

# Nitrogen Fertilizer Source and the Impact to Flue-Cured Tobacco Nutrient Assimilation, Yield, Quality, Value, & Chemistry

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# Background

- N recommendations for FCV are well defined
- Limited reports of N source to macro, secondary, and micronutrient assimilation in FCV
- Objective: explore the impact of N source to FCV growth from transplanting through harvest

# Methods & Materials

- Four growing environments (2016 & 2017)
- Four N sources:
  - 100 %  $\text{NO}_3^-$
  - 50 %  $\text{NO}_3^-$  + 50 %  $\text{NH}_4^+$
  - 25 %  $\text{NO}_3^-$  + 75 %  $\text{NH}_4^+$
  - 100 %  $\text{NH}_4^+$
- Split-application:  $\frac{1}{2}$  10 DAT and  $\frac{1}{2}$  4-5 WAT
- 168 kg  $\text{K}_2\text{O}$  & 60 kg  $\text{SO}_4^{2-}$  ha<sup>-1</sup>
- Tissue sample collection:
  - 3 WAT
  - At Layby (5-6 WAT)
  - 2 Weeks after Layby
  - At Flowering (8-10 WAT)
  - After Curing (tip leaf position only)
- Cured leaf measurements: yield, quality, price, value, and chemistry
- PROC MIXED ( $\text{LSD}_{0.10}$ ) SAS
- Figures created w/Sigma Plot

**Table 1. Applied macro and secondary nutrient totals from each nitrogen (N) fertilizer source <sup>a</sup>.**

N Source <sup>b</sup>	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O <sup>c</sup>	Ca	Mg	S <sup>c</sup>
CaNO <sub>3</sub>	80 – 92	0	0	98 – 112	0	0
NH <sub>4</sub> NO <sub>3</sub>	80 – 92	0	0	12 – 14	3	0
UAN	80 – 92	0	0	0	0	9 – 10
NH <sub>4</sub> SO <sub>4</sub>	80 – 92	0	0	0	0	72 – 105

<sup>a</sup> Lower Coastal Plain Research Station = 85 kg N ha<sup>-1</sup>; Upper Coastal Plain Research Station = 92 kg N ha<sup>-1</sup>; Oxford Tobacco Research Station = 80 kg N ha<sup>-1</sup>.

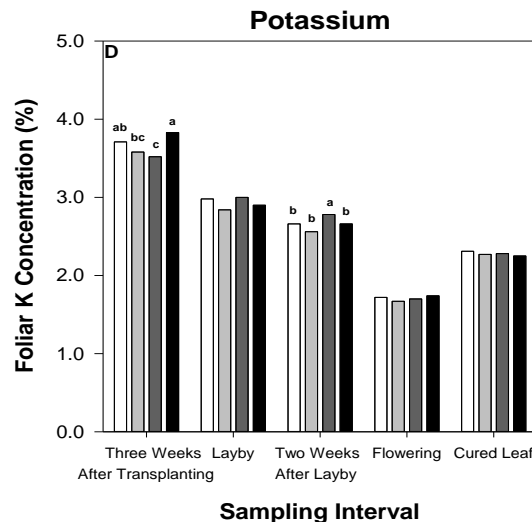
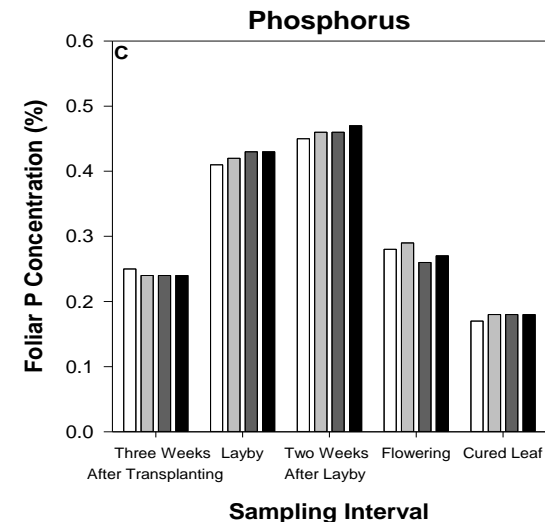
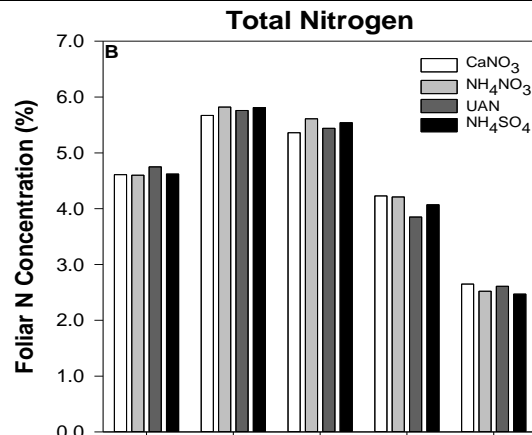
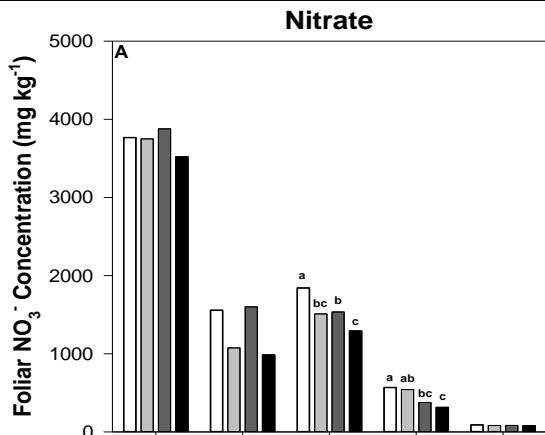
<sup>b</sup> CaNO<sub>3</sub> = 15.5-0-0-19 %Ca calcium nitrate (100 % NO<sub>3</sub><sup>-</sup>); NH<sub>4</sub>NO<sub>3</sub> = 27-0-0-4 %Ca-1 %Mg calcium ammonium nitrate (50 % NO<sub>3</sub><sup>-</sup> + 50 % NH<sub>4</sub><sup>+</sup>); UAN = 28-0-0-3%S liquid urea-ammonium nitrate (25 % NO<sub>3</sub><sup>-</sup> + 75 % NH<sub>4</sub><sup>+</sup>); NH<sub>4</sub>SO<sub>4</sub> = 21-0-0-24%S (100 % NH<sub>4</sub><sup>+</sup>).

<sup>c</sup> 168 kg K<sub>2</sub>O and 54 kg SO<sub>4</sub><sup>2-</sup> ha<sup>-1</sup> applied to each treatment as 0-0-50-18%S.

Parameter	LCPRS-16	LCPRS-17	OTRS-17	UCPRS-17	Average
pH	6.3	5.7	5.7	6.0	5.9
OM (%)	0.48	0.57	0.66	0.67	0.60
CEC	3.3	2.8	3.9	3.3	3.3
P (kg ha <sup>-1</sup> )	149	147	258	96	163
K (kg ha <sup>-1</sup> )	176	158	299	374	252
Ca (kg ha <sup>-1</sup> )	482	435	853	885	664
Mg (kg ha <sup>-1</sup> )	217	109	230	91	162
S (kg ha <sup>-1</sup> )	42	19	22	94	44
Cl <sup>-</sup> (kg ha <sup>-1</sup> )	5	2	115	81	51
Zn (kg ha <sup>-1</sup> )	3.2	4.6	6.0	3.2	4.3
Mn (kg ha <sup>-1</sup> )	17	24	19	29	22
Cu (kg ha <sup>-1</sup> )	1.2	1.0	3.3	3.9	2.4
B (kg ha <sup>-1</sup> )	--	0.5	0.7	0.6	0.6

\*Soil analyses conducted by Waters Agricultural Laboratories, Inc. in Warsaw, NC using the Mehlich III method.

\*\*Soil samples collected from upper 15 cm of each testing area.



**Figure 1. Foliar macronutrient concentration at various stages of tobacco growth. Treatment means followed by different letters within the same nutrient and sampling interval are significantly different at the  $\alpha = 0.10$  level. Treatment means absent of letters are not significantly different.**

N Sufficiency ranges:

- 4.0 - 5.0 % pre-flowering
- 3.5 - 4.5 % at flowering
- 2.25 - 3.0 % at maturity
- 2.0 - 2.25 % in upper leaf at harvest

P Sufficiency Ranges:

- 0.2 - 0.5 % pre-flowering
- 0.2 - 0.5 % at flowering
- 0.17 - 0.5 % at maturity
- 0.14 - 0.3 % in upper leaf at harvest

K Sufficiency Ranges:

- 2.5 - 3.5 % pre-flowering
- 2.5 - 3.5 % at flowering
- 1.6 - 3.0 % at maturity
- 1.5 - 2.5 % in upper leaf at harvest

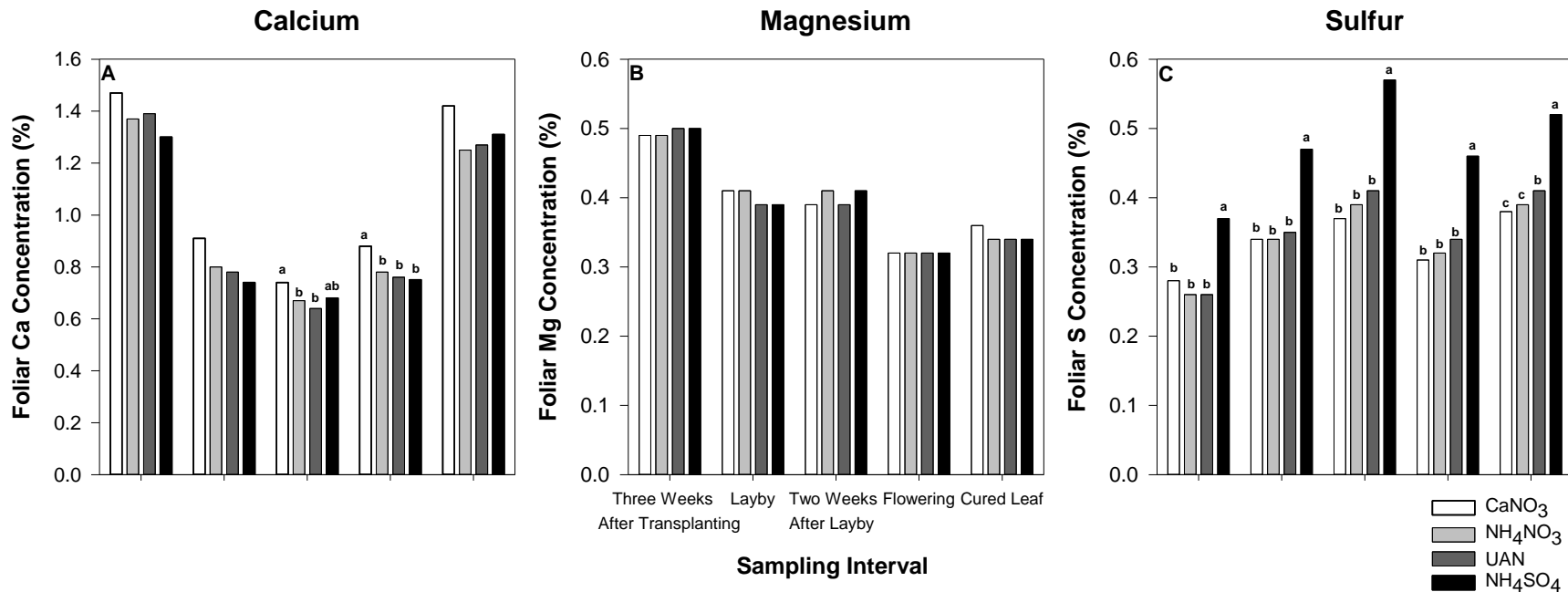


Figure 2. Foliar macronutrient concentration at various stages of tobacco growth. Treatment means followed by different letters within the same nutrient and sampling interval are significantly different at the  $\alpha = 0.10$  level. Treatment means absent of letters are not significantly different.

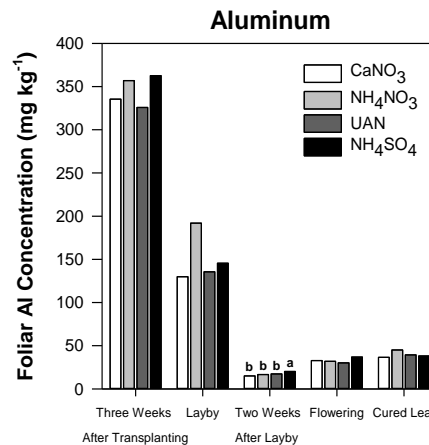
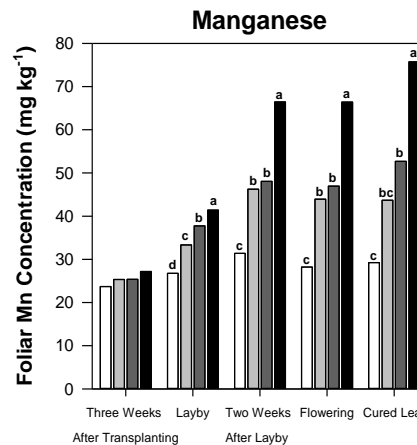
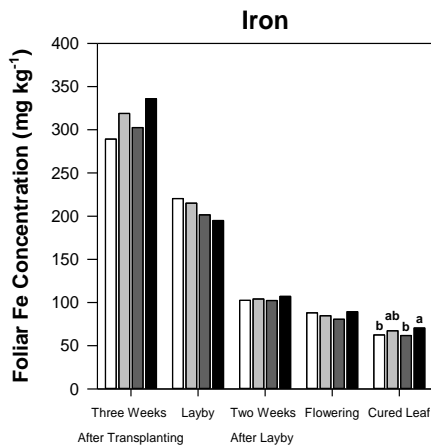
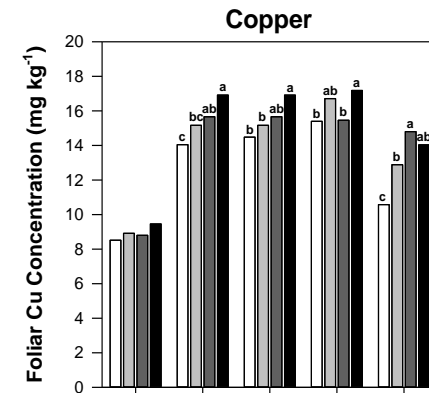
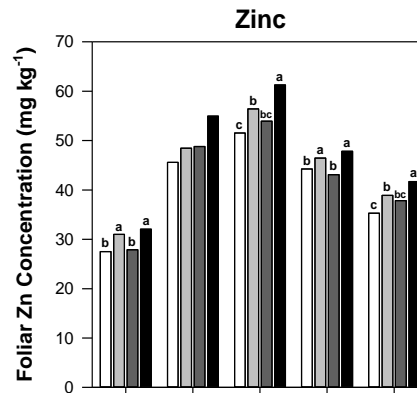
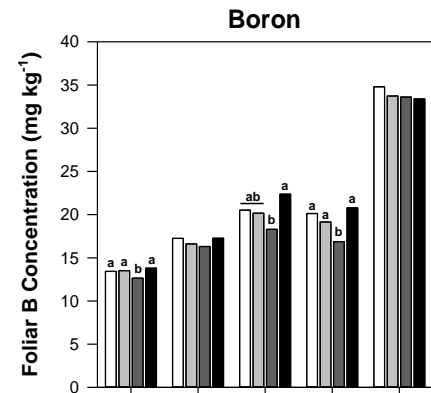
Ca sufficiency = 0.75 - 1.5 %

Mg sufficiency = 0.2 - 0.6 %

S sufficiency = 0.15 - 0.6 %  
(0.15 - 0.4 % in upper leaves)

**Figure 3. Foliar micronutrient concentration at various stages of tobacco growth. Treatment means followed by different letters within the same nutrient and sampling interval are significantly different at the  $\alpha = 0.10$  level. Treatment means absent of letters are not significantly different.**

Sufficiency Ranges:  
 Fe = 50 - 300 mg kg<sup>-1</sup> (40 - 200 in upper leaves)  
 Mn = 20 - 250 mg kg<sup>-1</sup> (20 - 350 in upper leaves)  
 Zn = 20 - 60 mg kg<sup>-1</sup> (18 - 60 in upper leaves)  
 Cu = 5 - 10 mg kg<sup>-1</sup>  
 B = 18 - 75 mg kg<sup>-1</sup> (18 - 30 in upper leaves)

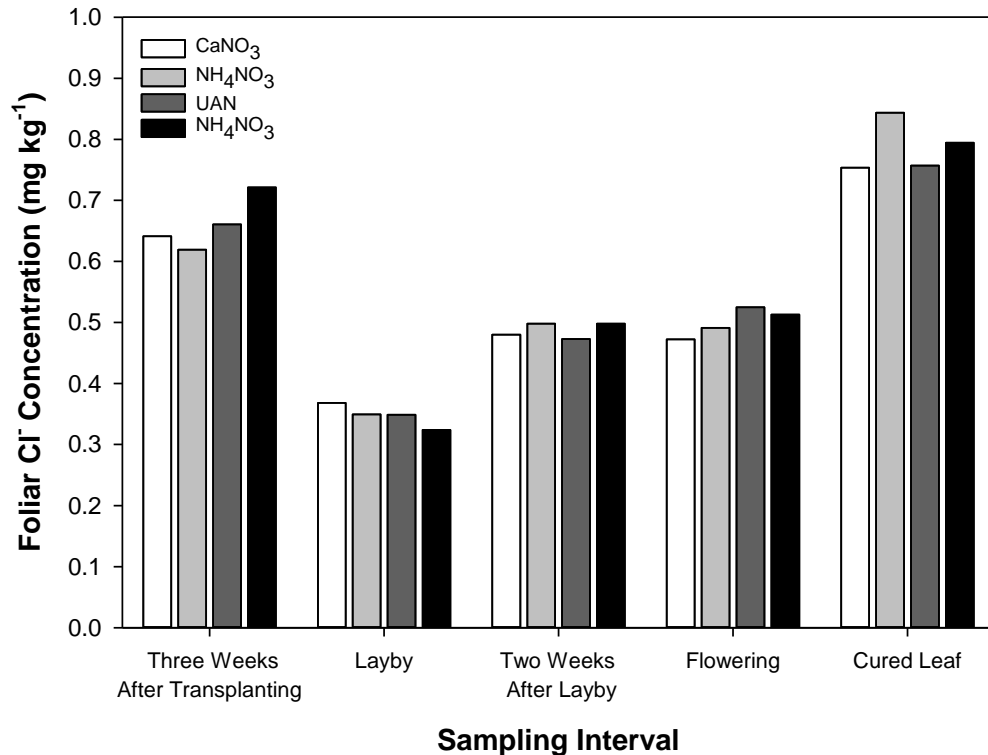


Sampling Interval

Sampling Interval

Sampling Interval





< 1.0 % across N sources and sampling intervals

Unlikely to be problematic in similar growing environments.

**Figure 4. Foliar micronutrient concentration at various stages of tobacco growth. Treatment means followed by different letters within the same nutrient and sampling interval are significantly different at the  $\alpha = 0.10$  level. Treatment means absent of letters are not significantly different.**

**Table 2. The influence of nitrogen (N) fertilizer source to cured leaf yield, quality, price kg<sup>-1</sup>, value ha<sup>-1</sup>, and total alkaloid and reducing sugar concentration<sup>a,b</sup>.**

N Source <sup>c</sup>	Yield kg ha <sup>-1</sup>	Quality <sup>d</sup>	Value \$US ha <sup>-1</sup>	Price \$ kg <sup>-1</sup>	Total Alkaloids	Reducing Sugars
					%	
CaNO <sub>3</sub>	3,323 a	79 a	11,812 a	3.62 a	2.68 a	15.6 a
NH <sub>4</sub> NO <sub>3</sub>	3,227 a	76 a	10,722 a	3.40 a	2.79 a	15.8 a
UAN	3,178 a	74 a	10,418 a	3.28 a	2.69 a	16.5 a
NH <sub>4</sub> SO <sub>4</sub>	3,050 a	73 a	9,959 a	3.24 a	2.68 a	16.4 a

<sup>a</sup> Treatment means followed by the same letter within the same column are not significantly different at the  $\alpha = 0.10$  level.

<sup>b</sup> Lower Coastal Plain Research Station = 85 kg N ha<sup>-1</sup>; Upper Coastal Plain Research Station = 92 kg N ha<sup>-1</sup>; Oxford Tobacco Research Station = 80 kg N ha<sup>-1</sup>.

<sup>c</sup> CaNO<sub>3</sub> = 15.5-0-0-19%Ca calcium nitrate (100 % NO<sub>3</sub><sup>-</sup>); NH<sub>4</sub>NO<sub>3</sub> = 27-0-0-4%Ca-1%Mg calcium ammonium nitrate (50 % NO<sub>3</sub><sup>-</sup> + 50 % NH<sub>4</sub><sup>+</sup>); UAN = 28-0-0-3%S liquid urea-ammonium nitrate (25 % NO<sub>3</sub><sup>-</sup> + 75 % NH<sub>4</sub><sup>+</sup>); NH<sub>4</sub>SO<sub>4</sub> = 21-0-0-24%S (100 % NH<sub>4</sub><sup>+</sup>).

<sup>d</sup> Quality assessed on a scale of 1-100, with 100 being of the highest quality.

# Conclusions

- N source did not impact measured parameters
  - Statistically significant differences with no practical value
- Suspected soil acidification with  $\text{NH}_4^+$  application
  - Useful information in some regions of the world
- Confirms flexibility with N source selection
  - In growing environments that are well drained with good seasonal rainfall

# Acknowledgements

- Altria Client Services
- Lower Coastal Plain, Oxford Tobacco, & Upper Coastal Plain Research Station
- NCDA&CS – Agronomic Division
  - Plant Analysis Reference Procedures for the Southern Region of the United States
  - <http://www.cropsoil.uga.edu/~oplank/sera368.pdf>
  - ISBN: 1-58161-368-7