Residual Nitrogen Investigations for Strip-tilled Flue-cured Tobacco Production in Virginia

E. B. Brown[1], T. D. Reed[1], C. D. Teutsch[1], B. F. Tracy[2]

[1]Virginia Tech Southern Piedmont Agricultural Research and Extension Center, Blackstone, VA [2]Virginia Tech Department of Crop and Soil Environmental Sciences, Blacksburg, VA

Introduction

The majority of tobacco fields in Virginia are classified as highly erodible. Typical production involves multiple field cultivation passes to prepare for transplanting followed by 4 or more row cultivations. This results in the potential for significant risk of soil loss from fields. No-till production has been shown to reduce soil loss from tobacco by up to 92% but transplant establishment can be problematic and significant yield losses may occur (Jones, 1998). Strip-tillage production practices have the potential to reduce early season soil loss while maintaining yields comparable to conventional tillage (Jerrell, 2001). However, the contribution of soil surface residue present at transplanting toward the overall N fertilization requirements of flue-cured tobacco is not well understood.

Objective

To evaluate residual soil nitrogen levels and nitrogen uptake by tobacco with different strip-tillage cover management programs.

Figure 1. Strip-tillage rows were prepared with a two-row strip-till rig into a wheat cover crop.

Materials and Methods

- Research was conducted at the Virginia Tech Southern Piedmont Center near Blackstone, VA
- Tobacco was preceded with soybeans and a wheat cover crop seeded on appropriate treatments
- Plots consisted of 6 rows 12.2 m (40 ft.) long planted on 1.2 m (48 in.) centers
  - Tobacco was harvested from rows 3 and 4
  - Soil and plant samples were collected from rows 2 and 5
  - Rows 1 and 6 served as border rows
- Treatments were arranged in an RCB design with 4 replications
- Conventional tillage plots were prepared by chisel plowing, disking, and field cultivation prior to transplanting
- Wheat cover crop treatments received N topdressing using 30% UAN in late February as described in Table 1
- Chemical burndown with paraquat of the wheat cover occurred one week prior to tobacco transplanting
- Plots were strip-tilled with a 2-row KMC Rip-Strip till rig the day before transplanting
- 785 kg ha^{-1} 0-6-18 fertilizer was applied as two bands with the 2-row transplanter and additional tobacco sidedressing was applied according to Table 1

Table 1. Description of nitrogen fertilization treatments for five strip-tillage (ST) treatments and one conventional tillage (CT) treatment.

Nitrogen Application	ST1	ST2	ST3	ST4	ST5	CT
Wheat topdress (Feb, 30% UAN)	22	22	45	45	0	-
Tobacco sidedress (May, 30% UAN)	22	22	22	22	22	22
Tobacco sidedress (May, 30% UAN)	45	**22**	45	**0**	45	45
Tobacco sidedress (Jun, 15-0-15)	17	17	17	17	17	17
Total nitrogen applied (kg ha^{-1})	106	84	129	84	84	84

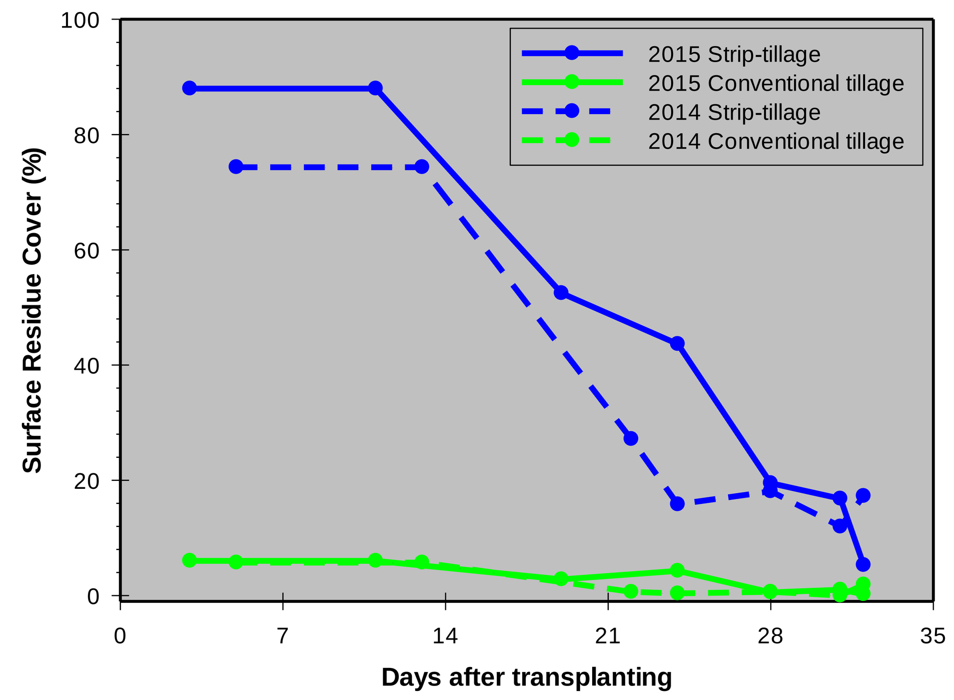

Figure 2. Surface residue cover measurements from transplanting through layby cultivation for 2014 and 2015.

Figure 3. Sukup® HRC used to preserve surface residue present at first cultivation (left) and layby (right).

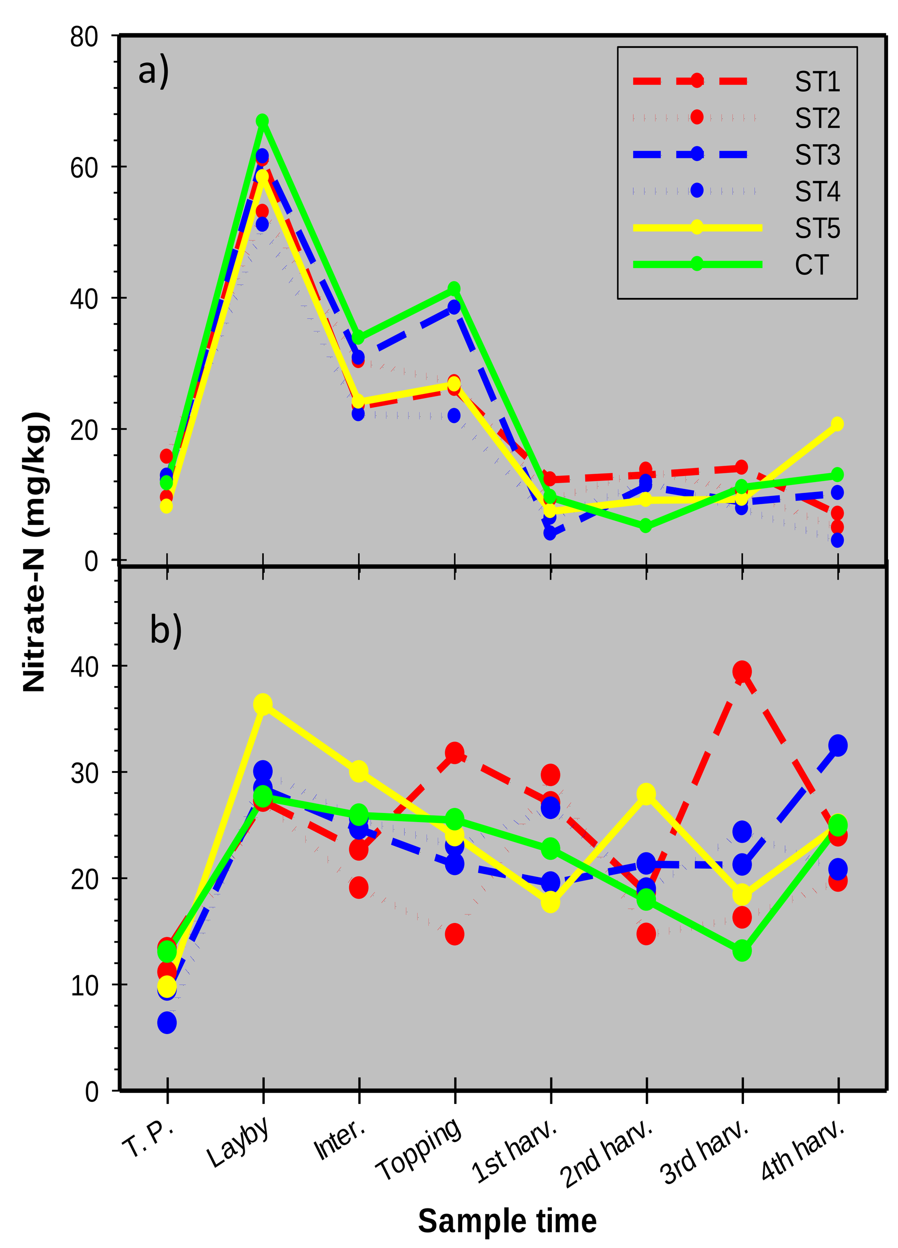

Figure 4. Nitrate-N concentrations for soil samples taken throughout the growing season for 2014 (a) and 2015 (b).

Figure 5. Rolling spider cultivator was used to apply sidedress fertilizer (17 kg ha^{-1} of 15-0-15) at 2nd cultivation.

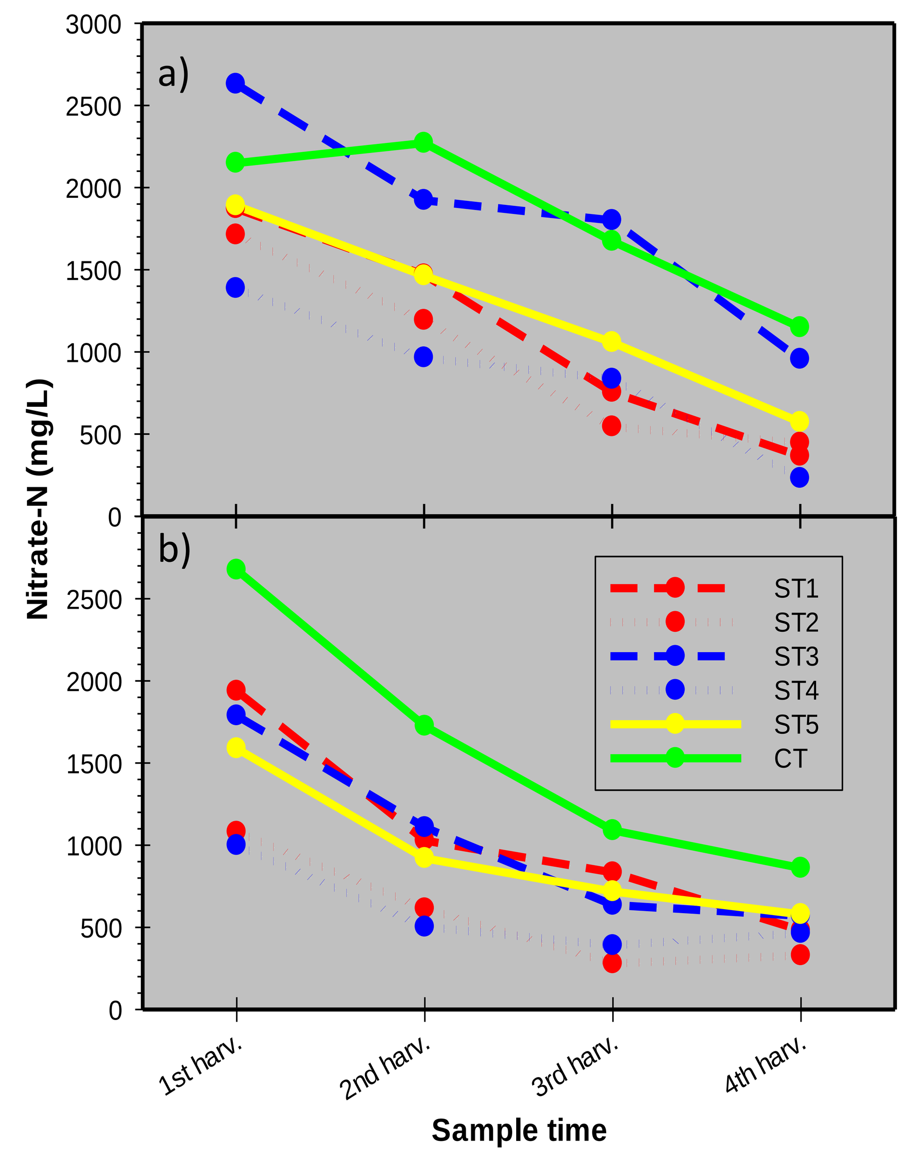

Figure 6. Nitrate-N concentration for petiole sap samples from the 4th leaf through each of the four harvests in 2014 (a) and 2015 (b).

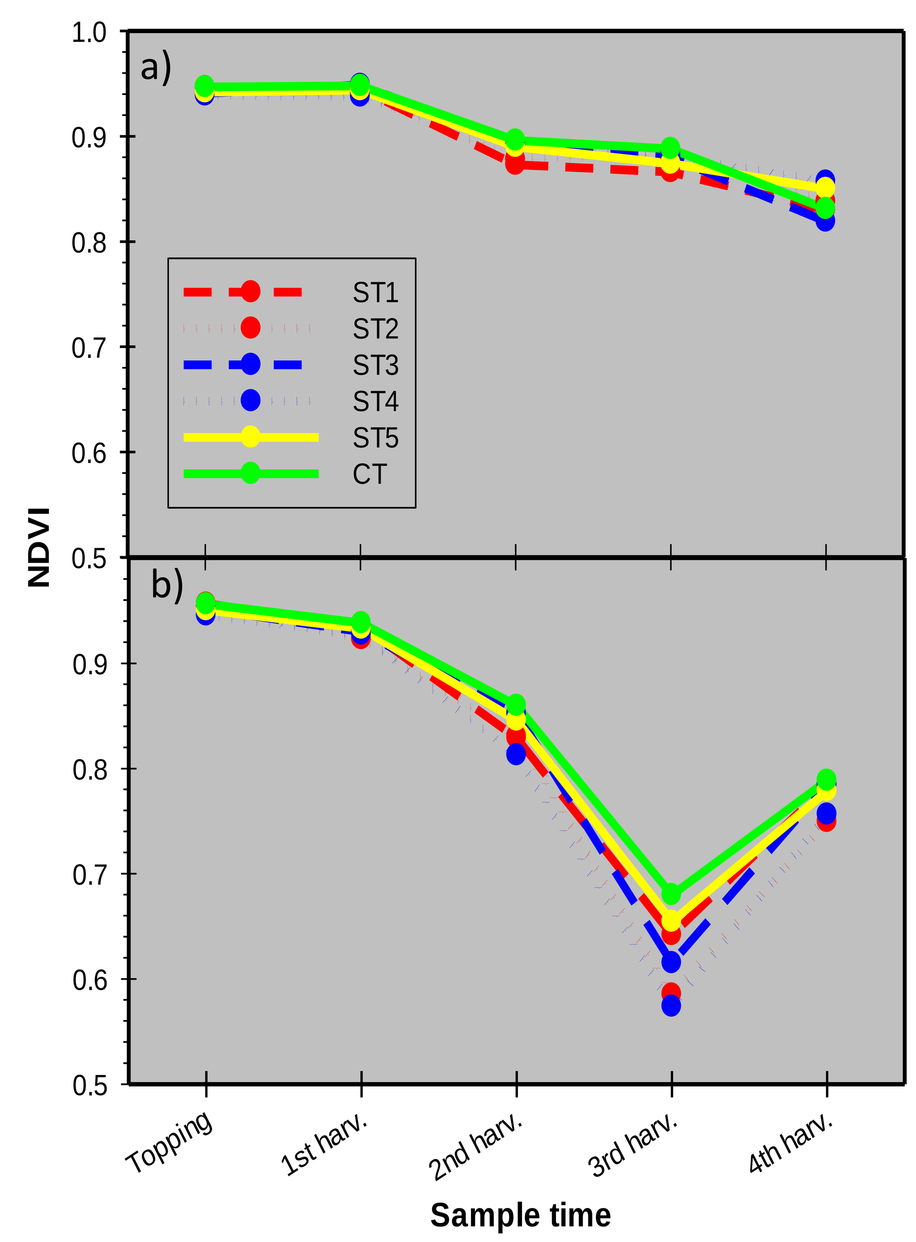

Figure 7. NDVI for the uppermost leaves on the plants from topping through each of the four harvests in 2014 (a) and 2015 (b).

Table 2. Yield (kg ha^{-1}) and quality (grade index, 0-100) results for 2014 and 2015 growing seasons.

	2014 Yield	2014 Grade Index	2015 Yield	2015 Grade Index
ST1	3811 b	72	4002 a	67
ST2	3814 b	71	3718 c	77
ST3	4080 a	72	3787 bc	75
ST4	3727 b	75	3865 abc	79
ST5	3663 b	76	3926 ab	77
CT	4180 a	71	3990 a	71

Data Collection

- Soil surface residue counts were made using diagonal transects across plots from transplanting through layby (final) cultivation
- Soil nitrate levels (Maynard et al., 2008) were measured for samples taken from layby cultivation through harvest completion
- Normalized Difference Vegetation Index (NDVI) was measured on the uppermost leaves using a shoulder carried GreenSeeker from topping (removal of apical bud) through harvest completion
- Petiole sap nitrate levels were measured using a CARDY nitrate meter for samples taken from the 4th leaf from the top of the plant at the time of each harvest
- Yield and quality were evaluated from the harvested and cured leaves

Summary

- Approximately 20% of soil surface cover was present 4 weeks after transplanting (Fig. 2).
- Soil nitrate generally decreased after topping in 2014, but in 2015 there was no consistent pattern, which can be seen in Fig. 4.
- Treatments receiving topdressed N and corresponding reduced tobacco sidedress N (ST2 & ST4) exhibited lower petiole sap nitrate-N levels (Fig. 6).
- Conventional tillage exhibited the highest levels of petiole sap nitrate-N levels in both seasons (Fig. 6).
- In 2014, NDVI decreased through each of the four harvests, but in 2015, NDVI increased at the last harvest, perhaps due to late season rainfall (Fig. 7).
- Significant yield differences were observed between the CT treatment and at least 2 ST treatments in both years (Table 2).
- Cured leaf quality (grade index) had no significant differences in either year (Table 2).

Conclusion

The topdressing of a wheat cover crop to provide additional growth and soil surface residue cover for strip-tilled tobacco was not found to have an adverse effect on the cured leaf quality of flue-cured tobacco.

References

Jerrell, S. L. 2001. Strip-tillage production systems for tobacco. M. S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg.

Jones, B. G. 1998. Impact of conservation tillage on soil erosion and agronomic performance of flue-cured tobacco. M. S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg.

Maynard, D. G. Y. P. Kalra, and J. A. Crumbaugh. 2008. Nitrate and exchangeable ammonium nitrogen. In: M. R. Carter and E. G. Gregorich, editors, Soil sampling and methods of analysis 2nd ed. CRC Press, Boca Raton, FL. p. 71-80.