VERIFICATION OF NITROGEN AND PHOSPHORUS APPLICATION RATES TO FLUE-CURED TOBACCO

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With rising input costs, flue-cured tobacco producers must consider modern fertility programs that focus on reduced application rates of alternative nutrient sources. To demonstrate the usability of these fertility programs, research was conducted in 2012, 2013, and 2014 to assess the impacts of reduced input fertilizer programs on flue-cured tobacco produced in the North Carolina Piedmont. Treatments evaluated included all possible combinations of 2 rates of liquid nitrogen (72 and 95 kg N/ha) and 3 rates of phosphorus (0, 25, and 56 kg P_2O_5/ha). Treatments were arranged in a randomized complete block design with a factorial treatment arrangement and replicated 4 times within each environment. Results confirm that lower application rates of nitrogen and phosphorus are acceptable for tobacco growth and development in the North Carolina Piedmont, as there were no differences in early-season tobacco growth or final leaf yield, quality, and value among the treatments imposed. In addition, the application of liquid nitrogen is suitable for the production of tobacco with acceptable leaf yield and quality. Producers in this region should consider the nutrient sources and application rates evaluated in this study in order to remain economically and environmentally sustainable.

Additional key words: crop nutrition, *Nicotiana tabacum*, soil fertility

INTRODUCTION

With increasing focus on fertilizer cost and environmental impacts, flue-cured tobacco (*Nicotiana tabacum* L.) producers must consider reduced input fertility programs. Current recommendations are that producers apply 56–72 kg N/ha to finer textured soils and 0–56 kg P_2O_5/ha as directed by soil testing (2). From 2012 to 2015, production surveys of Cooperative Extension Agents in the Piedmont growing region of North Carolina indicate that application rates are actually much higher for both nutrients. Survey responses indicate the average rates of applied nitrogen (N) and phosphorus (P) in this production region might be as high as 98 and 118 kg/ha, respectively (unpublished data). Further investigations are warranted to demonstrate to agronomists and producers that reduced application rates of N and P fertilizers are acceptable in the Piedmont growing region of North Carolina.

MATERIALS AND METHODS

Research was conducted in 4 on-farm environments in the North Carolina Piedmont from 2012 to 2014 to assess the impacts of reduced input fertilizer programs to flue-cured tobacco. Descriptions that outline soil series, pH, and phosphorus and potassium availability within each environment are presented in Table 1. Two application rates of liquid 28% urea–ammonium nitrate (72 and 95 kg N/ha) and 3 application rates of phosphorus (0, 28, and 56 kg P_2O_5/ha) from triple super phosphate were evaluated. Nitrogen was split-applied with a CO_2-pressurized backpack, with half the targeted rate applied side dress 10 days after transplanting (DAT), and the remaining half applied 5–7 weeks later at layby. Phosphorus was also applied side dress 10 DAT. All fertilizer was band-applied beside the plant posttransplanting, approximately 10 cm away from the center of the row at a 10-cm depth. In each environment the variety NC 196 (Goldleaf Seed Company, Hartsville, SC) was planted at a density 14,820 plants/ha. Plots were comprised of 4 treated rows measuring 12.1 m in length and 1.12 to 1.22 m in width. The center 2 rows of each plot were harvested for yield and quality measurements. Tobacco was produced as described in recommendations from the North Carolina Cooperative Extension Service (1), with the exception of treatments evaluated. Treatments were arranged in a randomized complete block design with a factorial treatment arrangement and were replicated a minimum of 3 times in each environment.

Plant height measurements from the apical meristem to the plant base were collected prior to N application at layby to quantify early-season growth. Crop yield was quantified at each harvest interval and cured leaf subsamples were assigned a U.S. Department of Agriculture grade to designate leaf quality quantitatively. Crop value was determined by a combination of leaf yield and quality. Results were subjected to ANOVA with the use of the PROC GLM procedure in SAS (Version 9.4, SAS Institute Inc., Cary, NC). Treatment means were separated with Fisher's Protected LSD at $\alpha = 0.05$. Interactions of Environment $\times$ N Rate $\times$ P Rate as well as the interaction of N Rate $\times$ P Rate were not observed; therefore, data are pooled over environments and presented by the main effects of N Rate and P Rate.

RESULTS

Results confirm that reduced application rates of N and P are acceptable for tobacco growth and development in the North Carolina Piedmont, as there were no

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Table 1. Soil series, taxonomic class, pH, and phosphorus and potassium indices at individual growing environments.[a,b]

Environment	Soil Type	Soil Taxonomic Class	Soil pH	P Availability kg P/ha	K Availability kg K/ha
Forsyth 2012	Clifford sandy Loam	Fine, kaolinitic, mesic, Typic Kanhapludults	6.2	154	321
Davidson 2013	Clifford sandy Loam	Fine, kaolinitic, mesic, Typic Kanhapludults	5.6	232	179
Stokes 2013	Fairview sandy Clay loam	Fine, kaolinitic, mesic Typic Kanhapludults	6.8	61	234
Stokes 2014	Fairview sandy Clay loam	Fine, kaolinitic, mesic Typic Kanhapludults	6.5	53	281

[a] Soil pH, P availability, and K availability represent the top 20 cm of the soil profile.
[b] Soil samples were analyzed by the North Carolina Department of Agriculture and Consumer Services under the Mehlich-3 extraction method.

differences in early-season tobacco growth or final leaf yield, quality, and value among the treatments imposed (Table 2). Furthermore, visual N and P deficiencies were not observed during this experiment. Results from this study demonstrate that current recommendations from the North Carolina Cooperative Extension Service are appropriate (2). These practices ensure the production of high-yielding, high-quality tobacco while also reducing the cost of production and negative environmental impacts associated with excessive nutrient application. Producers should consider the fertilizer programs evaluated in this study in order to remain economically and environmentally sustainable.

Table 2. Tobacco plant height at layby, yield, quality, and value as influenced by the main effects of nitrogen and phosphorus application rate.[a,b]

Main Effect	Plant Height cm	Yield kg/ha	Quality[d]	Value $/ha
kg N/ha[c]				
72	25.22 a	2,647 a	82 a	10,270 a
95	24.89 a	2,775 a	82 a	10,685 a
$P > F$	0.9543	0.2092	0.9307	0.3303
kg P_2O_5/ha[e]				
0	25.02 a	2,789 a	82 a	10,810 a
28	25.60 a	2,650 a	80 a	10,550 a
56	24.56 a	2,690 a	84 a	10,043 a
$P > F$	0.9145	0.3753	0.3289	0.2812

[a] Treatment means separated with the use of Fisher's Protected LSD at $\alpha = 0.05$. Data are pooled across 4 growing environments.
[b] Treatment means followed by the same letter within the same column and main effect are not significantly different.
[c] Nitrogen supplied from 28% urea–ammonium nitrate.
[d] Quality is assessed on a scale of 1–100, with 100 representing the highest quality.
[e] Phosphorus supplied from 0–46–0 triple super phosphate.

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