Winter Cover Crop Effect on Nutrient Cycling for Cotton

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Abstract

Use of winter cover crops can provide supplemental nutrients to a subsequent cash crop, in addition to increasing organic material in the soil profile. An experiment was conducted in 2009-2010 at Tifton, GA to assess the nutrient cycling of several winter cover crops in conventional and strip-tillage management on cotton. The factorial arrangement of treatments included conventional vs. strip-tillage and four winter cover crop treatments (crimson clover, rye, wheat, or no cover). All plots were fertilized in-season following the Extension guidelines. Results show that larger biomass quantities and in some cases higher nutrient concentrations caused more total release of N, P, K, Ca, and Mg from crimson clover residue compared to rye or wheat. This resulted in greater total nutrient content in the cotton plant for N, K, and Mg following crimson clover in 2009. However, there were no nutrient content differences in cotton tissue in 2010 for any cover crop treatment. There was also a significant difference in plant height in 2009, with taller cotton plants in crimson clover plots. Crimson clover plots likewise caused an 8-16% reduction in yield ($P<0.10$) in 2009, and had 7-11% lower micronaire value than the cotton following the other cover crop treatments that year. No differences in yield or any fiber quality measures were observed in 2010. Based on these results, the nutritive value of cover crops can play a role in nutrient availability and uptake by the cotton plant, but must be managed appropriately in accordance with sidedress fertilization and other management strategies (such as application of a plant growth regulator) to prevent excessive vegetative growth of the cotton and potential yield loss.

Introduction

Cotton (*Gossypium hirsutum* L.) farmers are searching for cost effective means of growing a profitable yet sustainable crop. Reduced tillage practices have gained interest to some growers in the southeastern U.S. due to the highly erodible soils in the region. In addition, fertilizer is a significant input cost to row crop farmers. The use of winter cover crops has potential to alleviate soil erosion and fertilizer costs. However, knowing the rate of decomposition and the nutrient content of the various cover crops that are commonly grown prior to cotton will help farmers gauge the potential nutritional benefits of a given quantity of residue. Thus, this experiment was implemented to determine the decomposition rates and nutrient concentrations of two grass cover crops (rye [*Secale cereale* L.] and wheat [*Triticum aestivum* L.]) and one leguminous cover crop (crimson clover [*Trifolium incarnatum* L.].

Objectives

The objectives of this experiment were to examine the nutrient influence on cotton growth/performance from the various cover crops and evaluate rate of decomposition of each in the two tillage systems. The data for this presentation will focus on the nutrient cycling aspect. The decomposition data was presented at the 2011 Crop Science Society of America Annual Meeting by Wann et al.

Materials and Methods

Cover Planting Date: 11 Nov. 2008 and 23 Dec. 2009
Cotton Planting Date: 12 May 2009 (DPL 164) and 26 May 2010 (DPL 161)
Harvest Date: 2 Nov. 2009 and 1 Nov. 2010
Location: UGA Lang-Rigdon Farm, Tifton, GA
Replications: 4
Experimental Design: Randomized Complete Block with a 2x4 factorial arrangement
Treatment Effect #1: [Tillage]

1) Conventional – rip and bed
2) Strip-Till – in-row subsoil shank

Treatment Effect #2: [Winter Cover]

1) Crimson Clover
2) Rye
3) Wheat
4) None

Crop Management: based on UGA Cooperative Extension recommendations for pest control and fertilization under irrigated conditions (sidedress N applied as 28-0-0-5 [S] at 56 kg N ha^{-1} on 7 July 2009 and 22 kg N ha^{-1} on 26 July 2010)

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Results

Table 1. Nutrient content, plant height, yield, and micronaire for cover crop treatment effects on cotton, 2009.

	N	P	K	Ca	Mg	Height	Yield	Micro-naire
Cover Crop[a]	---------- kg ha^{-1} ----------					cm	kg ha^{-1}	
	Total content in cotton plants							
Crimson Clover	279 A	39 A	278 A[b]	255 A	22 A	175 A	1530 B	4.1 B
Rye	179 B	39 A	216 B	236 A	14 B	146 B	1678 A	4.4 A
Wheat	223 B	41 A	239 B	268 A	16 B	151 B	1706 A	4.4 A
No Cover	174 B	31 A	213 B	227 A	16 B	147 B	1690 A	4.6 A
	Total released by cover							
Crimson Clover	81 a	10 a	148 a	39 a	8 a			
Rye	21 b	6 b	57 b	3 b	2 b			
Wheat	30 b	7 b	63 b	3 b	2 b			

[a] Data pooled over tillage treatments. Means within a column followed by the same letter are not significantly different at P=0.05, unless otherwise noted.
[b] Significance level P=0.10.

Table 2. Nutrient content, plant height, yield, and micronaire for cover crop treatment effects on cotton, 2010.

	N	P	K	Ca	Mg	Height	Yield	Micro-naire
Cover Crop[a]	---------- kg ha^{-1} ----------					cm	kg ha^{-1}	
	Total content in cotton plants							
Crimson Clover	91 A	13 A	75 A	20 A	10 A	92 A	1314 A	4.5 A
Rye	84 A	17 A	81 A	32 A	13 A	84 A	1230 A	4.6 A
Wheat	88 A	17 A	83 A	35 A	14 A	85 A	1214 A	4.6 A
No Cover	91 A	19 A	95 A	37 A	14 A	86 A	1300 A	4.5 A
	Total released by cover							
Crimson Clover	48 a	7 a	157 a	17 a	7 a			
Rye	13 b	3 b	26 b	1 b	1 b			
Wheat	9 b	2 b	13 b	1 b	1 b			

[a] Data for conventional tillage plots only. Means within a column followed by the same letter are not significantly different at P=0.05.

Discussion and Conclusions

Greater biomass in 2009 resulted in differences in total nutrient content between years. Crimson clover supplied more N, P, K, Ca, and Mg than the other cover crops in both years (Tables 1 and 2). There was likewise more N, K, and Mg in cotton plants following crimson clover than with the other cover crop treatments in 2009 (Table 1). However, in 2010 the relative nutrient content in cotton plants was less because of smaller plants. Likewise there were no nutrient content differences in cotton vegetative tissue in 2010 (Table 2).

Since plants were taller and there was greater biomass (data not shown) in cotton following crimson clover, the extra vegetation is considered rank growth, as yields were suppressed. In addition, micronaire was decreased following crimson clover in 2009 (Table 1), which is often an indication of too much N supplied to the plant.

These results emphasize the importance of nutrient management when cover crops are used prior to cotton. Excessive biomass of a leguminous cover crop coupled with a high sidedress N application can be detrimental to cotton production. Adjustment of sidedress fertilization rates depending on cover crop use needs further investigation.