

# **Nitrogen Source and Placement Effects on Nitrous Oxide Emissions from Irrigated Strip-Till and No-Till Corn Production Systems**

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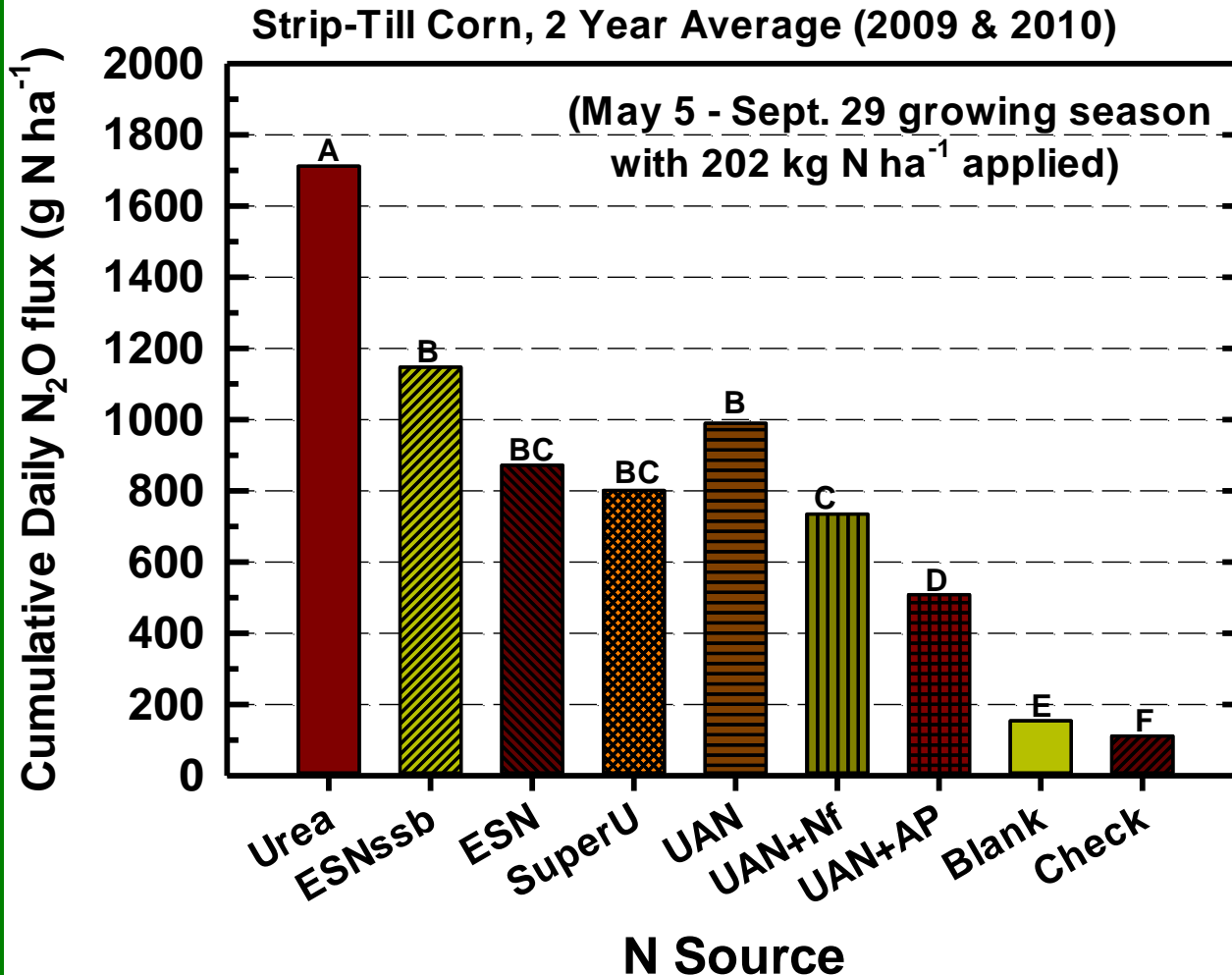
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# Background Information:

- **Agriculture contributes ~67% of U.S. total N<sub>2</sub>O emissions, with application of N fertilizers to croplands contributing a significant portion of this amount.**
- **Global Warming Potential of N<sub>2</sub>O is ~296 times greater than CO<sub>2</sub>.**
- **Application N fertilizer generally increases N<sub>2</sub>O emissions from cropping systems.**
- **Therefore, it is important that we develop management practices to reduce N<sub>2</sub>O emissions from agricultural cropping systems.**

# Review of N Source Research Completed in 2010



N<sub>2</sub>O-N loss per  
unit of N applied

was:

**0.8% Urea**

**0.5% ESNssb**

**0.4% ESN**

**0.3% SuperU**

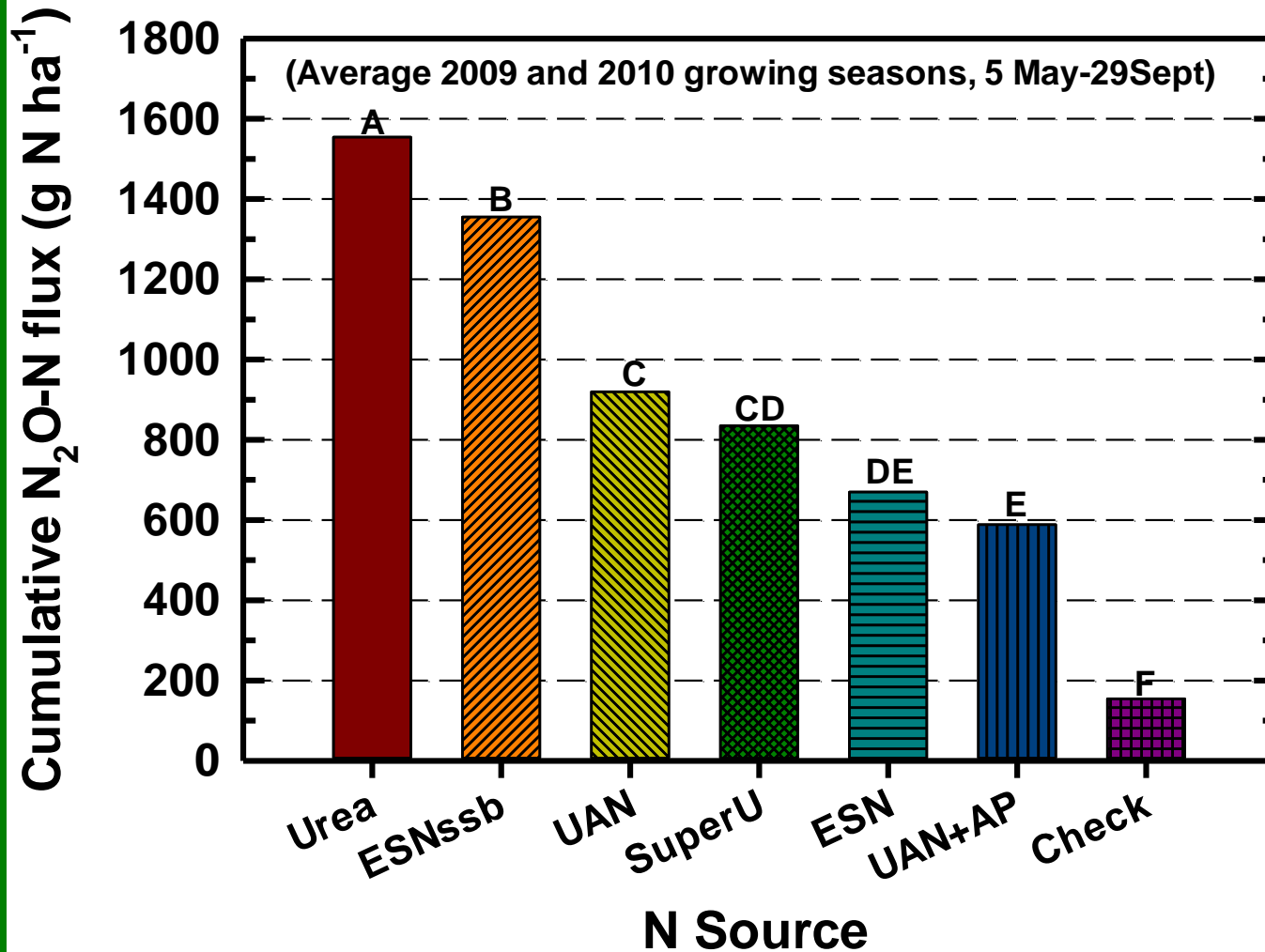
**0.4% UAN**

**0.3% UAN+Nf**

**0.2% UAN+AP**

Published: Halvorson et  
al., 2011, JEQ 40:1775-1786

# Average Cumulative Growing Season Soil N<sub>2</sub>O-N Flux in Irrigated No-Till Continuous Corn for 2009 and 2010



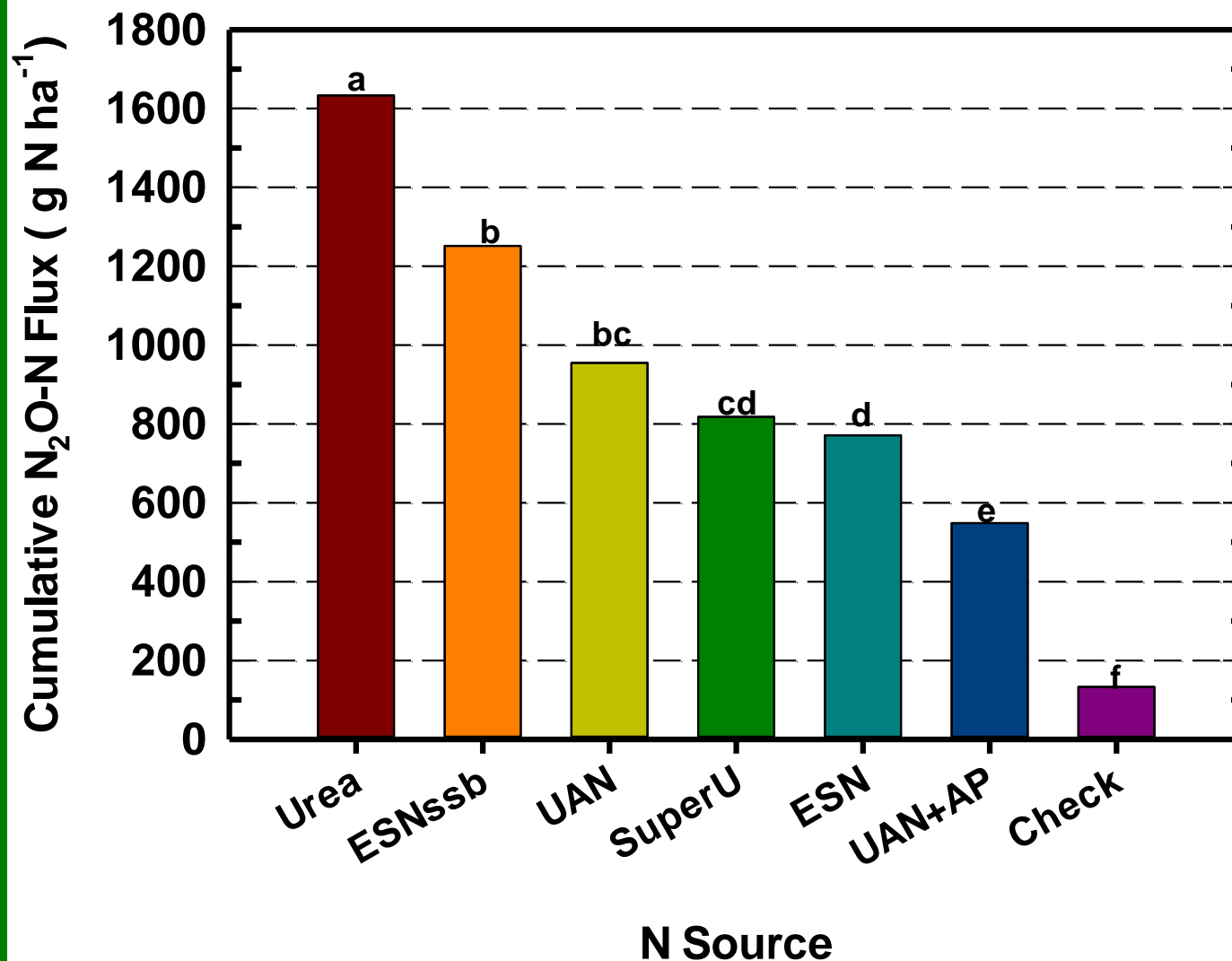
N<sub>2</sub>O-N loss per unit of N applied:

- 0.7% Urea
- 0.6% ESNssb
- 0.4% UAN
- 0.3% ESN
- 0.3% SuperU
- 0.2% UAN+AP

Manuscript: In rough draft form. Will be submitted to JEQ

# Averaged across Strip-Till and No-Till

Growing Season Cumulative N<sub>2</sub>O FLux (6 May - 29 Sept.)  
Average of Strip-Till and No-Till systems (2009-2010)



No Tillage  
x N Source  
Interaction

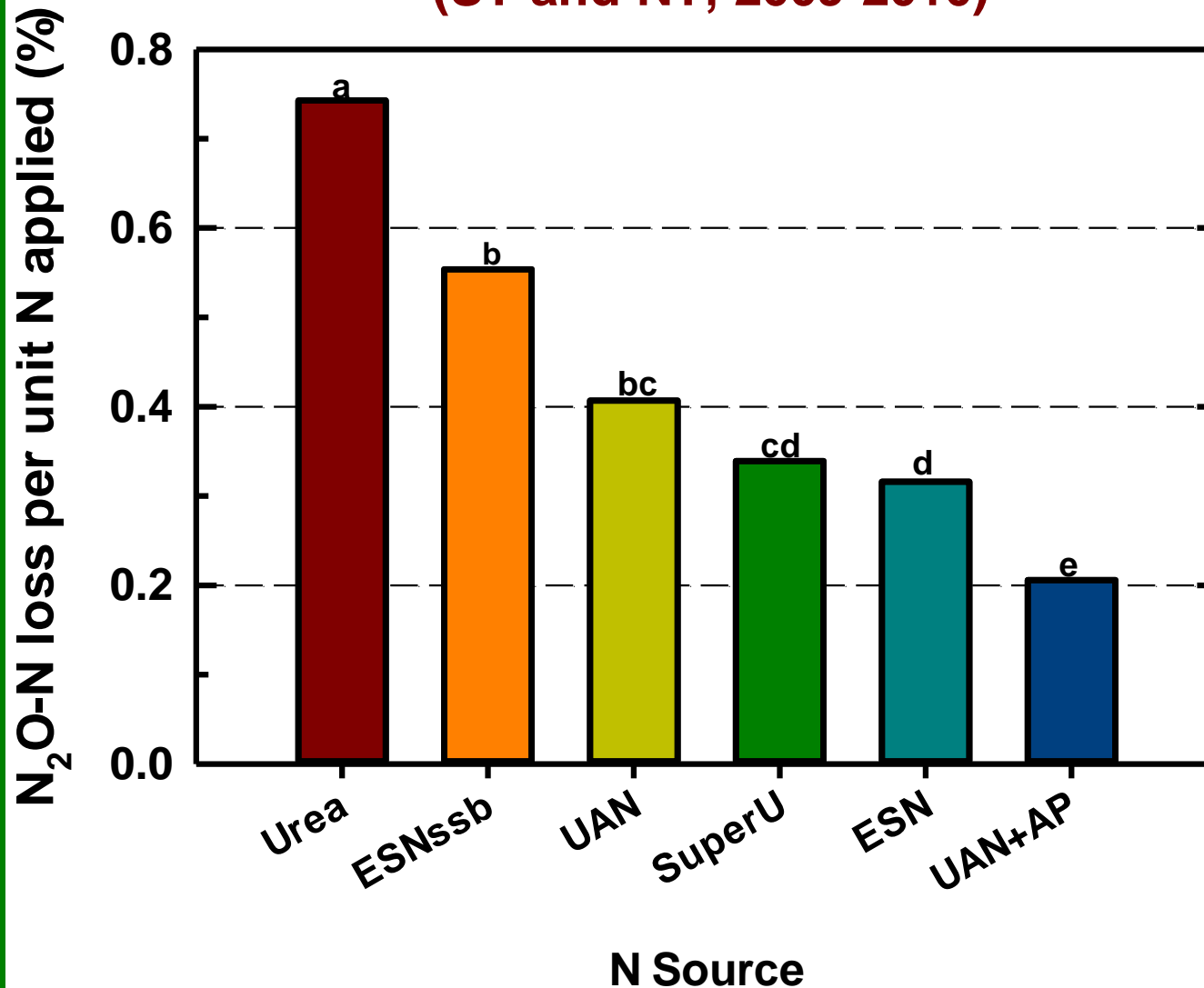
# **N Source Effects on Reducing N<sub>2</sub>O-N Emissions Compared to Urea and UAN, Averaged Across Strip-Till and No-Till corn (4 site years)**

- **Compared to Urea**
  - ESNssb (23%)
  - UAN (42%)
  - SuperU (50%)
  - ESN (53%)
  - UAN+AgrotainPlus (66%)

- **Compared to UAN**
  - SuperU (14%)
  - ESN (19%)
  - UAN + AgrotainPlus (43%)

# Averaged across Strip-Till and No-Till

Average N<sub>2</sub>O-N loss/unit N applied  
(ST and NT, 2009-2010)



No Tillage x  
N Source  
Interaction

# 2011 Study Objective and Treatments:

- **Study Objective:** Evaluate effects of N fertilizer source and placement (surface broadcast and band) on growing season N<sub>2</sub>O emissions under ST and NT, irrigated continuous corn production.
- **N Fertilizer Sources compared:**
  - dry granular urea (46-0-0)
  - polymer-coated urea (ESN, 44-0-0)
  - stabilized urea (SuperU, 46-0-0)
  - liquid UAN (32% N) (Strip-Till only)



# N Management Details

- **N Rate:**
  - 202 kg N/ha all N sources
- **N Placement:**
  - surface broadcast or band applied at corn emergence
  - 19 mm (0.75”) irrigation water applied next day
- **Designation of N Treatments:**
  - ESN: ESN bd = band; ESN bc = broadcast
  - SuperU: SUBd = band; SuperU: SUBc = broadcast
  - Urea: U bd = band; U bc = broadcast
  - UAN: UAN bd = band; UAN bc = broadcast (Strip-Till only)

# Greenhouse Gas Measurements

- **Randomized complete block design with 3 replications and 2 GHG measurements per rep (total 6 GHG measurements/treatment) per tillage treatment.**
- **N<sub>2</sub>O measurements: 2 to 3 times per week, immediately following crop planting until crop harvest (growing season).**
- **Static, vented chamber technique was used to collect the gas samples in the field.**
- **Gas chromatograph used to determine N<sub>2</sub>O concentration in gas sample.**

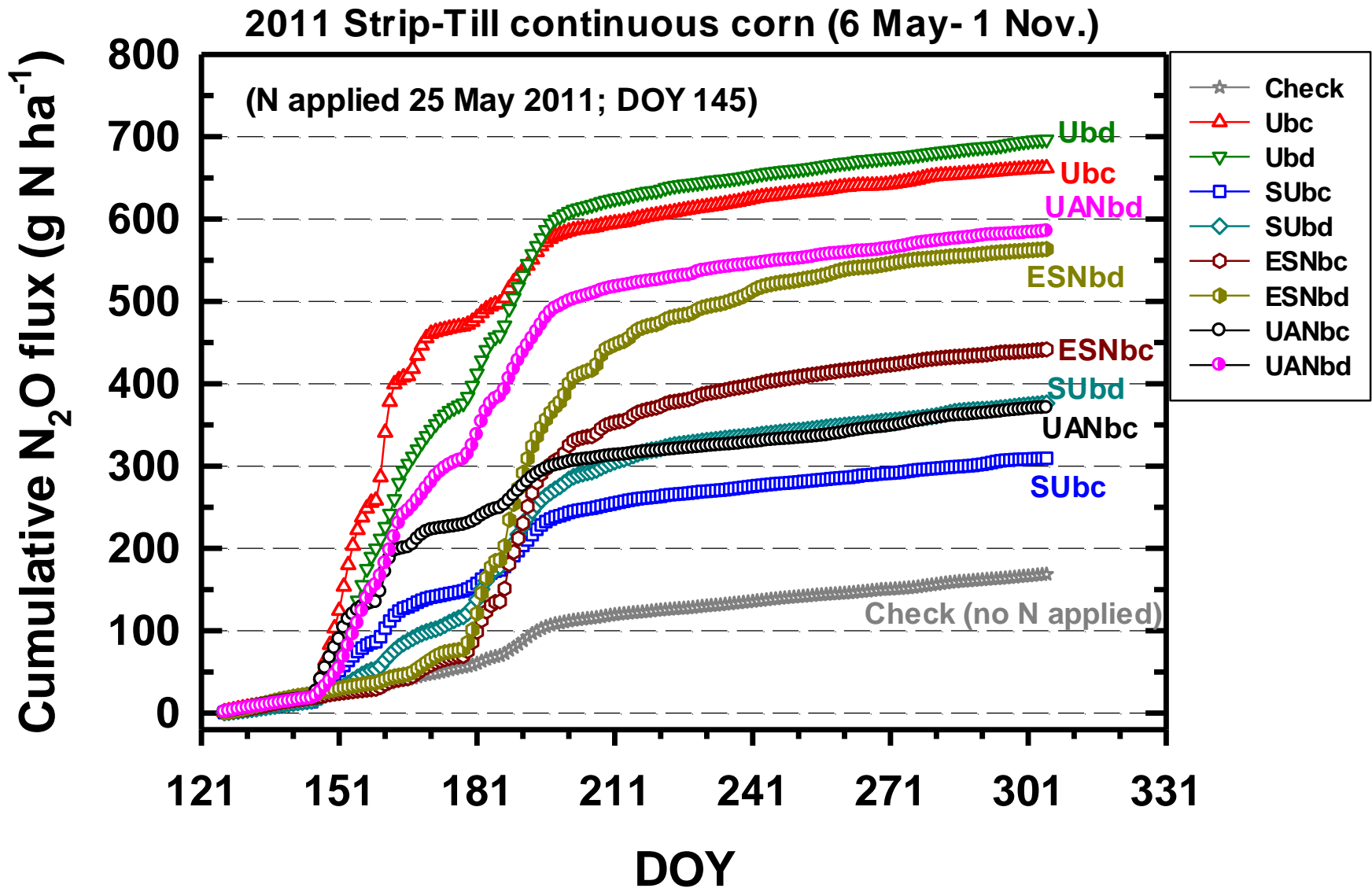


**ARS Technicians collecting GHG samples, soil temp, and water data in ST-CC rotation**

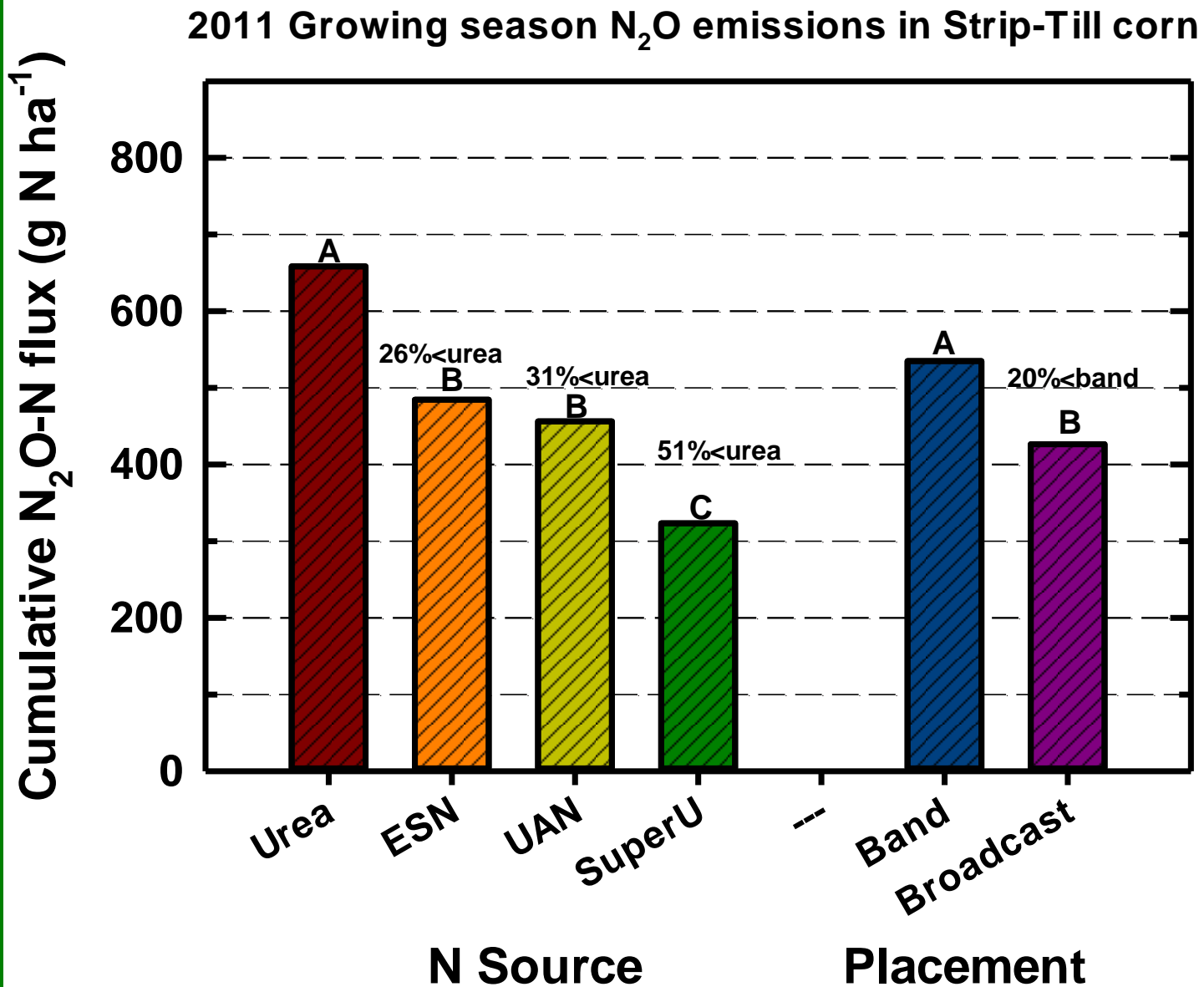


**Injecting field gas samples into vials for analysis on Varian 3800 GC.**

# Cumulative Soil N<sub>2</sub>O-N Flux During Growing Season in Irrigated Strip-Till Continuous Corn

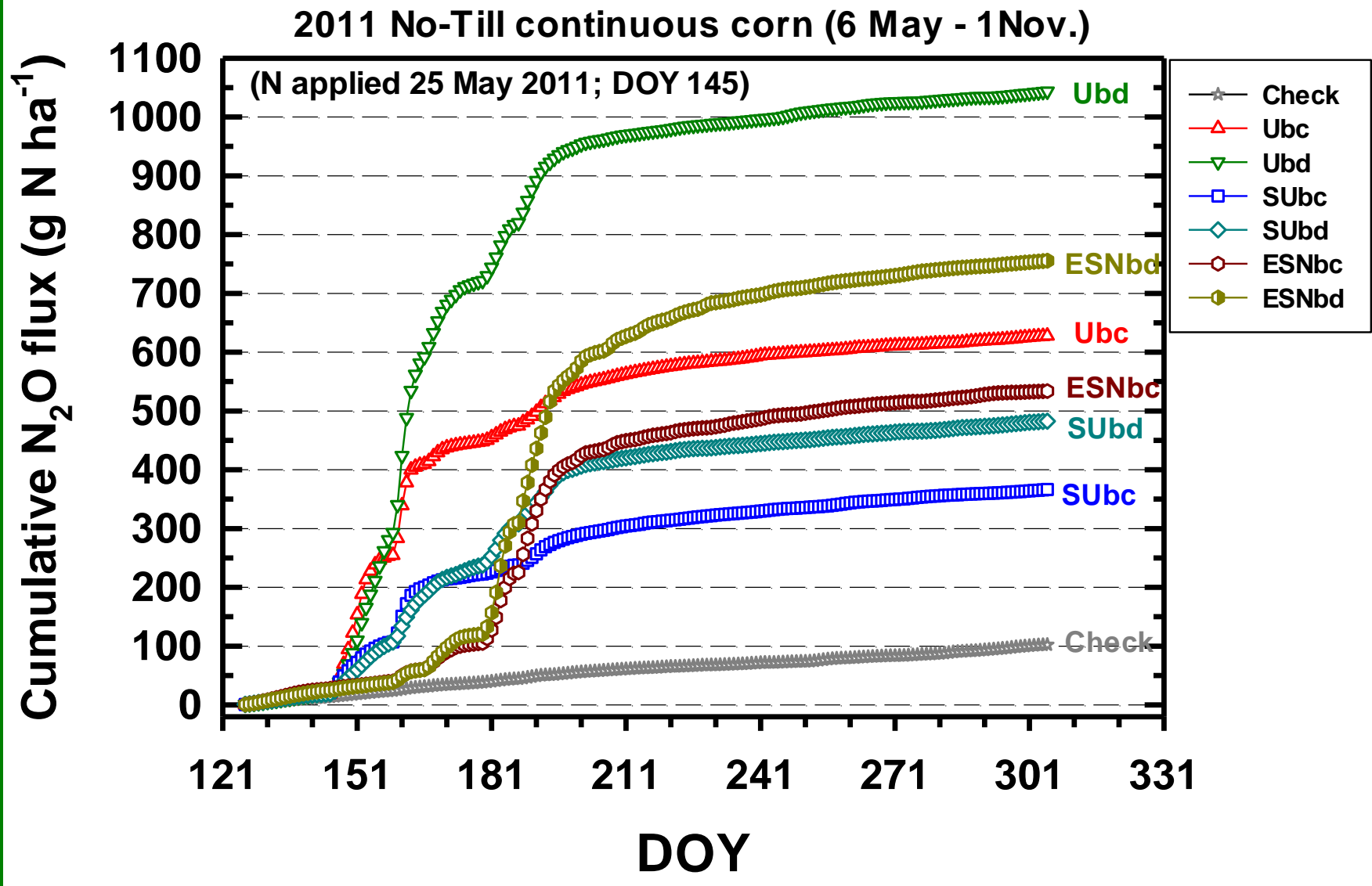


# Growing Season Cumulative Soil N<sub>2</sub>O-N Flux Under Irrigated Strip-Till Continuous Corn

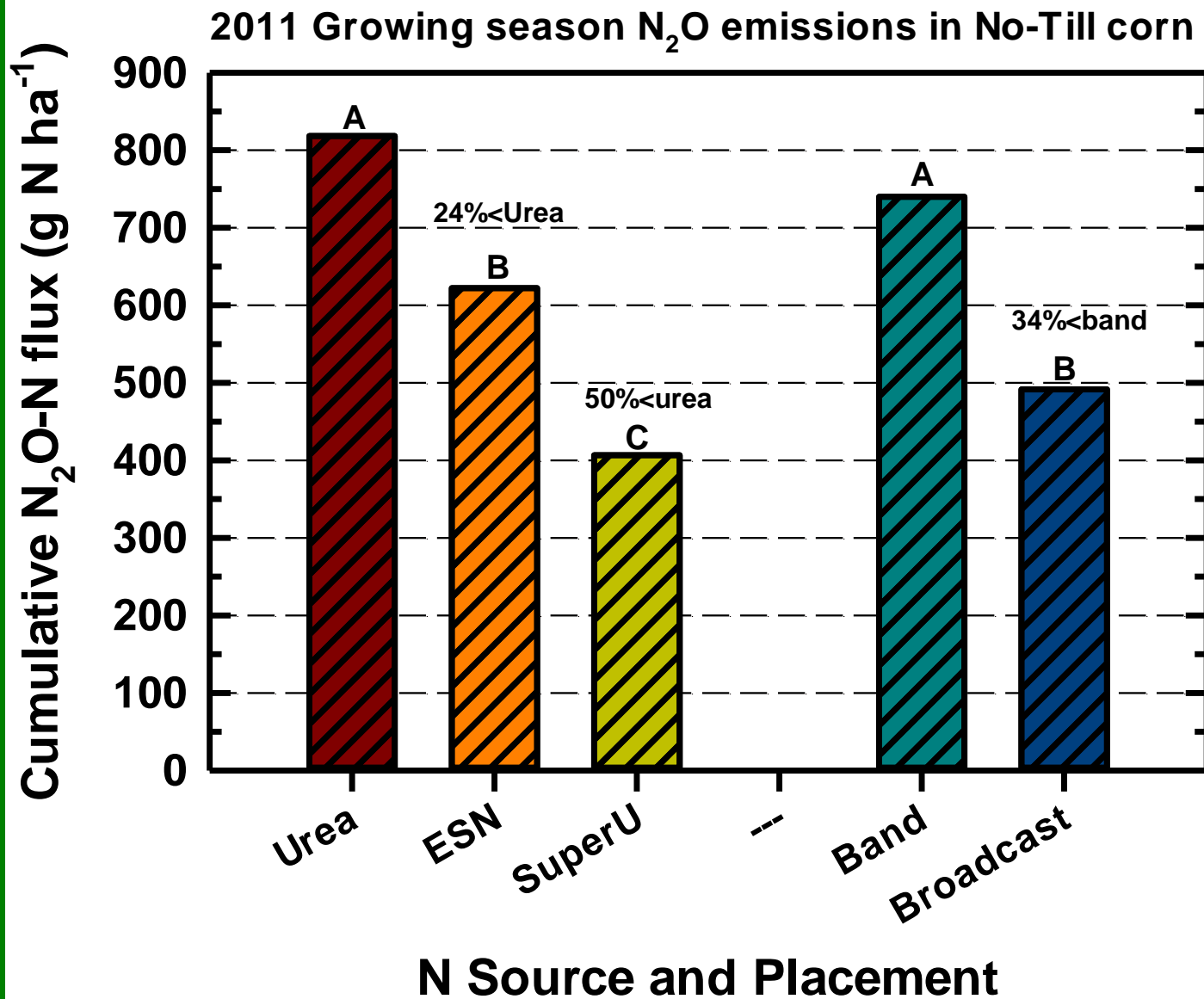


No N source x  
N placement  
interaction

# Cumulative Soil N<sub>2</sub>O-N Flux During Growing Season in Irrigated No-Till Continuous Corn

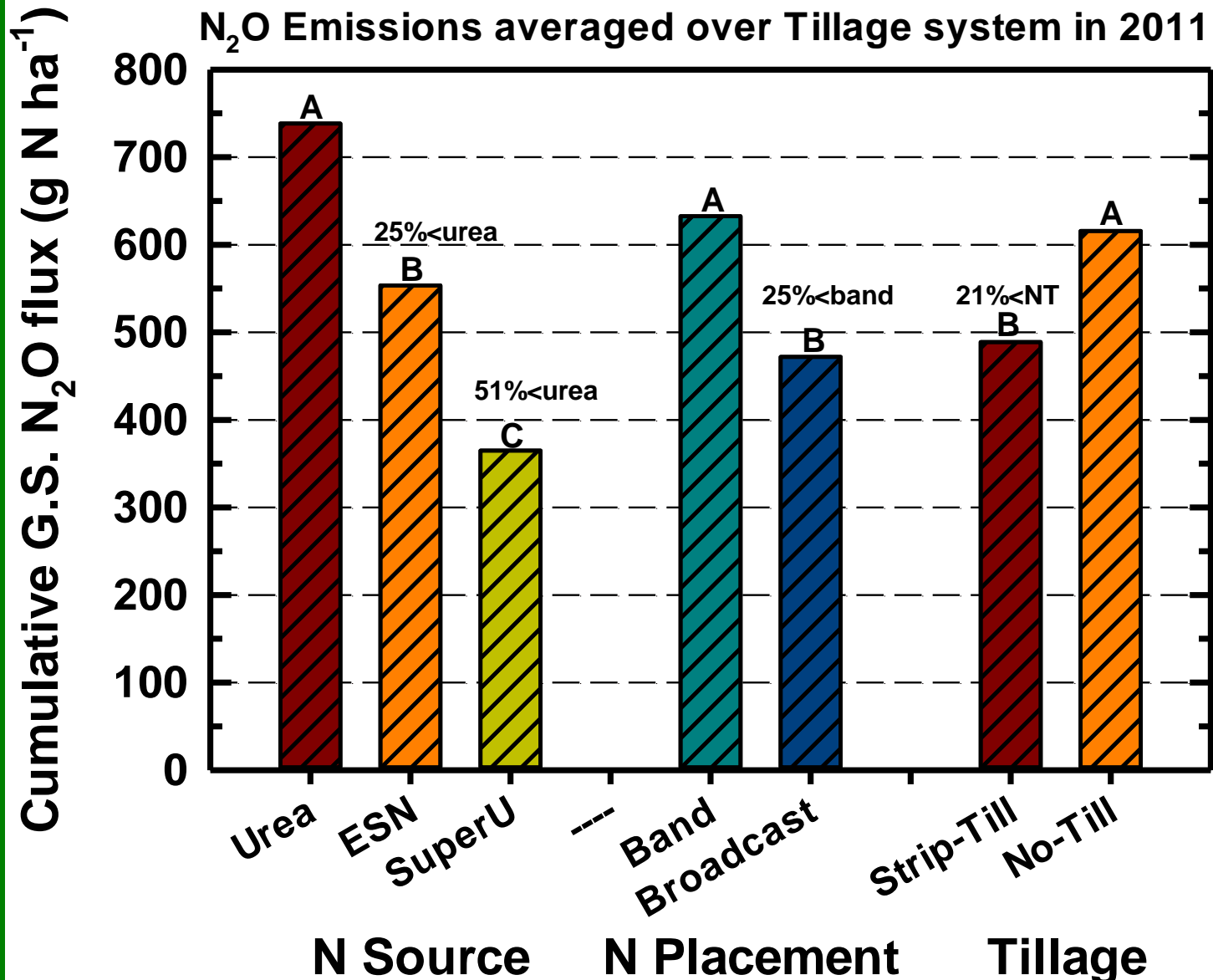


# Growing Season Cumulative Soil N<sub>2</sub>O-N Flux Under Irrigated No-Till Continuous Corn



No N source x  
N placement  
interaction

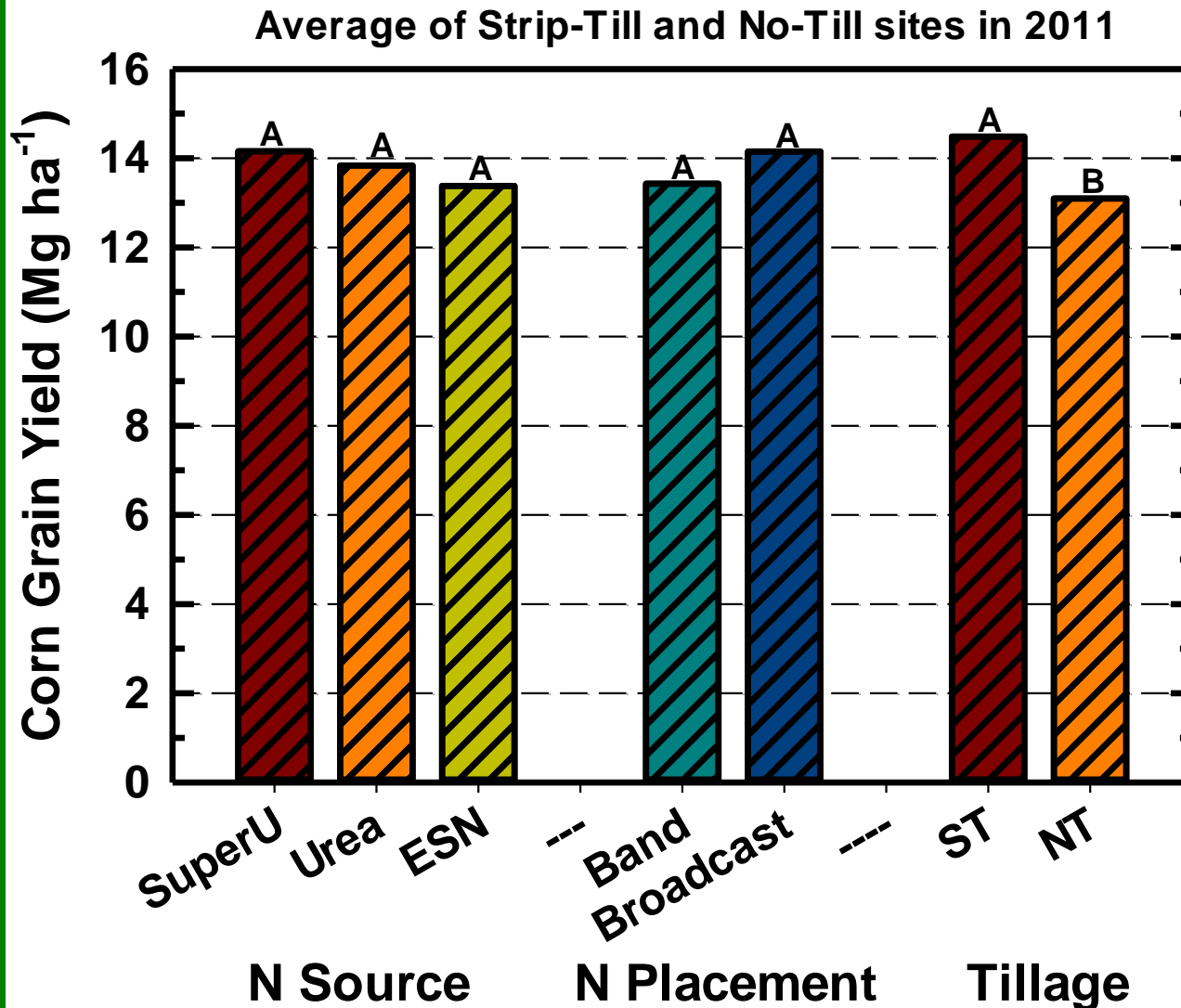
# Growing Season Cumulative Soil N<sub>2</sub>O-N Flux, Averaged Across No-Till and Strip-Till in 2011



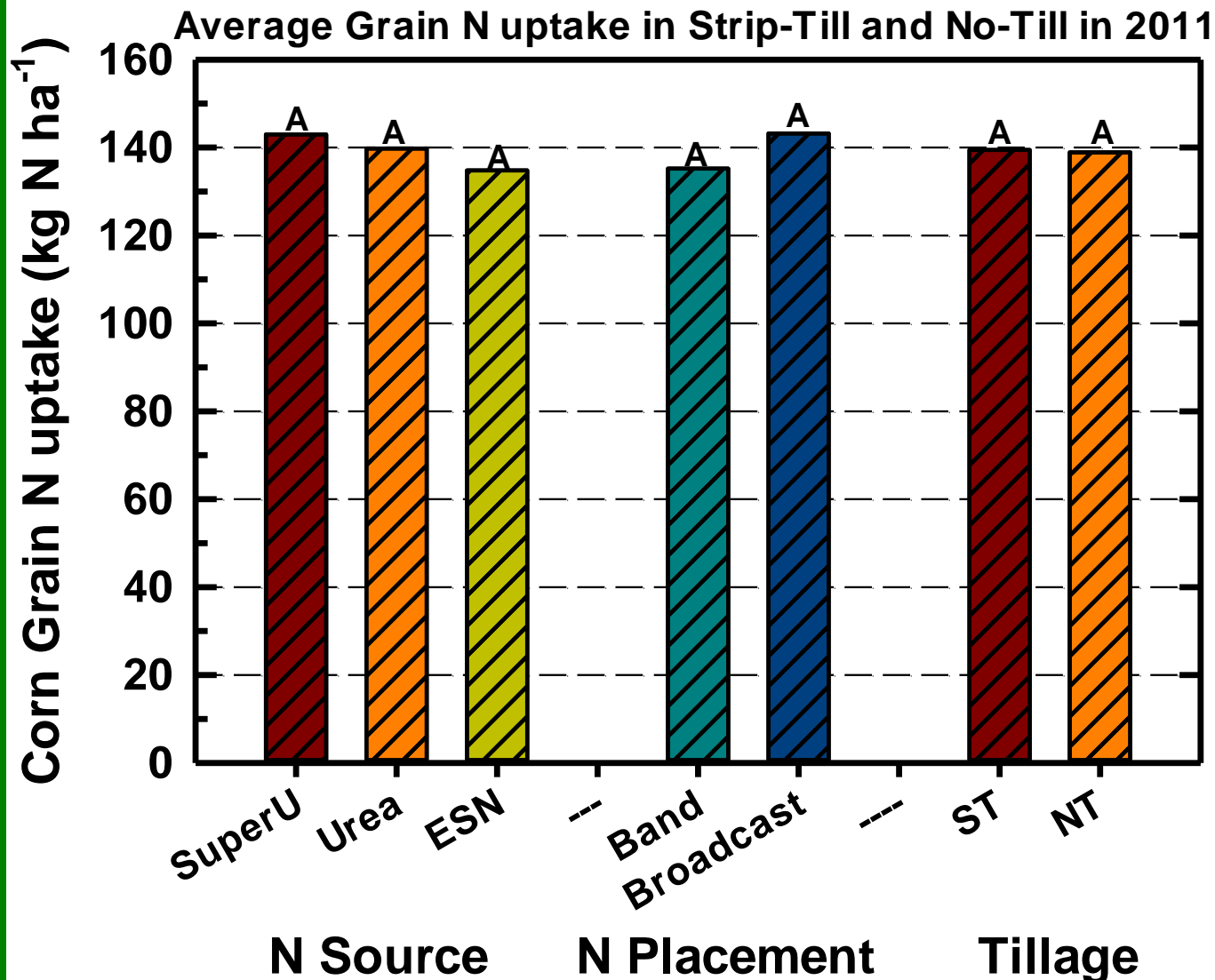
No N source x N placement interaction.



# N Source and Placement Effects on Grain Yield Average Over Strip-Till and No-Till



# N Source and Placement Effects on Grain N Uptake Averaged across Strip-Till and No-Till



# Summary

- **ESN, SuperU, UAN+AgrotainPlus, and UAN significantly reduced N<sub>2</sub>O emissions when compared to urea; and ESN and UAN+AP compared to UAN.**
- **Growing season N<sub>2</sub>O-N losses per unit of N applied were generally < 0.8% for urea, <0.6% for ESNssb, and <0.4% for all other sources.**
- **Broadcast placement reduced N<sub>2</sub>O emissions compared to band placement in both tillage systems in 2011.**
- **Corn grain yields or N uptake generally did not differ among N sources or with N placement.**
- **N source selection is a management option for reducing N<sub>2</sub>O emissions in semi-arid, irrigated cropping systems.**

# Thanks to Funding Sources

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- **Fluid Fertilizer Foundation**
- **USDA-ARS GRACEnet program**

**Thanks for Listening!!**

**Questions???**