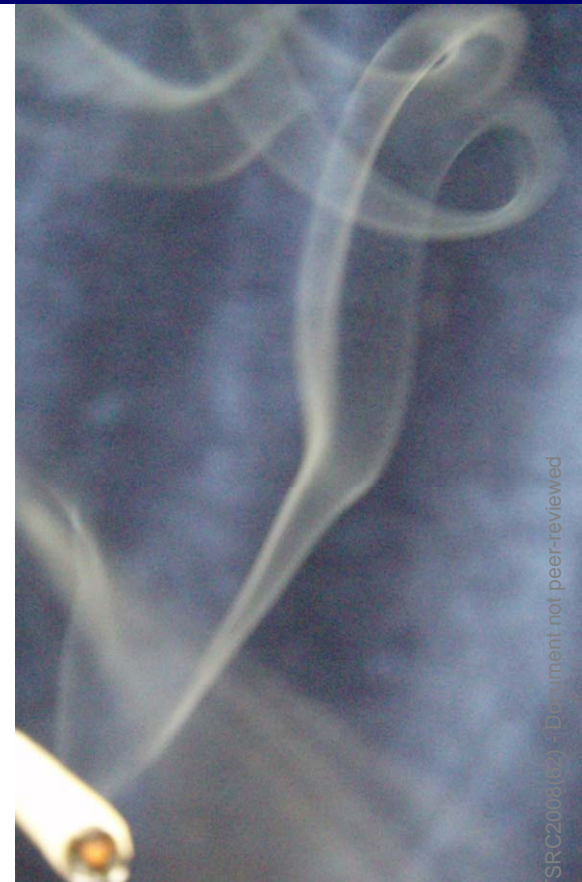
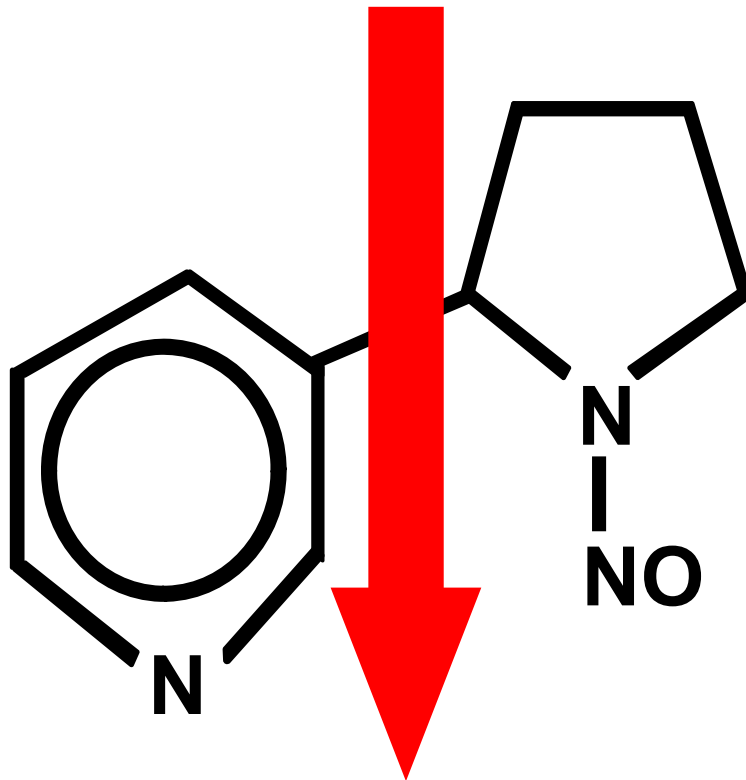


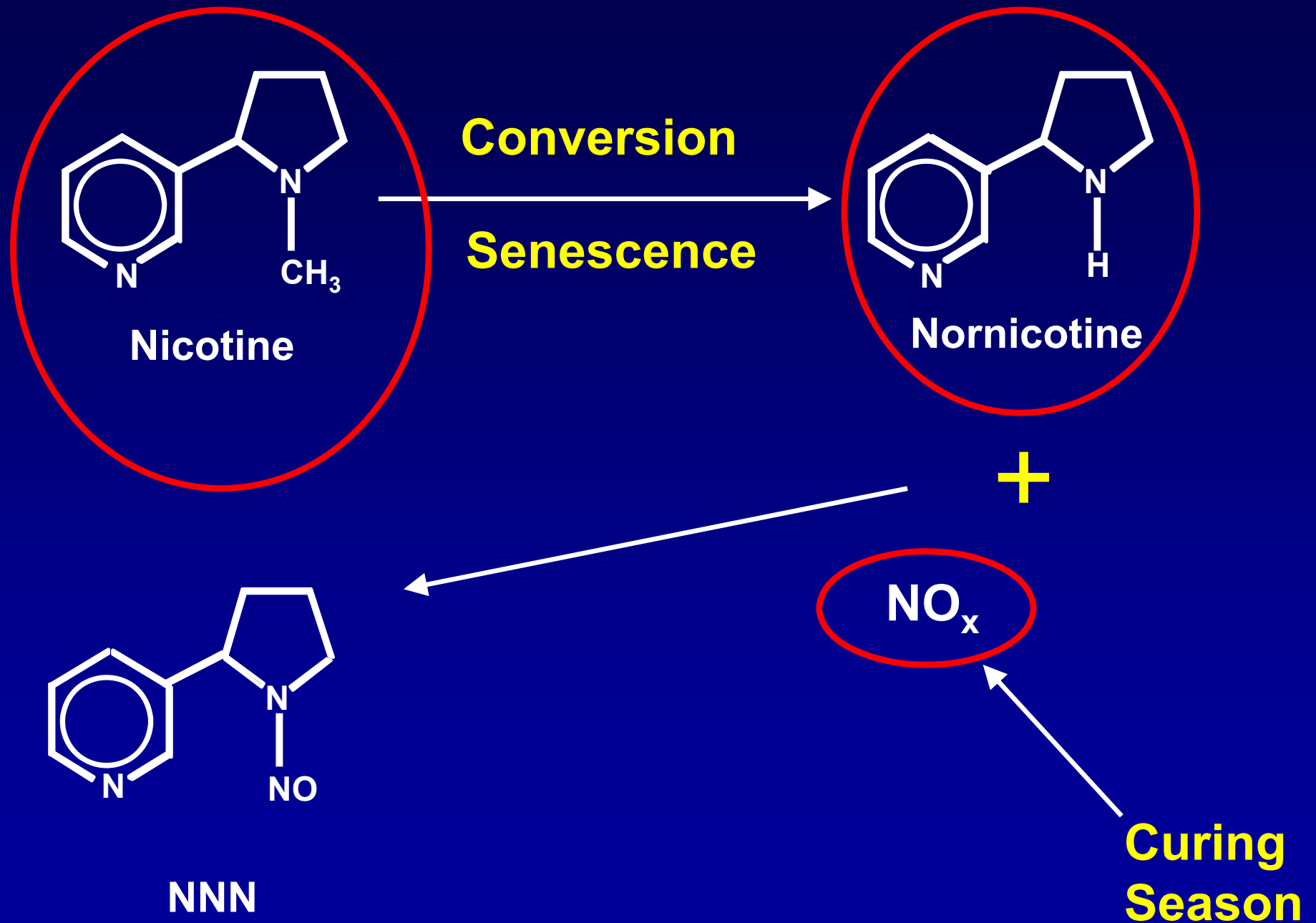
# Reducing TSNAs in Air-Cured Tobacco – By What Measure?

Anne Jack

University of Kentucky



# NNN Formation



# TSNA Formation in Burley

- **Nornicotine (conversion)**
  - Seedlot, variety
- **Curing environment**
- **Microbial populations (nitrite)**
  - Curing environment, possibly location
- **Variety**
  - Alkaloid, inherent factors
- **Storage**
- **Agronomic practices**
  - Nitrate, total alkaloid accumulation



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# Decrease TSNAs, Decrease Alkaloids



↓ TSNAs, ↓ TA,  
↓ TSNA / TA?

# Decrease TSNAs, TA Constant



# Seed Screening



# Seed Screening

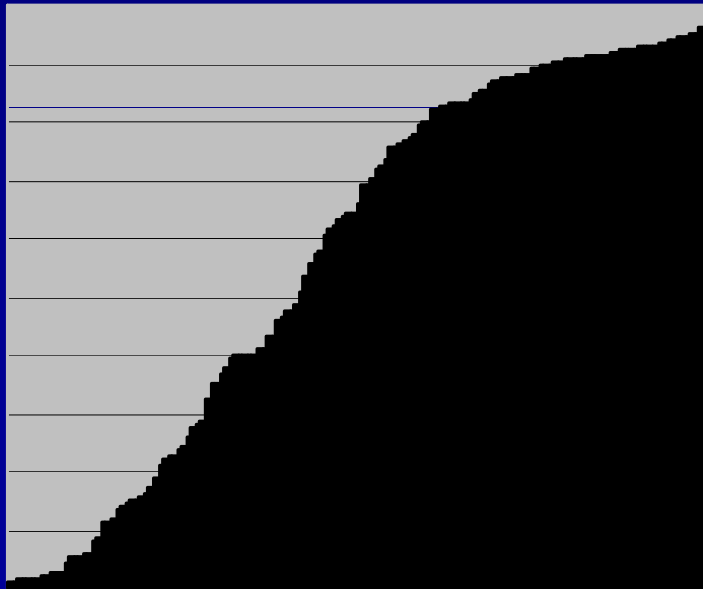
- **Reducing nornicotine**
  - Single most effective step in reducing NNN
- **No decrease in TA**
- **Nornicotine easily reduced**
  - Screening Foundation seed





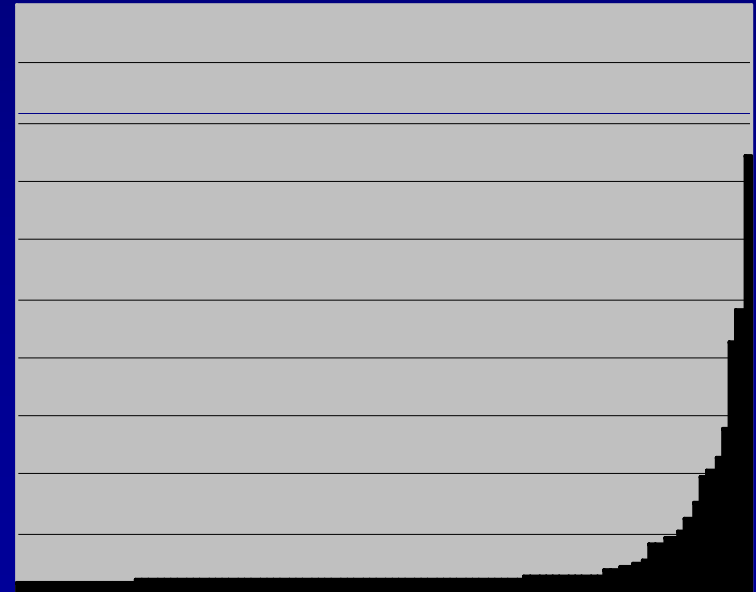
# Effect of Screening

Unscreened



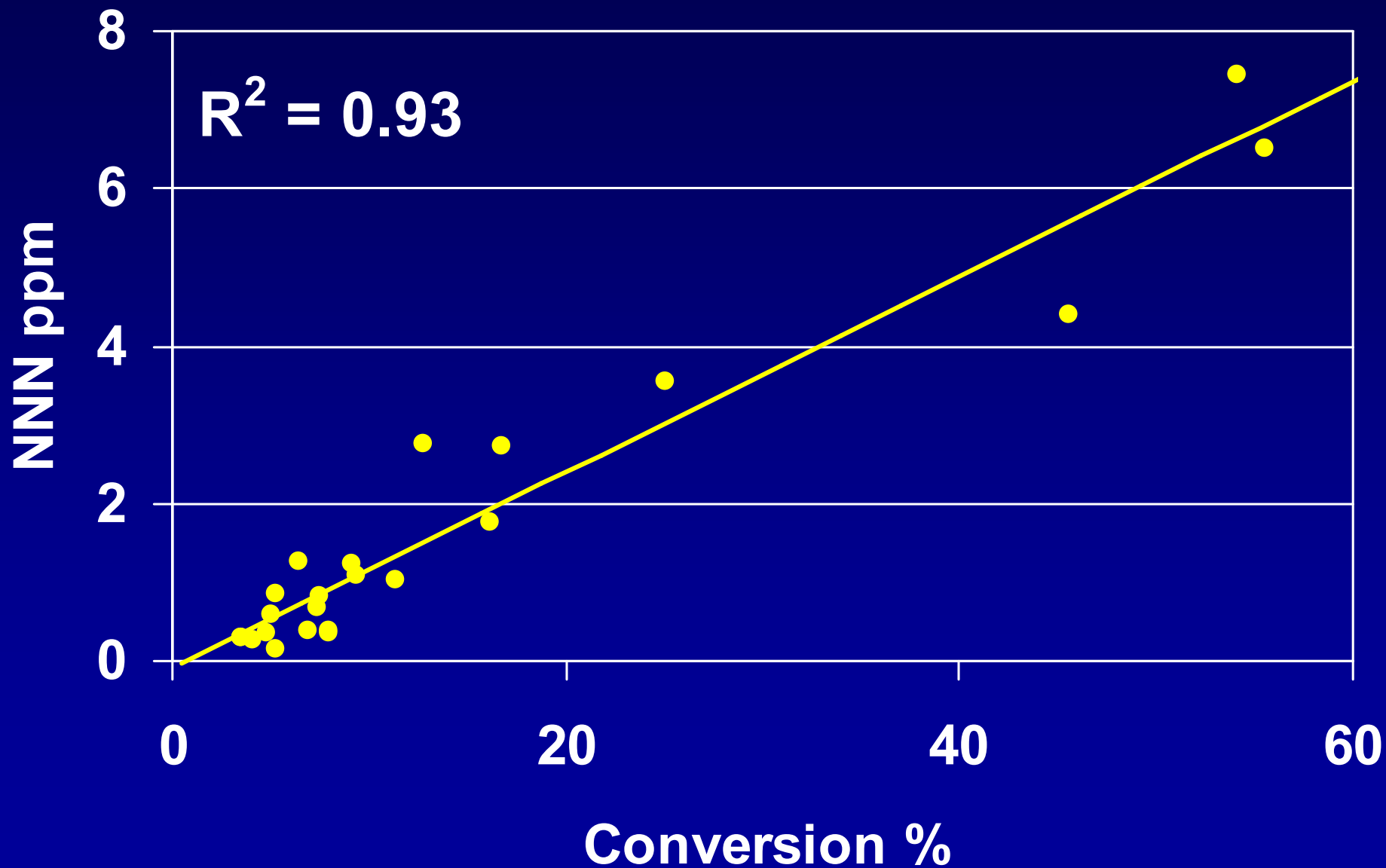
57

Screened

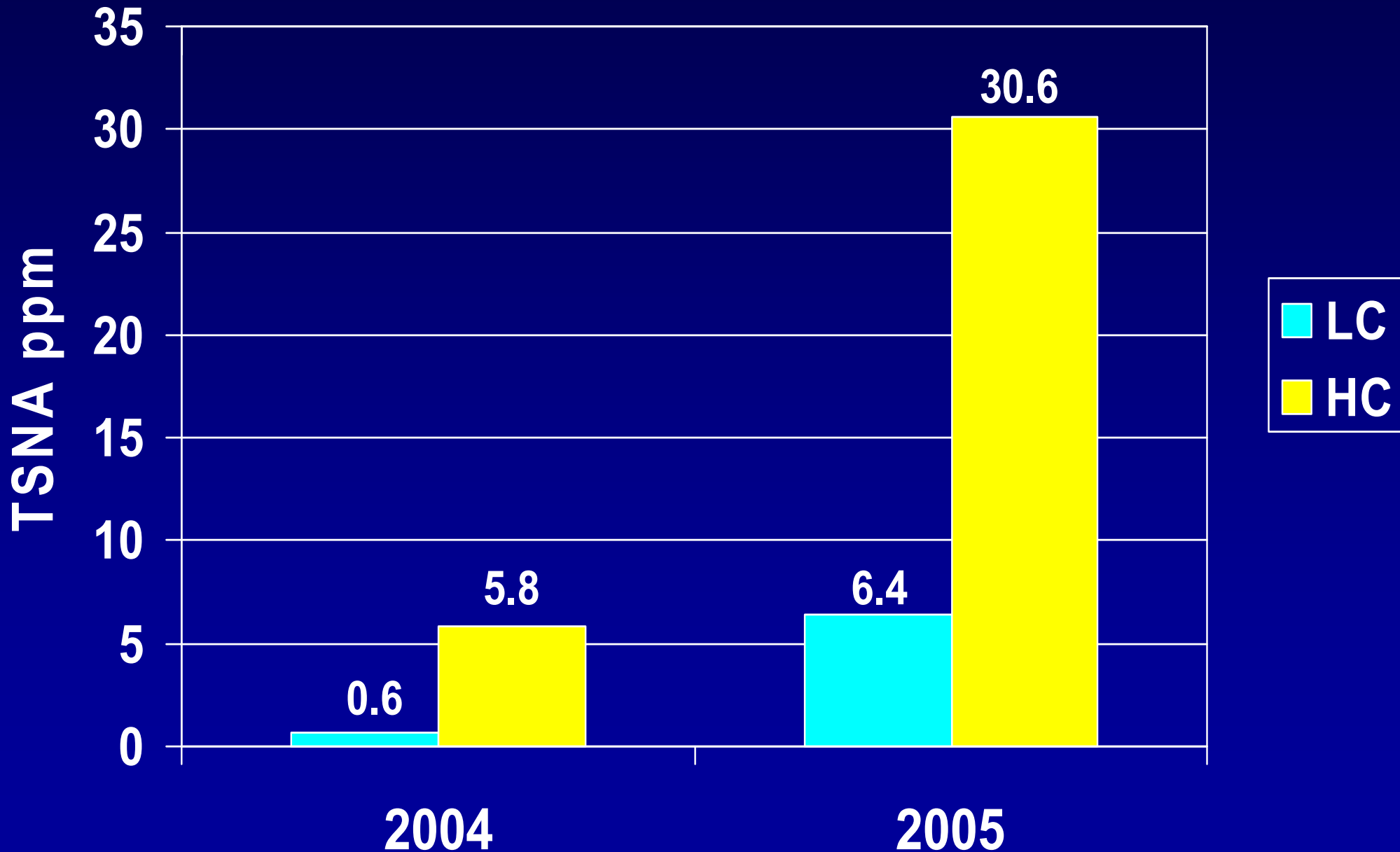


5

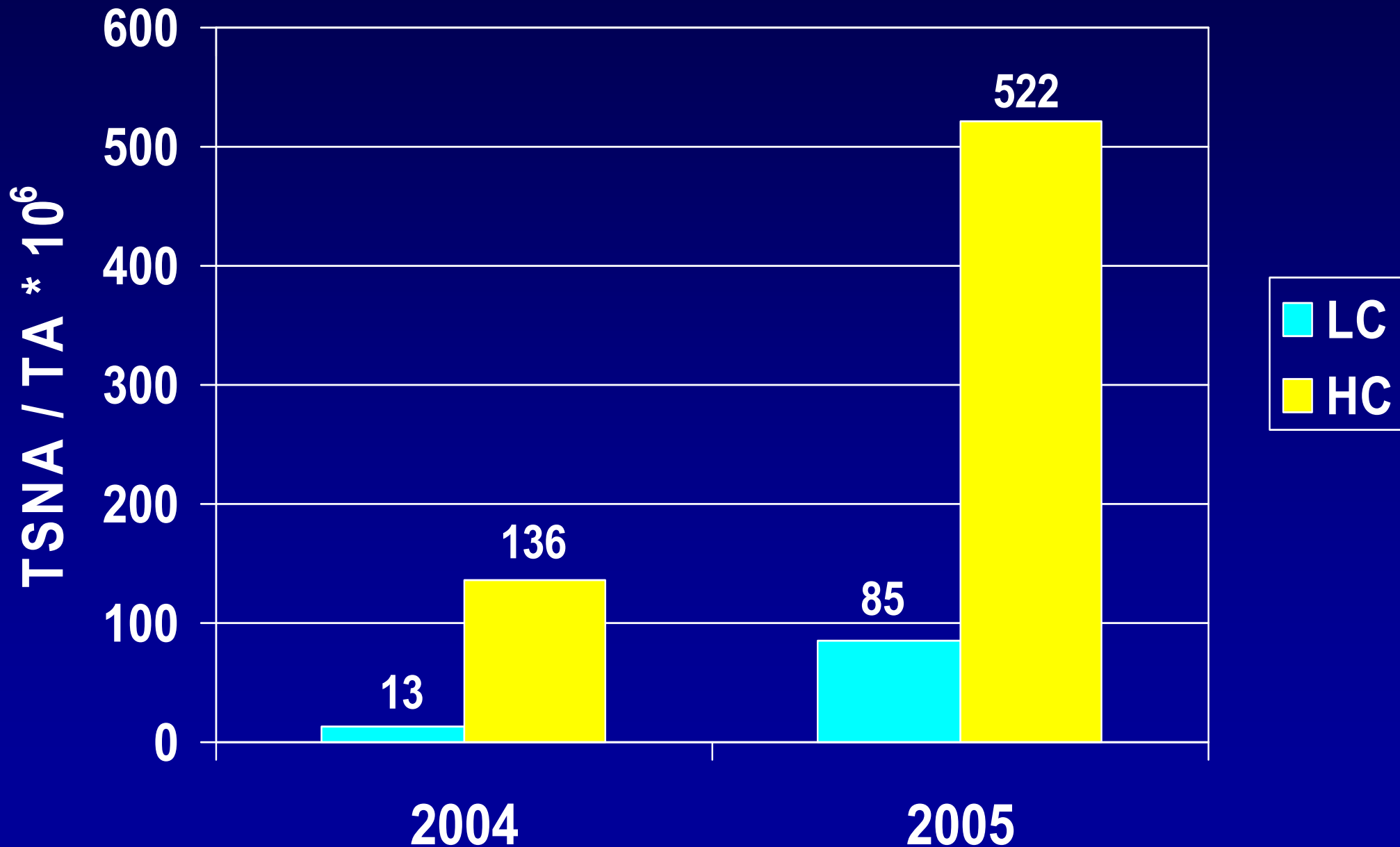
# NNN vs Conversion



# TSNA – High vs Low Converter



# TSNA / TA – High vs Low Converter



# Storage



# Storage Strategies

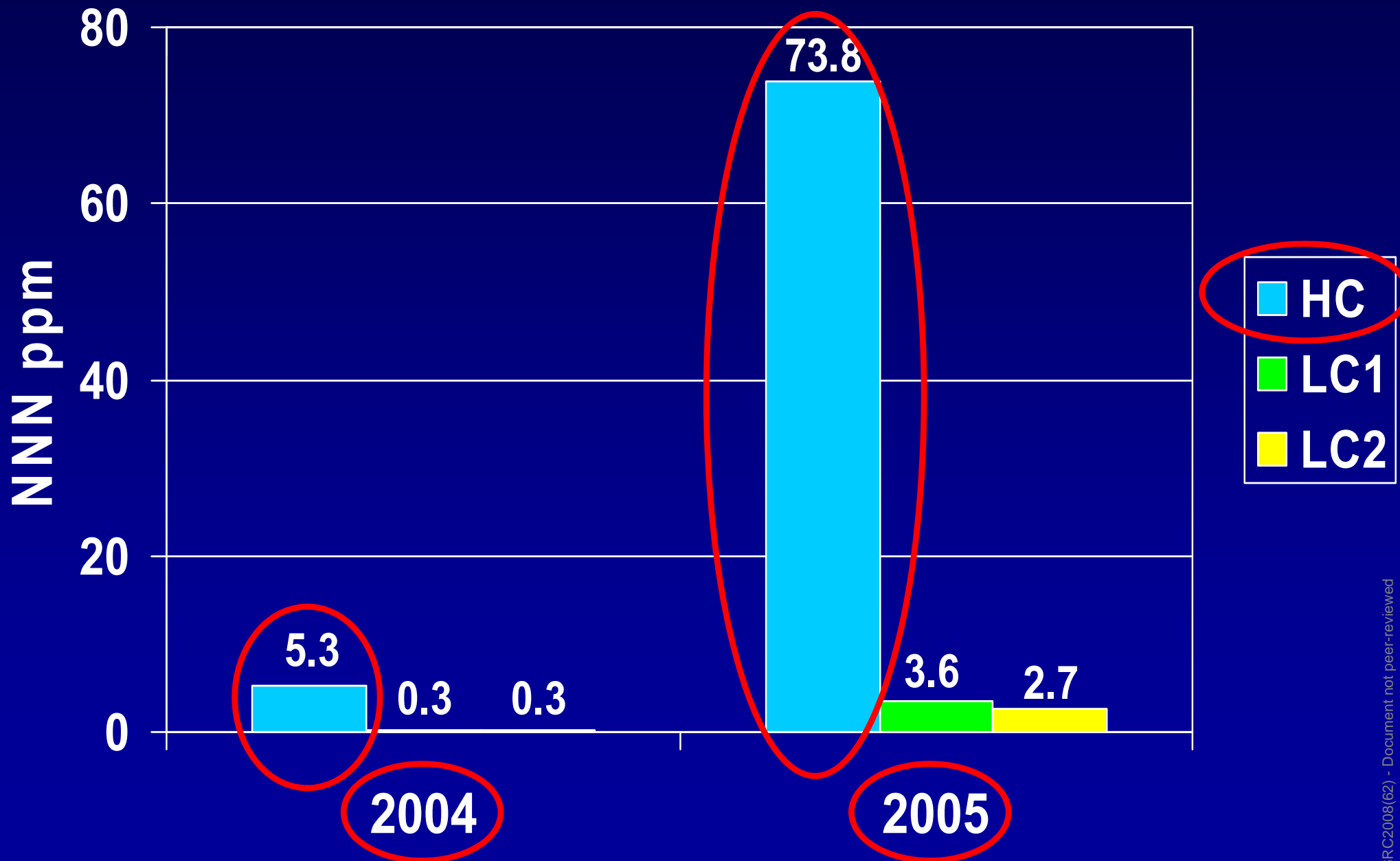
- **Extra time in storage → potential for ↑ TSNAs**
  - strip, bale & deliver as soon as possible
- **Moisture content**
  - ↑ moisture ↑ TSNAs
  - Moisture: ~ 24%
- **No TA ↓**



# Curing



# NNN – 3 Varieties 2 Years





# Conversion and Curing

- **Low converters will not accumulate high levels of NNN**
  - Under NORMAL curing conditions
- **High converter will accumulate high levels of NNN**
  - Under NORMAL curing conditions
- **Flash curing**
  - Low TSNA
  - Even in a high converter



# Factors Affecting Curing

- Temperature, RH, air movement
  - Optimal for quality, optimal for TSNAs
  - **Challenge**
    - Produce quality tobacco with acceptable TSNAs
  - **Barn modifications have not yet resulted in a practical & economical system**
- Potential?



# Variety



# Variety

- **Conversion**
  - In the past, effect of variety often confounded with conversion
  - Now, most seed screened
    - Minimal differences in conversion between varieties
- **Inherent varietal differences**
  - Significant differences reported between varieties
    - Drying rate, nitrite, TSNAs
  - Little information on varietal differences
  - Potential for TSNA ↓ without TA ↓



# Microbes & Applied Chemicals



# Microbes, Applied Chemicals

- **Role of microbes**
  - Crucial importance
  - Details largely unknown
- **Many chemicals tested**
  - None consistently effective
- **Biological control**
  - Some promising results
  - Not yet any practical control method
- **Potential for TSNA ↓ without TA ↓**



# Decrease TSNAs, Alkaloids



# Fertilization



0 N

250 N

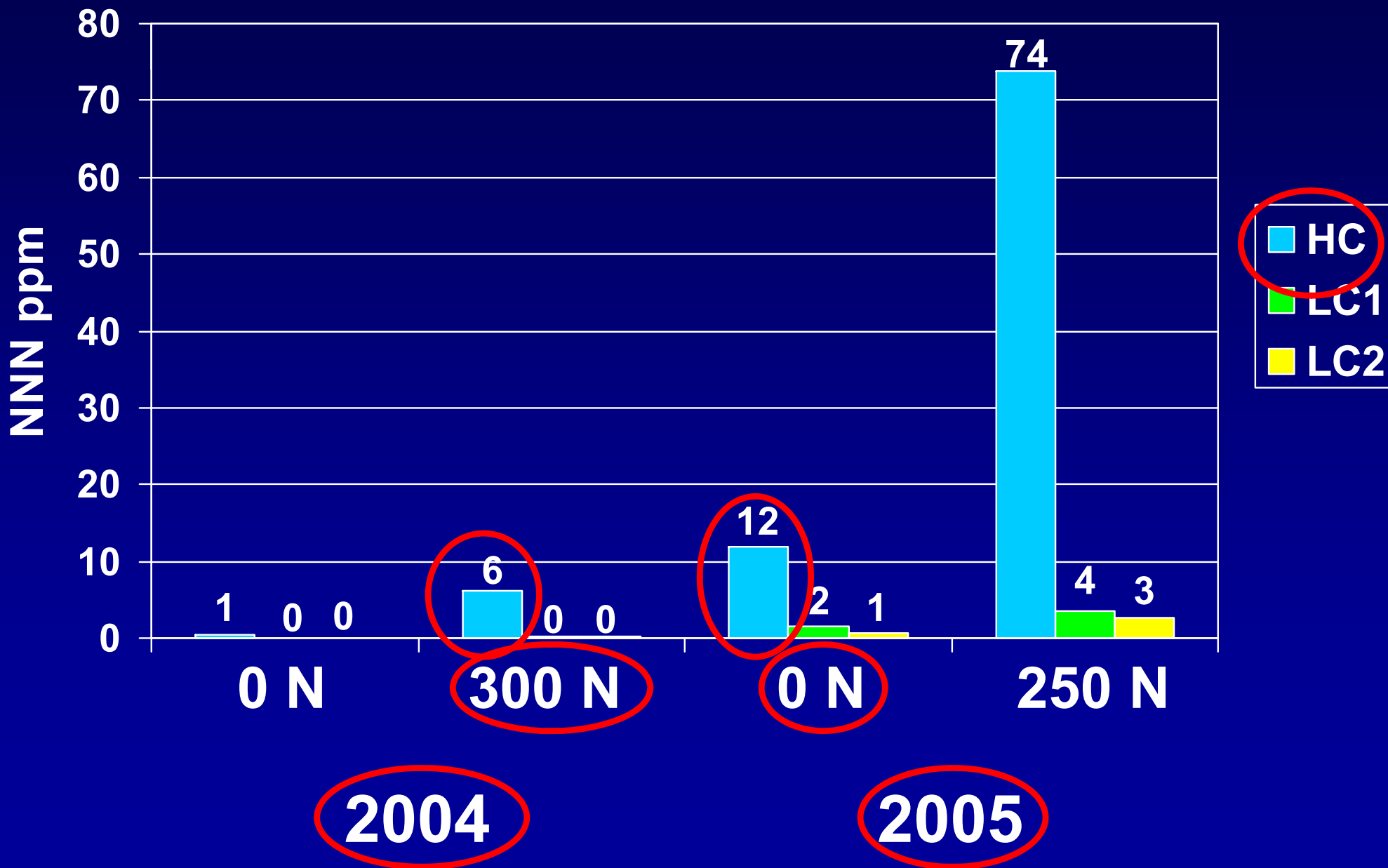


# Nitrogen Rates

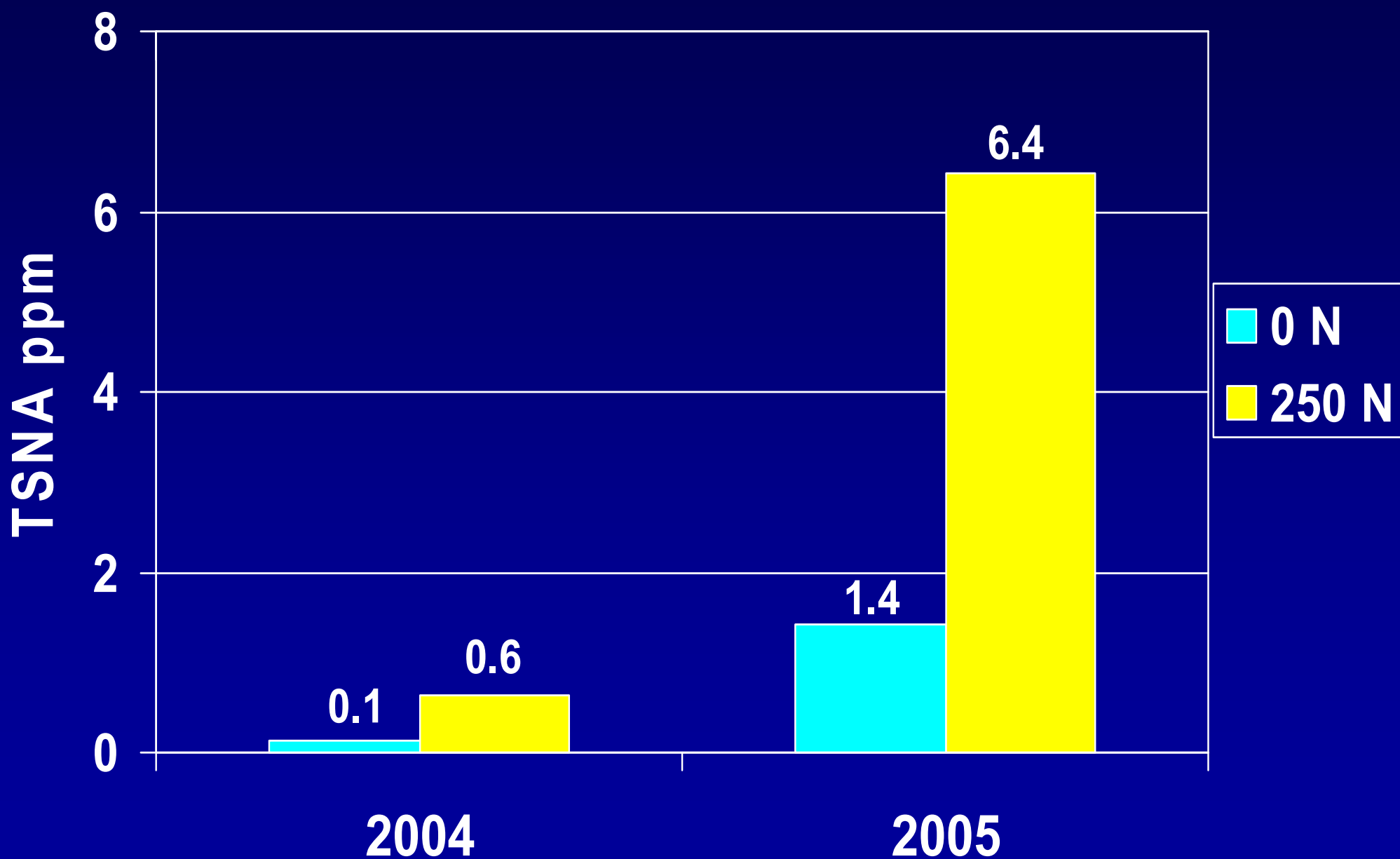
- **Extremes - high & low nitrogen rates**
  - Large differences in TSNAs – many studies
- **Within normal production range**
  - Results inconsistent
    - Some studies – +ve correlation N rate & TSNAs
    - Some studies – no relationship
- **Environmental conditions**
  - Large role in determining whether N rates affect TSNAs



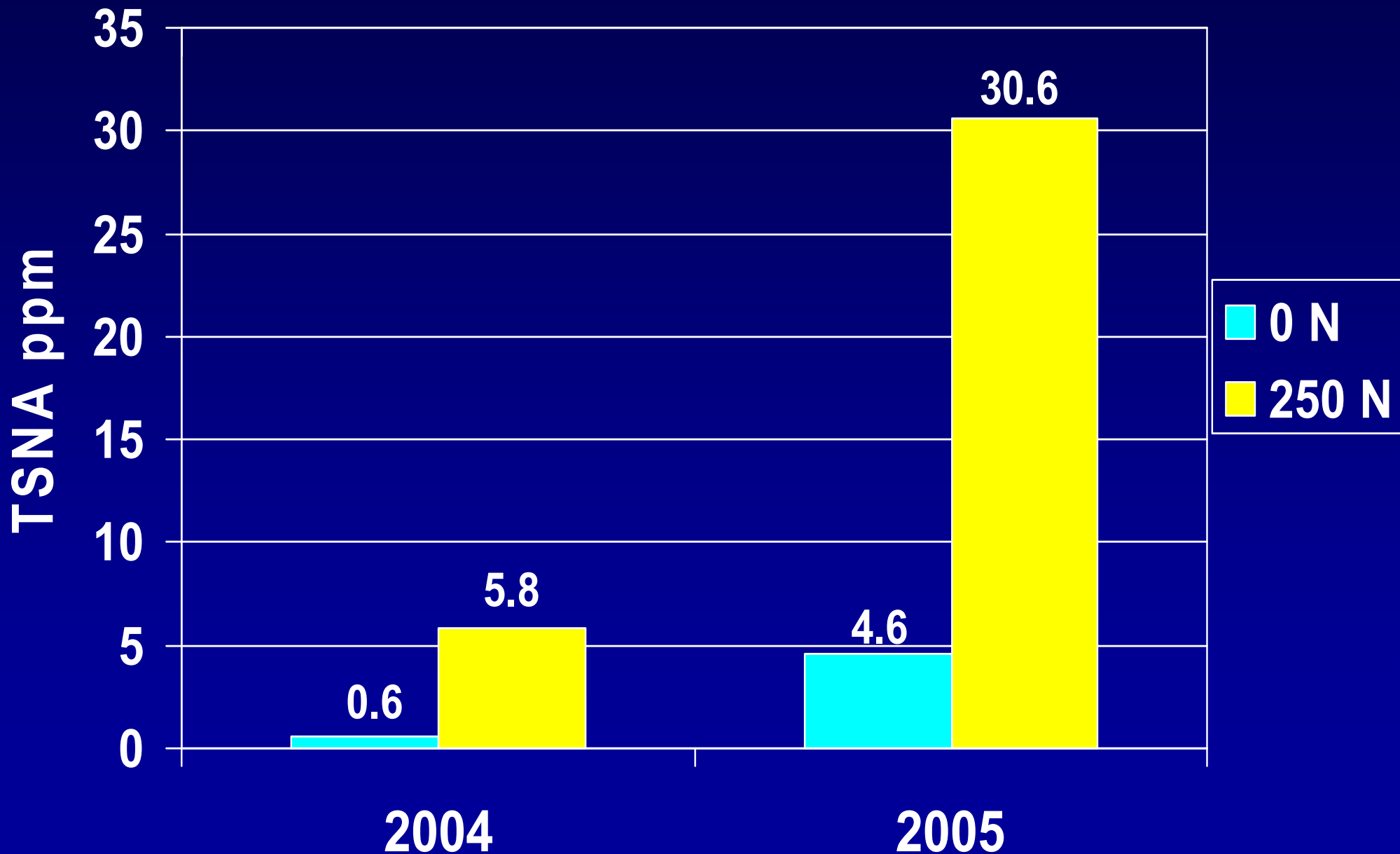
# NNN – N Rate and Years



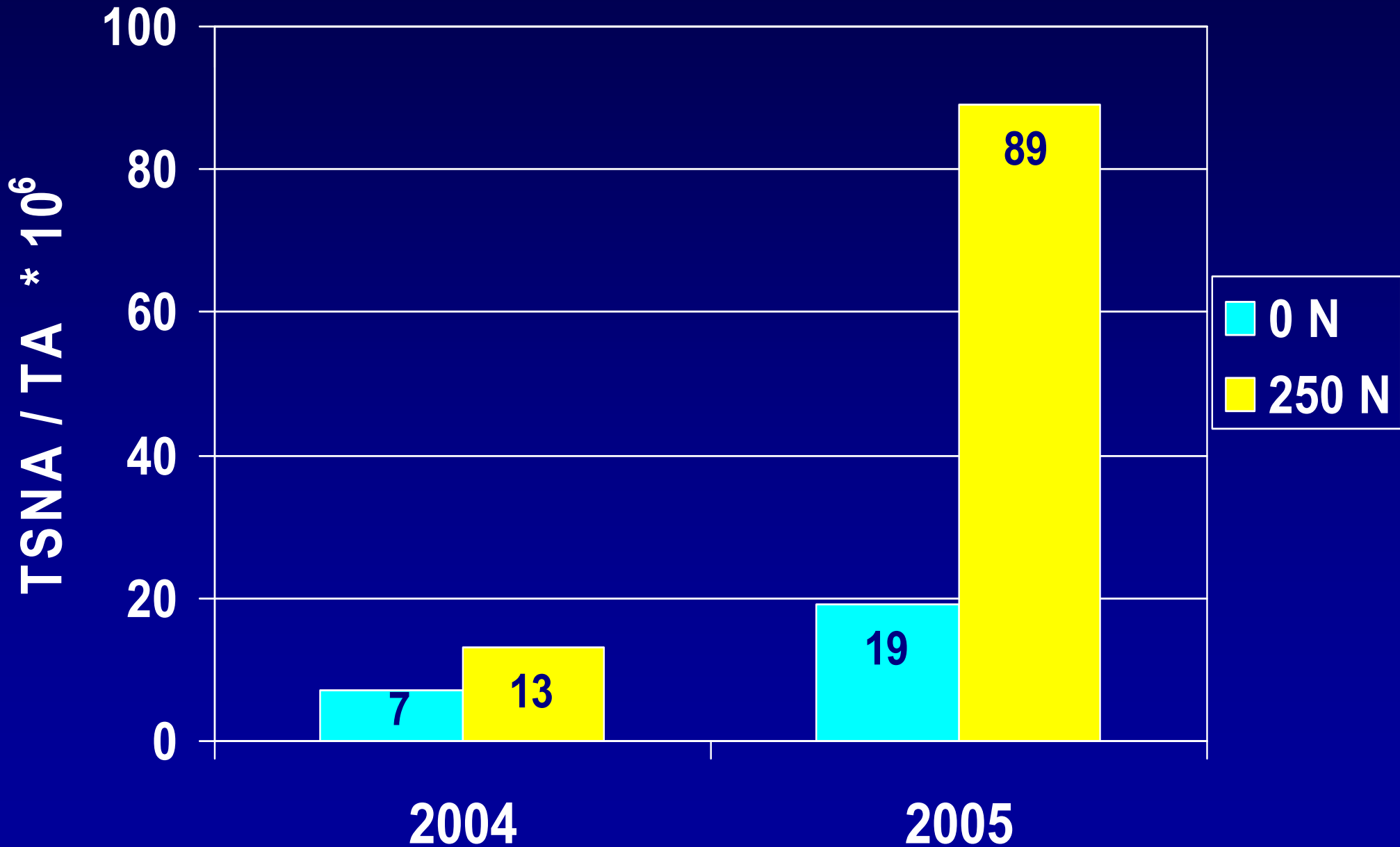
# TSNA – Nitrogen Levels, LC



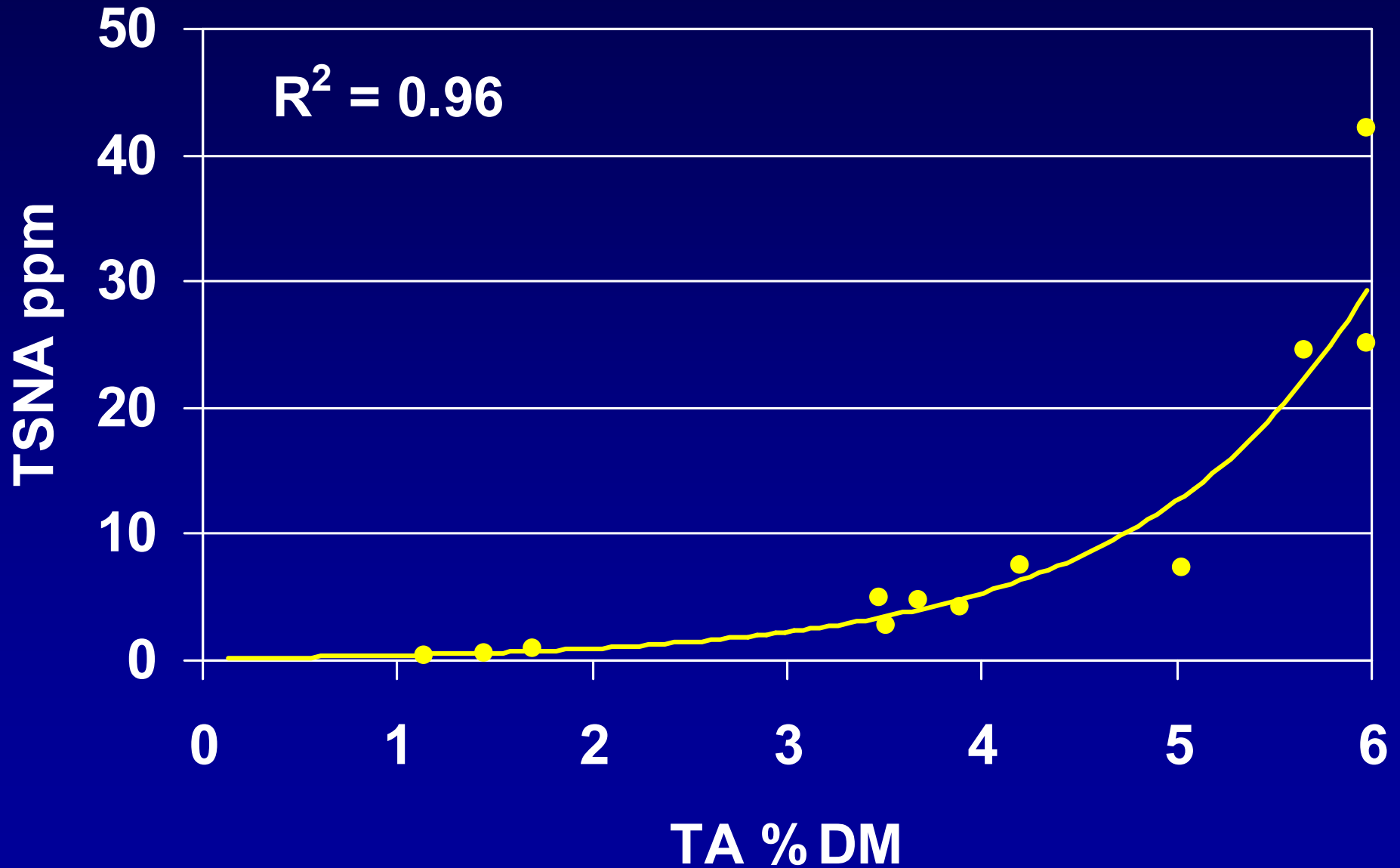
# TSNA – Nitrogen Levels, HC



# TSNA / TA – Nitrogen Levels, LC



# TSNA vs Total Alkaloids



# Topping

- **Topping late / high**
  - ↓ alkaloids
- **Some studies report effect on TSNAs**
  - **Especially combined with N rates**
    - Differences small
    - Unlikely to have much impact in currently acceptable range, especially with low converters



# Harvesting





# Maturity

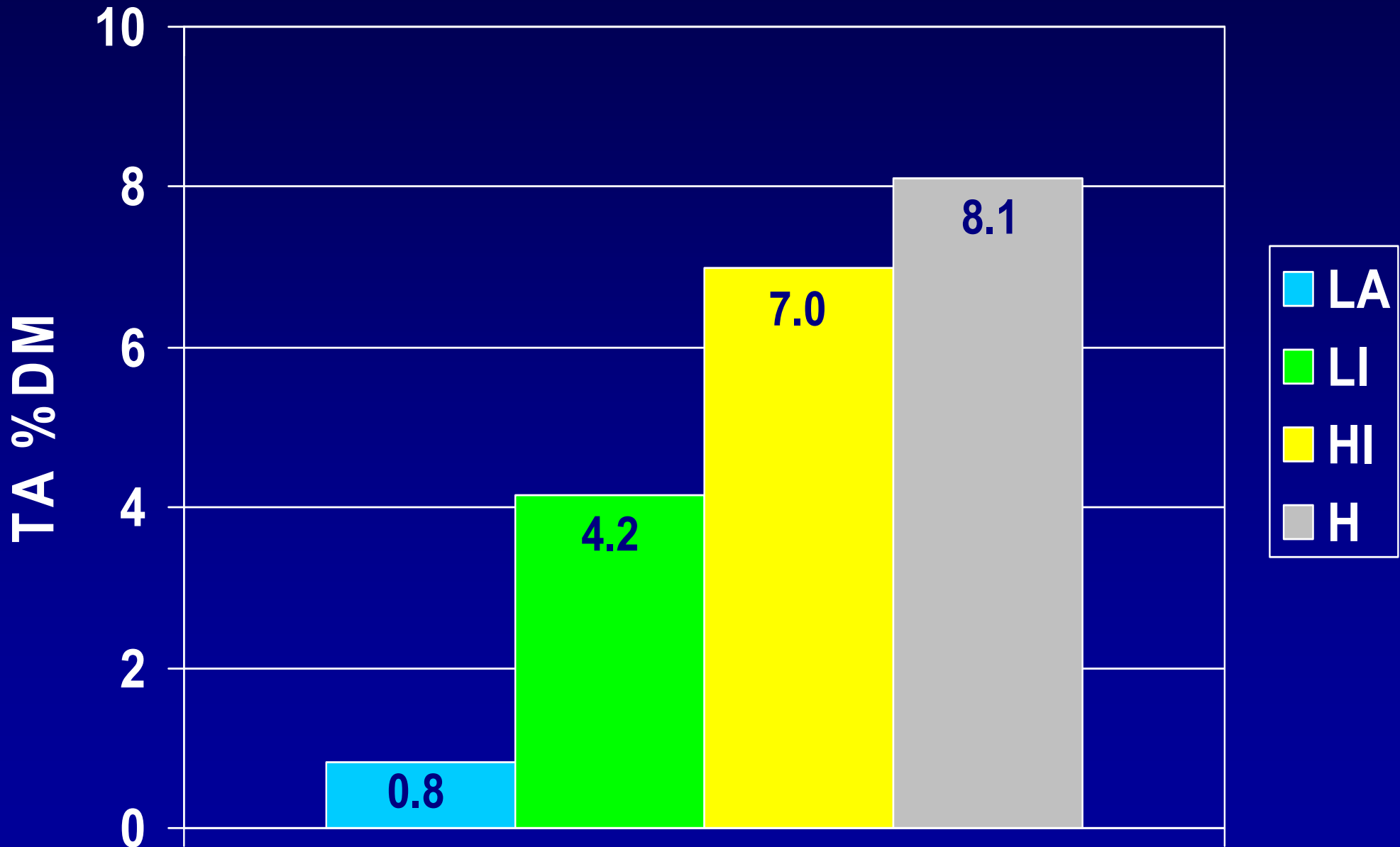
- **Earlier studies report**
  - **↑ TSNA with ↑ maturity at harvest**
- **With current low converter varieties**
  - **Maturity unlikely to have much impact**



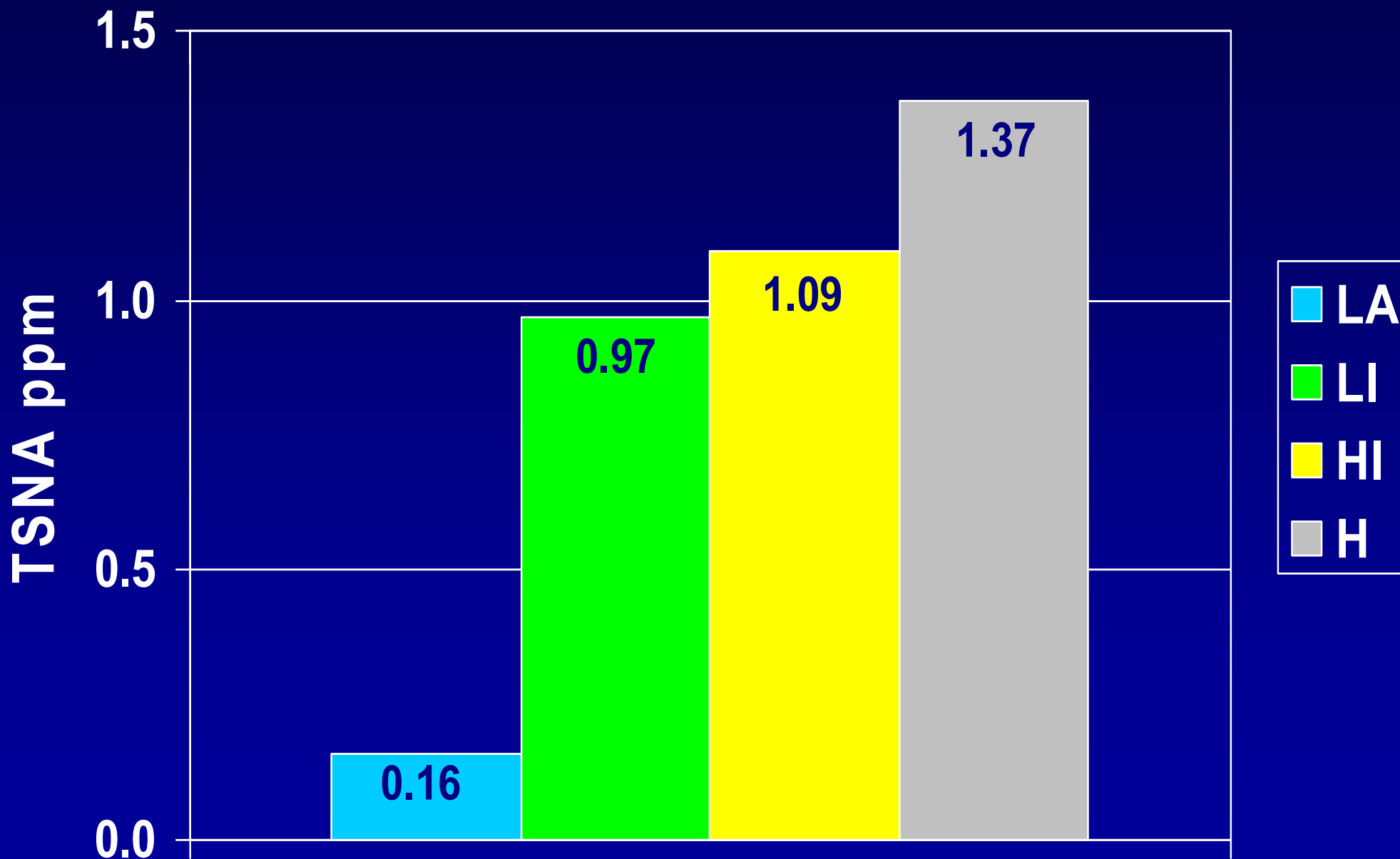
# Low Alkaloid Varieties



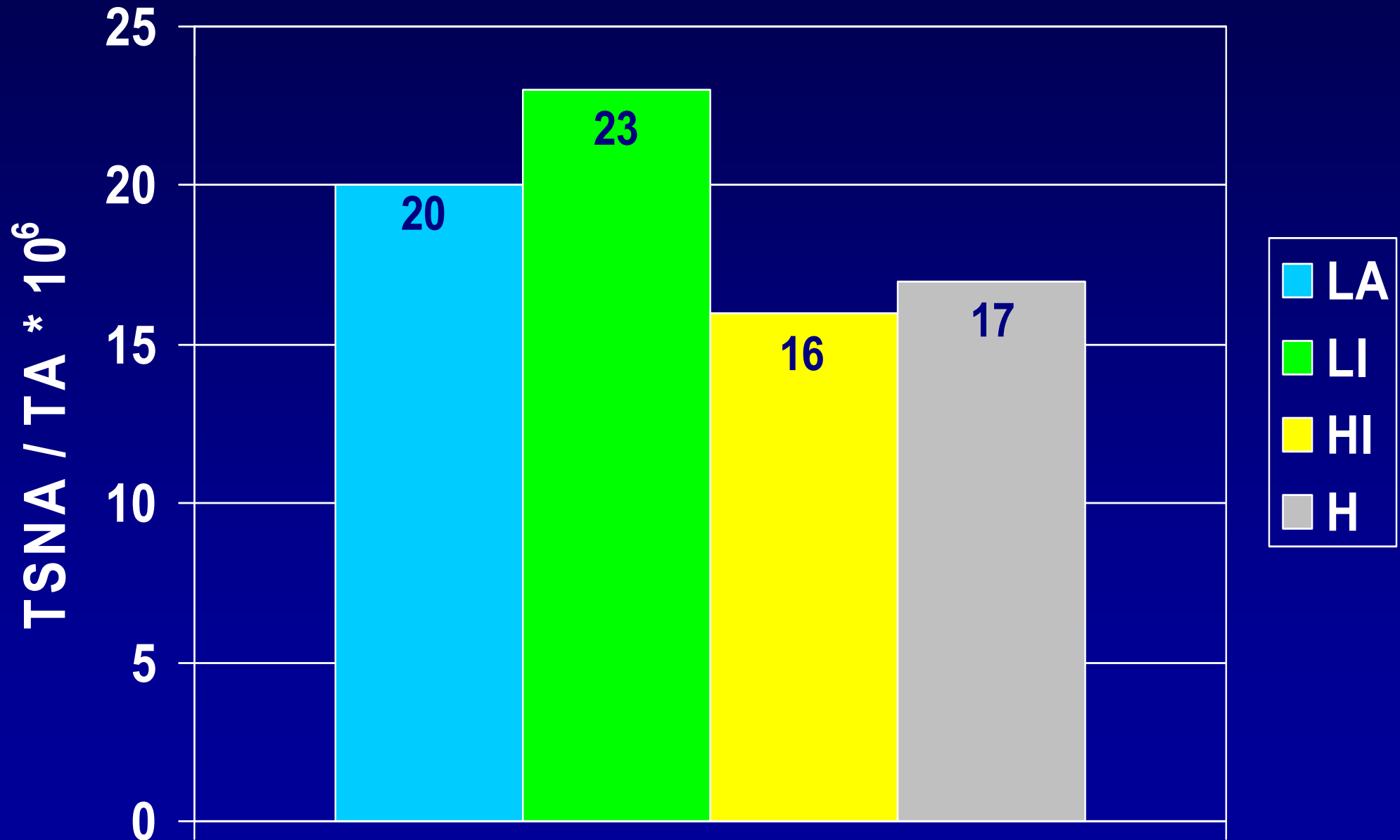
# TA – Low Alkaloid Series



# TSNA – Low Alkaloid Series



# TSNA / TA – Low Alkaloid Series



# Summary

- ↓ TSNAs, TA not ↓
  - Seed screening
  - Variety – inherent low TSNA
  - Storage management
  - Curing management
  - Control microbes
- ↓ TSNAs by ↓ TA
  - Fertilizer - ↓ TA, greater ↓ TSNA, ↓ TSNA / TA
  - Topping, spacing, time of harvest – effects likely small
  - Genetic low alkaloid - ↓ TA, ↓ TSNA, TSNA / TA not ↓



