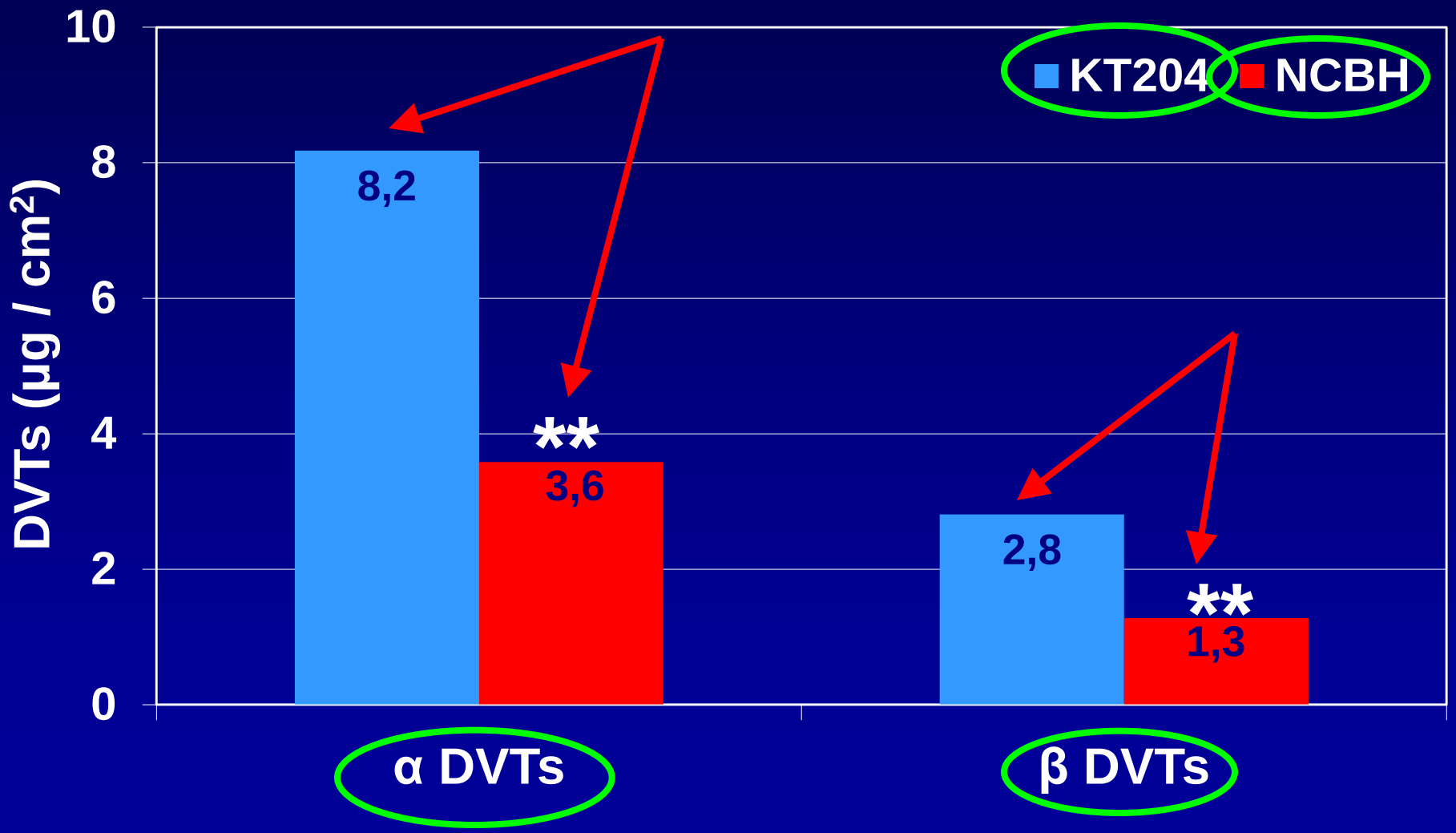
α DVTs, β DVTs : ANOVA

[1] log transformed

	α DVT[1]	β DVT[1]
Variety	**	**
Year	NS	NS
Var x Yr	NS	NS

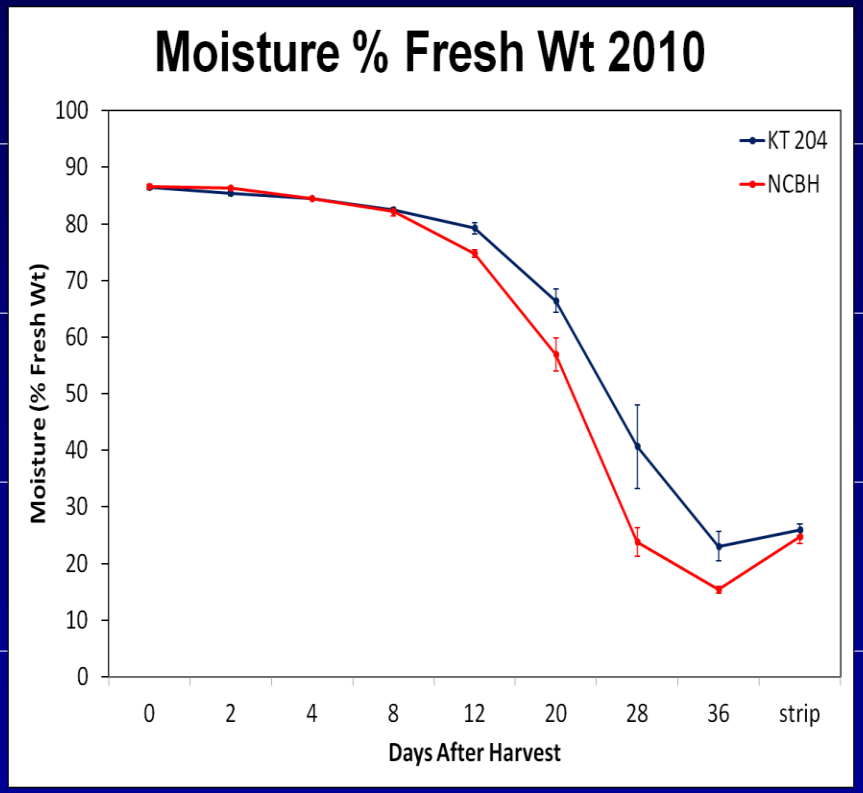
α DVTs, β DVTs (µg / cm²)

Variety Effects (pooled over years)



α DVTs, β DVTs (µg / cm²)

Variety Effects (pooled over years)



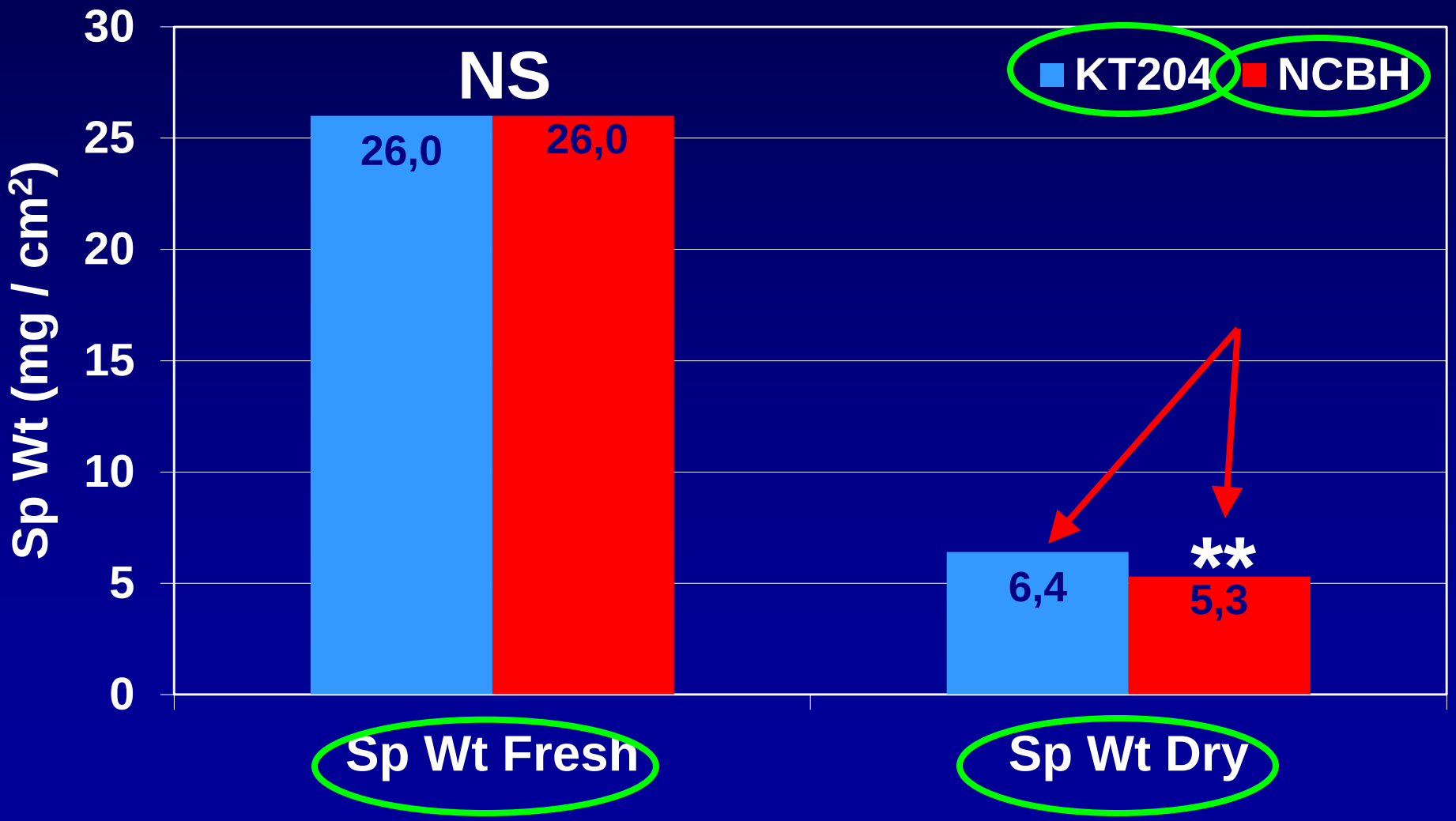
Leaf Thickness, Specific Wt : ANOVA

[1] loglog transformed

		Sp Wt[1]	
	Lf Thk	Fr	Dr
Variety	NS	NS	**
Year	**	***	***
Var x Yr	NS	NS	NS

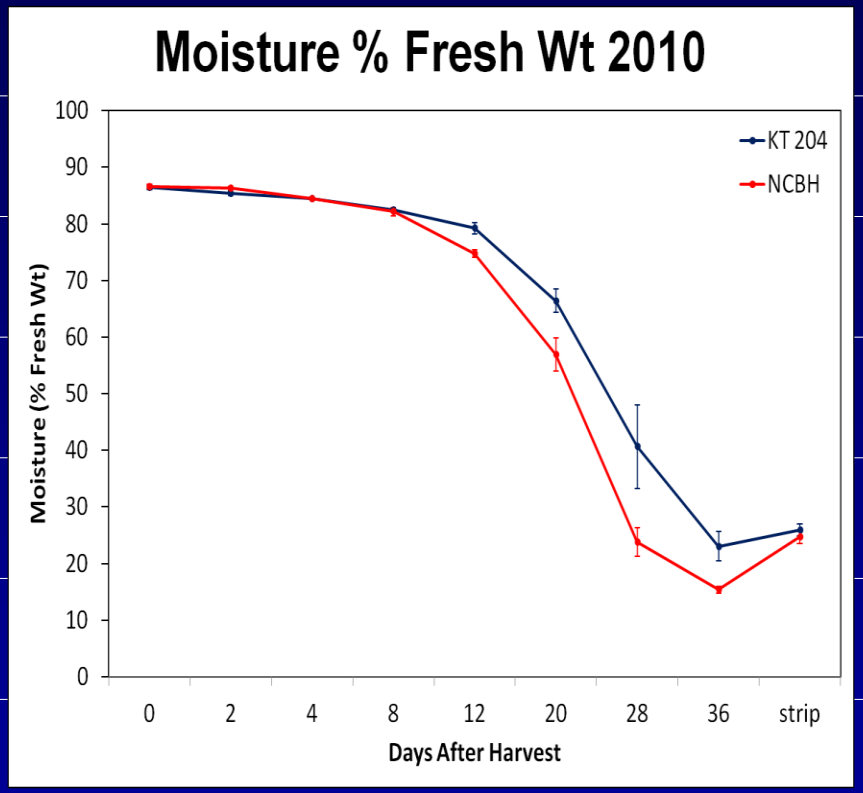
Sp Wt, Fresh & Dry (mg / cm²)

Variety Effects (pooled over years)



Sp Wt, Dry (mg / cm²)

Variety Effects (pooled over years)



Summary

Summary

	Variety	Year
TSNA	KT204 ↓	2010 ↑
NO_2 N	KT204 ↓	2010 ↑
NO_3 N	KT204 ↓	2010 ↑
Total Alkaloids	KT204 ↗	(2010 ↑)
Tot N	KT204 ↗	(2010 ↑)
Conversion	KT204 ↑	2010 ↓

Summary

	Variety	Year
TSNA	KT204 ↓	2010 ↑
NO_2 N	KT204 ↓	2010 ↑
NO_3 N	KT204 ↓	2010 ↑
Total Alkaloids	KT204 ↗	(2010 ↑)
Tot N	KT204 ↗	(2010 ↑)
Conversion	KT204 ↑	2010 ↓

Summary

	Variety	Year
TSNA	KT204 ↓	2010 ↑
NO_2 N	KT204 ↓	2010 ↑
NO_3 N	KT204 ↓	2010 ↑
Total Alkaloids	KT204 ↗	(2010 ↑)
Tot N	KT204 ↗	(2010 ↑)
Conversion	KT204 ↑	2010 ↓

Summary

	Variety	Year
TSNA	KT204 ↓	2010 ↑
NO_2 N	KT204 ↓	2010 ↑
NO_3 N	KT204 ↓	2010 ↑
Total Alkaloids	KT204 ↑	(2010 ↑)
Tot N	KT204 ↑	(2010 ↑)
Conversion	KT204 ↑	2010 ↓

Summary cont

	Variety	Year
TSNA	KT204 ↓	2010 ↑
DVTs	KT204 ↑	-
Sp Wt Dr	KT204 ↑	2010 ↓
Moisture	KT204 ↑	2010 ↓
Sp Wt Fr	-	2010 ↓
Leaf Thick L	-	2010 ↓
Leaf Thick M	-	2010 ↑

Conclusions

Conclusions

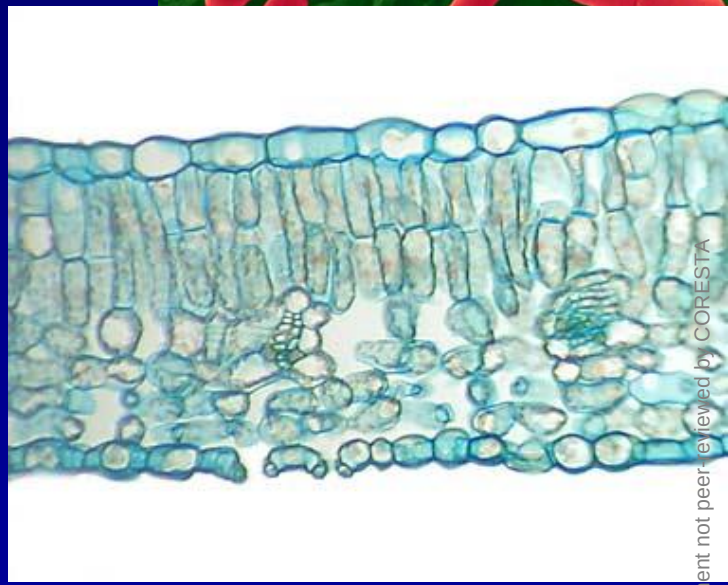
- KT 204 consistently lower TSNAs
  - ↑ very little during cure
  - NCBH 129 starts ↑ after 3-4 weeks
- KT 204 consistently lower nitrite
  - same accumulation pattern as TSNAs
  - other researchers similar results
    - likely KT 204 ↓ nitrite partly explains ↓ TSNAs
- KT 204 ↓ nitrate: ↑ alkaloids, tot N
  - not totally consistent
  - differential efficiency in N assimilation?

Conclusions cont

- Possible reasons for KT 204 ↓ nitrite
  - endogenous anti-oxidants
  - unique microbial profile
  - internal anatomy of leaf
- KT 204 ↓ nitrite not because of differential drying in cure
  - slower drying rate
    - higher DVTs
    - ↑ specific weight
    - no difference in leaf thickness

Conclusions cont

- **Current work**
  - compare varieties under controlled curing conditions
    - hot, humid / cool, dry / ambient
  - study microbial profile
    - metagenomics approach
    - nitrate reducers
- **Future work**
  - study histology
  - metagenomics
    - nitrite reducers, TSNAs metabolizers



Acknowledgements

- Financial support
  - PMI, Altria
- Lab staff
- Farm staff & student helpers