CEREAL COVER CROP PERFORMANCE

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ABSTRACT

A cereal cover crop combined with conservation tillage can enhance soil productivity of degraded southeastern soils. Direct comparisons regarding the performance of different cereal cover crops are limited. This experiment, located at Auburn University's Wiregrass Research and Extension Center in Headland, AL on a Fuquay sand (loamy, kaolinitic, thermic Arenic Plinthic Kandiudults), was designed to compare cover crop biomass performance across nitrogen (N) rates during the 2009-2012 growing seasons. The experiment consisted of a randomized complete block design with a split plot restriction. Main plots were cover crops [oat (*Avena sativa* L.), rye (*Secale cereale* L.), and ryegrass (*Lolium multiflorum* L.)] and subplots were N rate (0, 34, 67, and 101 kg N ha^{-1} as commercial fertilizer). Cover crop biomass responded linearly to applied N (P = <0.0001), but the biomass response to N varied by cover crops (Cover crop x N rate; P = 0.0008). Rye was the most responsive to N, followed by oat, with ryegrass the least responsive. Nitrogen content also responded linearly to applied N (P = <0.0001), but the interaction between N and cover crops was weak (P = 0.0963). Nitrogen content averaged across N rates (P = <0.0001) was similar between rye and oat, but averaged ~53% greater than ryegrass. These results support recommending rye as a single species cover crop when high biomass production is preferred.

OBJECTIVE

Evaluate cover crop biomass production and nitrogen contents across nitrogen rates.

MATERIALS AND METHODS

- Experimental plots were established with a split-plot treatment restriction arranged in a randomized complete block design with four replications at Headland, AL during the 2009-2012 growing seasons.
- Main plots consisted of cover crops [oat ('Harrison'), rye ('Wrens Abruzzi'), and ryegrass ('Marshall')]. Subplots were N rates (0, 34, 67, 101 kg N ha^{-1} as NH_4NO_3).
- All cover crops were planted, fertilized, and terminated on the same day each year (Table 1). Termination consisted of cover crop rolling (Fig. 1) and a chemical application of glyphosate.
- Biomass production was measured by cutting all aboveground tissue from two random 0.25 m^2 areas within each plot. Tissue was dried for 72 h at 55°C.
- All collected cover crop tissue was ground to pass through a 2-mm screen with a Wiley mill (Thomas Scientific, Swedesboro, NJ), then ground further to pass a 1-mm screen with a Cyclone grinder (Thomas Scientific, Swedesboro, NJ).
- Subsamples were analyzed for total C and N by dry combustion on a LECO TruSpec-CN analyzer (Leco Corp., St Joseph, MI). Nitrogen contents present in the cover crop tissue were determined by multiplying total N concentrations by the corresponding cover crop biomass yields.

Table 1. Planting dates, nitrogen fertilizer application dates, and termination dates for the 2009 – 2012 cover crop growing seasons at Auburn University's Wiregrass Research and Extension Center in Headland, AL.

Crop Year	Planting Date	Nitrogen Fertilizer Date	Termination Date
2008 - 2009	19 Nov. 2008	15 Dec. 2008	22 Apr. 2009
2009 - 2010	17 Nov. 2009	3 Feb. 2010	26 Apr. 2010
2010 - 2011	9 Nov. 2010	10 Dec. 2010	13 Apr. 2011
2011 - 2012	7 Nov. 2011	1 Dec. 2011	13 Apr. 2012

Fig. 1. Cover crop rolling operation for rye plots on 22 Apr. 2009 at Auburn University's Wiregrass Research and Extension Center in Headland, AL.

Fig. 2. Oat, rye, and ryegrass photographs taken in early February at Auburn University's Wiregrass Research and Extension Center in Headland, AL.

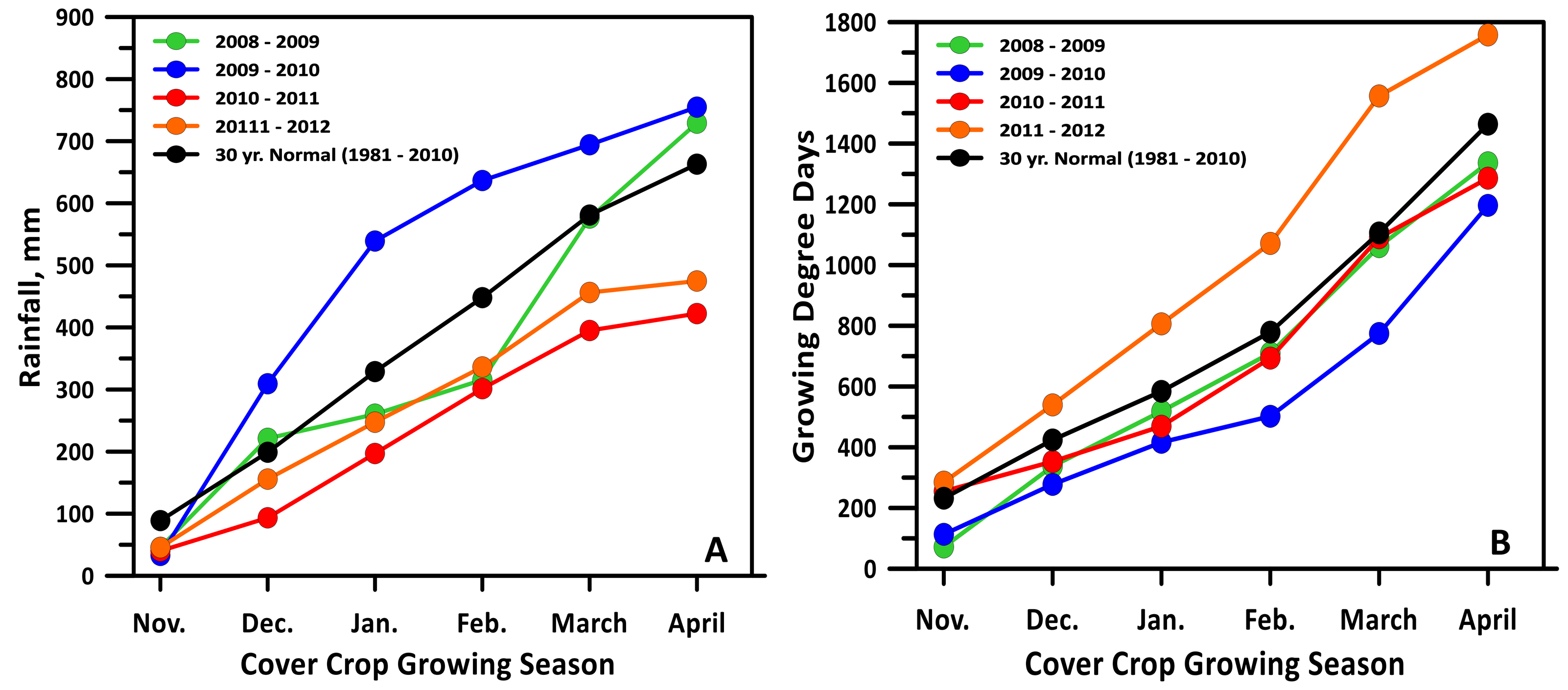

Fig. 3. Cumulative monthly rainfall and cumulative growing degree day calculations (4.4 °C base temp) for the 2009 – 2012 cover crop growing seasons compared to a 30 year normal at Auburn University's Wiregrass Research and Extension Center in Headland, AL. The 30 year normal period corresponds to 7 Nov. 1981 to 26 April 2010.

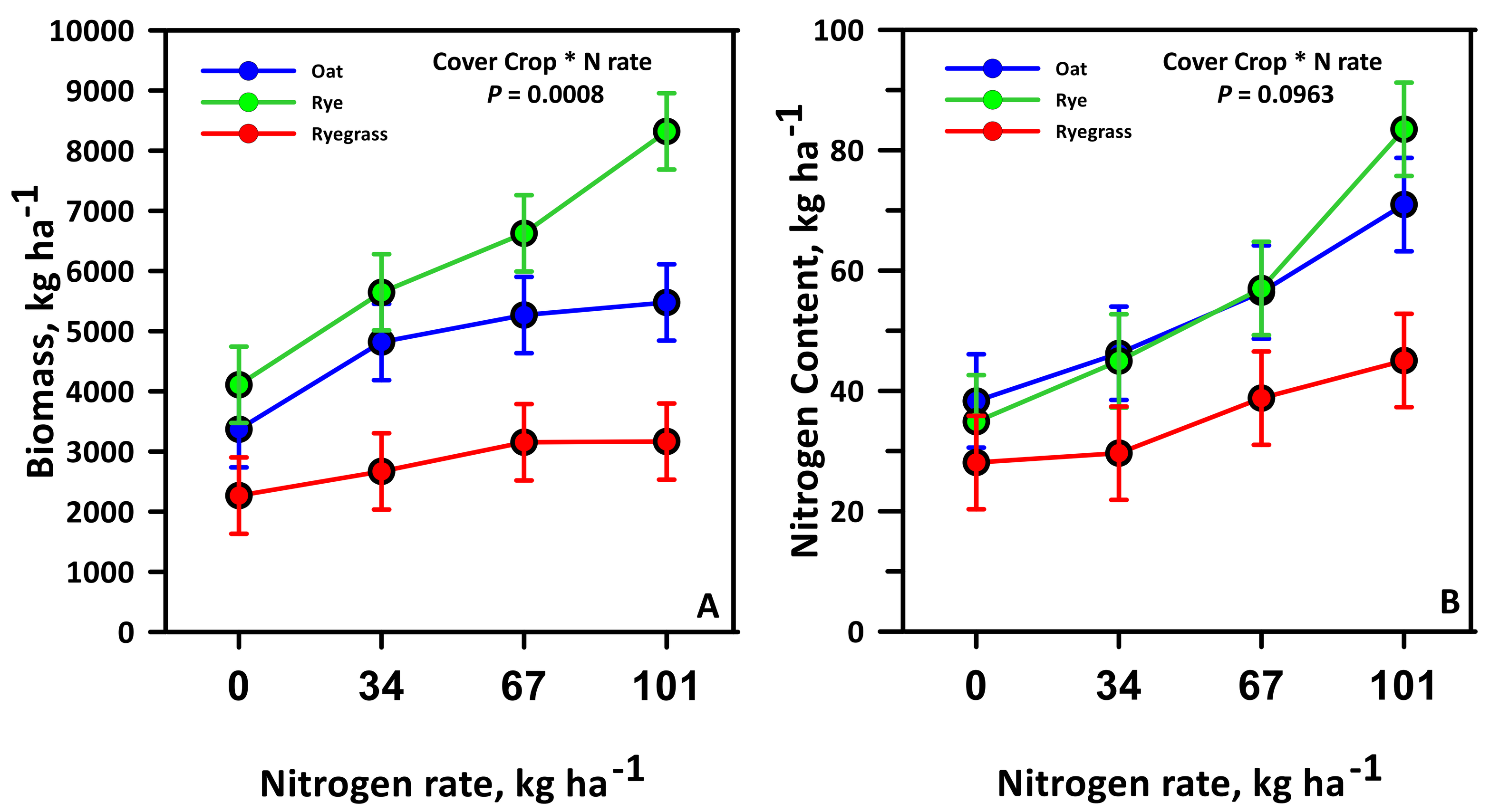

Fig. 4. Average biomass levels (A) and nitrogen contents (B) measuring during the 2009 – 2012 growing seasons at Auburn University's Wiregrass Research and Extension Center in Headland, AL. Error bars represent standard errors of the mean.

Table 2. Regression equations for cover crop biomass levels and cover crop nitrogen contents as a function of nitrogen rate for three different cover crops during the 2009 – 2012 growing seasons at Auburn University's Wiregrass Research and Extension Center in Headland, AL.

Cover Crop	Equation	Pr > F	R^2	C.V.
	Biomass			
Oat	Y = 3716.67 + 20.16x	0.0041	0.13	42.95
Rye	Y = 4128.96 + 40.53x	<0.0001	0.36	33.30
Ryegrass	Y = 2337.01 + 9.45x	0.0272	0.08	44.61
	Nitrogen content			
Oat	Y = 36.74 + 0.32x	0.0007	0.17	51.03
Rye	Y = 31.35 + 0.47x	<0.0001	0.46	35.53
Ryegrass	Y = 26.39 + 0.18x	0.0087	0.11	55.95

RESULTS AND DISCUSSION

- The 2009 and 2010 growing seasons produced equivalent cumulative rainfall amounts that were above normal, but the distribution between these years was different (Fig. 3A).
- The 2011 and 2012 growing seasons produced similar cumulative rainfall amounts and distributions, but amounts were below the normal and previous growing seasons (Fig. 3A).
- The 2010 growing season received the most rainfall throughout the growing season and resulted in below normal growing degree days. This corresponded to the coolest growing season (Fig. 3B) and a delay in application timing of N (Table 1).
- The 2012 growing season was dry with above normal growing degree days resulting in the warmest growing season (Fig. 3B). The 2009 and 2012 growing seasons were similar and near normal (Fig. 3B).
- Average cover crop biomass (2009 – 2012) responded linearly to applied N, but N response varied by cover crop species (Fig. 4A).
- The slope for rye was two times greater compared to oat and over four times greater compared to ryegrass (Table 2). The R^2 value for rye biomass was also greater compared to oat and ryegrass, while the C.V. was lower (Table 2).
- Average nitrogen contents (2009 – 2012) also responded linearly to applied N, but rye and oat produced similar N contents that were greater than ryegrass (Fig. 4B).
- The slope for rye was 1.5 times greater compared to oat (Table 2) that could be attributed to a sharp N content increase at 101 kg ha^{-1} (Fig. 4B). However, the average slope for oat and rye was over two times greater compared to ryegrass (Table 2).
- Similar to biomass production, the R^2 value for rye N contents was also greater compared to oat and ryegrass, while the C.V. was lower (Table 2).

CONCLUSIONS

- Despite rainfall and growing degree day variability across cover crop growing seasons (Fig. 3), rye biomass production (Fig. 5) was superior to oat and ryegrass.
- Nitrogen contents were similar between rye and oats, but greater compared to ryegrass.
- Rye resulted in less variability across measured variables, indicating it's benefit across multiple growing conditions.

Fig. 5. Typical final biomass production achieved with rye at Auburn University's Wiregrass Research and Extension Center in Headland, AL.