



Field-Scale Yield of Switchgrass Under Varying Nitrogen Management Treatments In New York State

Hilary Mayton¹, Julie Hansen¹, Ryan Crawford¹, Jamie Crawford¹, Donald Viands¹, Department of Plant Breeding and Genetics, Cornell University, Ithaca, NY¹

Introduction

Cornell University, in New York State, is one of several locations nationwide hosting a five year switchgrass production trial as part of a Regional Herbaceous Feedstock Partnership sponsored by the North Central Center Region SunGrant Initiative and the U. S. Department of Energy Biomass Program. Additional regions in the project include, Alabama (D. Bransby and C. Hopkins), Iowa (E. Heaton), Nebraska (R. Mitchell), Oklahoma (R. Ferris) South Dakota, (V. Owens), and Virginia (J. Fike).

Trial Objectives:

Gather biomass yield, sustainability, and economic data on a field-scale to assess potential expansion of switchgrass as a bioenergy feedstock resource in the US.

Materials & Methods



Figure 1. Trial site spring 2008 before tillage

The field site selected for this trial was in grass hay five years prior to establishment of switchgrass (Figure 1). Baseline soil samples were collected 22 April 2008 before plowing at nine locations and at 4 depths, 0-5 cm; 5-15 cm; 15-30 cm; 30-60 cm. Soil sampling will be repeated in year five of the experiment to assess changes in soil fertility. A randomized complete block design with four replications was used for the trial (approximately 0.4 ha acre per replicate). Upland switchgrass cultivar 'Cave-in-rock' was planted 29 May 2008 at 11.2 kg bulk seed per hectare. Weeds were controlled by mowing in July 2008, and the herbicide Permit was applied in August 2008. In early spring 2009, glyphosate and Banvel were applied to control weeds (Figure 2).

Nitrogen (N) fertilizer treatments (0, 56 and 112 kg/ha) applied as ammonium sulfate were made on 20 May 2009; 4 June 2010 and 31 May 2011. Switchgrass was harvested on 22 October 2009 and 4 November 2010 (Figure 2). Biomass samples were collected prior to harvest for evaluation of compositional characteristics.

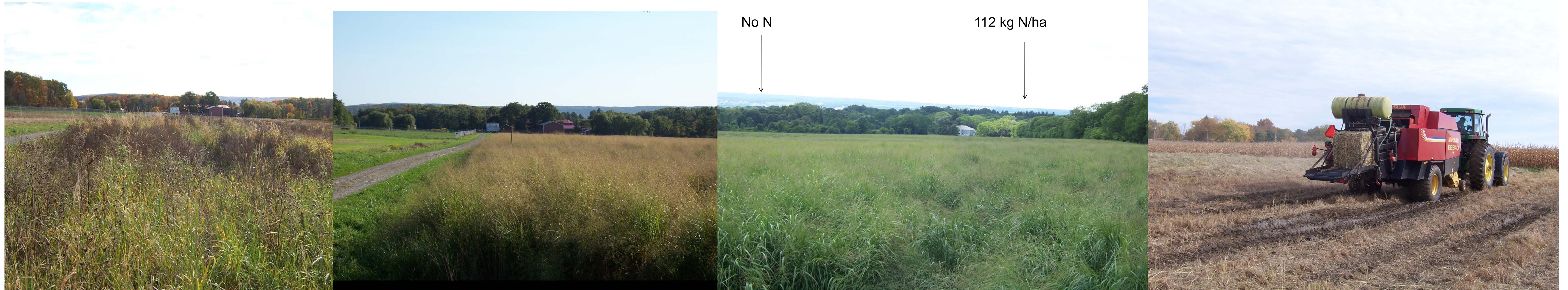


Figure 2. Pictured at the far left, switchgrass field site in the fall of 2008 with heavy weed competition in the seeding year. Middle left, solid switchgrass stand October 2011. Middle right, July 2009, 112 kg/ha N treated plots shows signs of lodging. Far right, high density bale harvester on wet soils 2009.

Results & Discussion

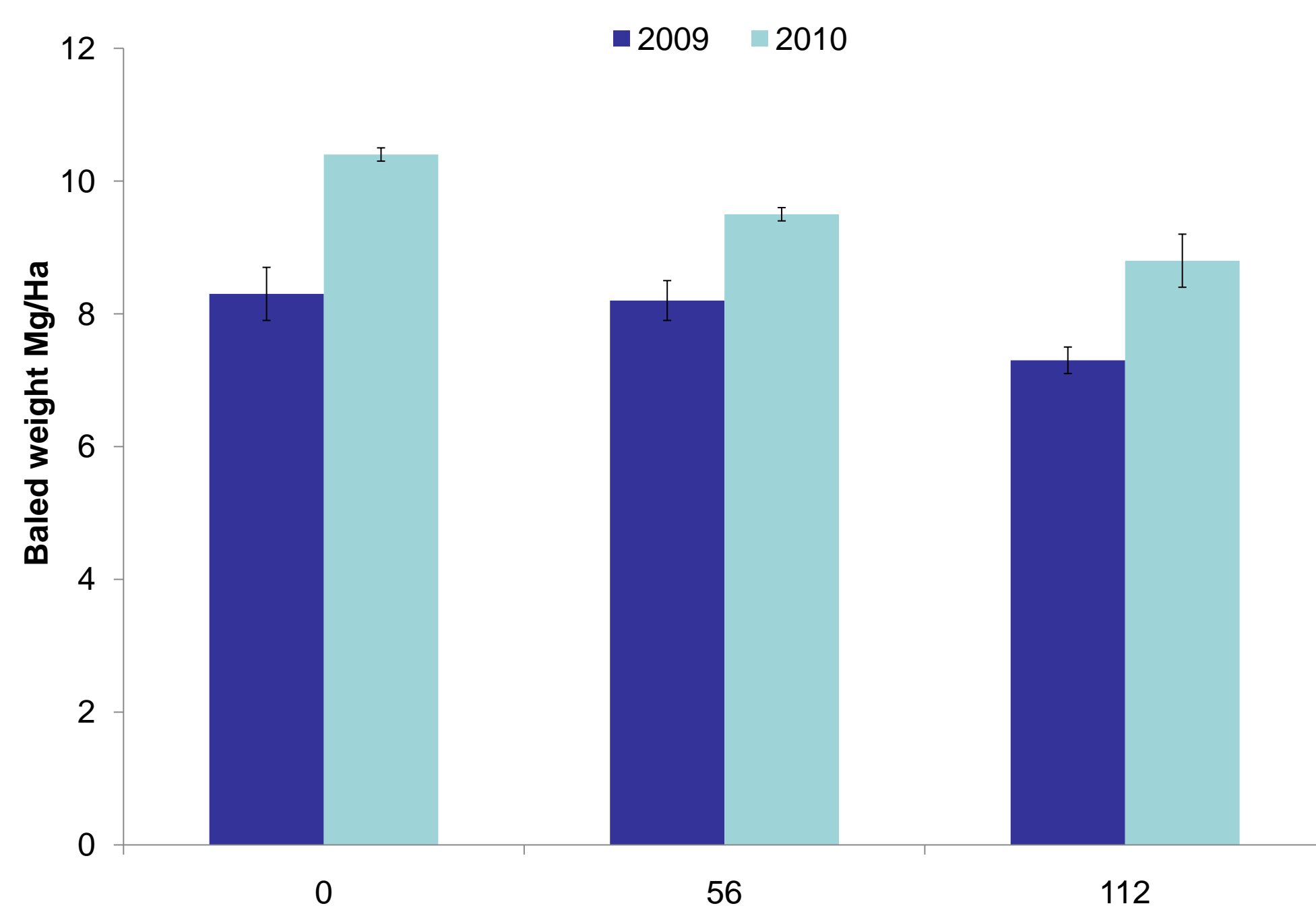


Figure 3. Yield of switchgrass as shown by N (ammonium sulfate kg/ha) treatment harvested in 2009 and 2010.

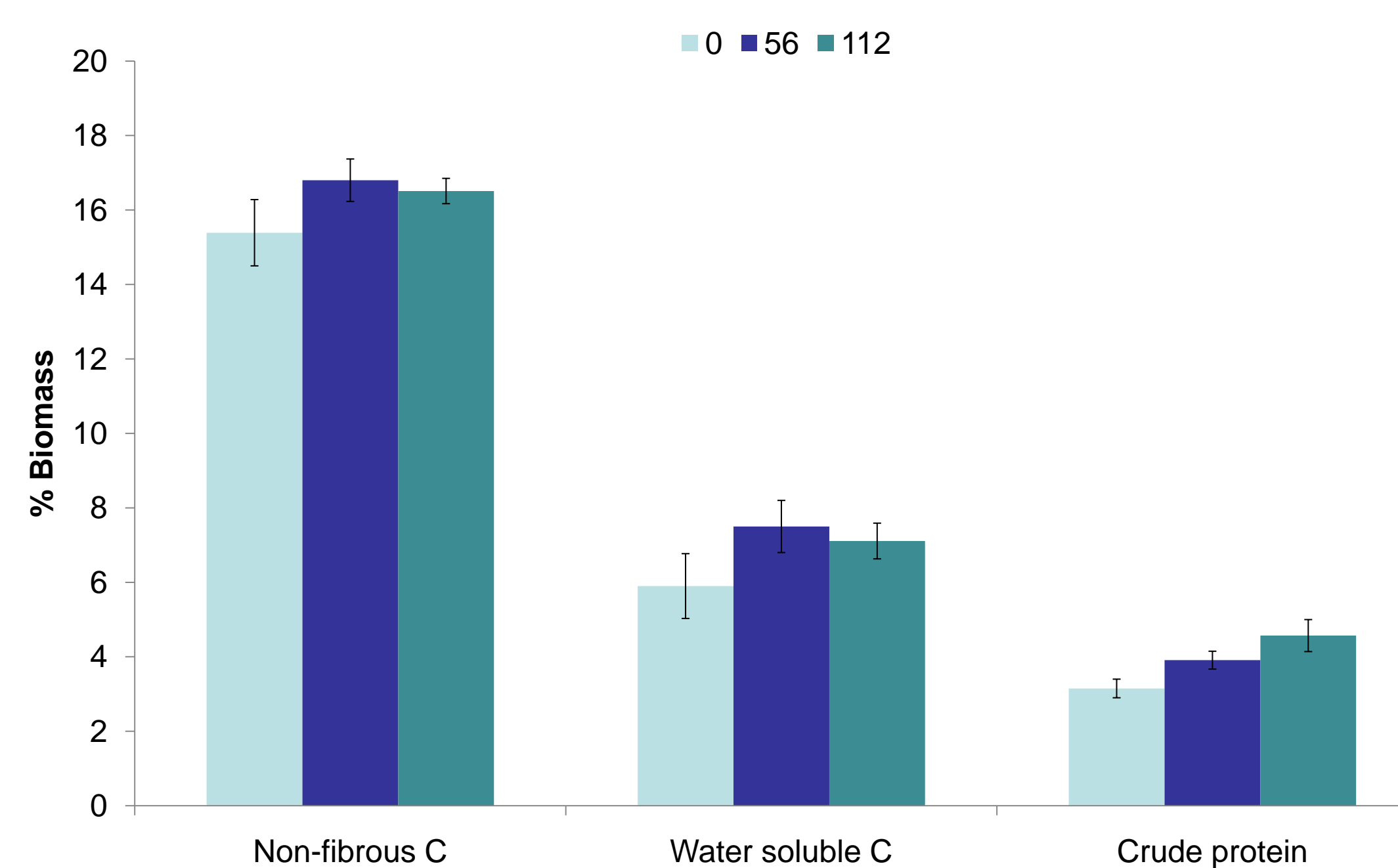


Figure 4. Non-fibrous carbohydrates¹, water soluble carbohydrates and crude protein differentiated by N treatment in biomass harvested in 2010.

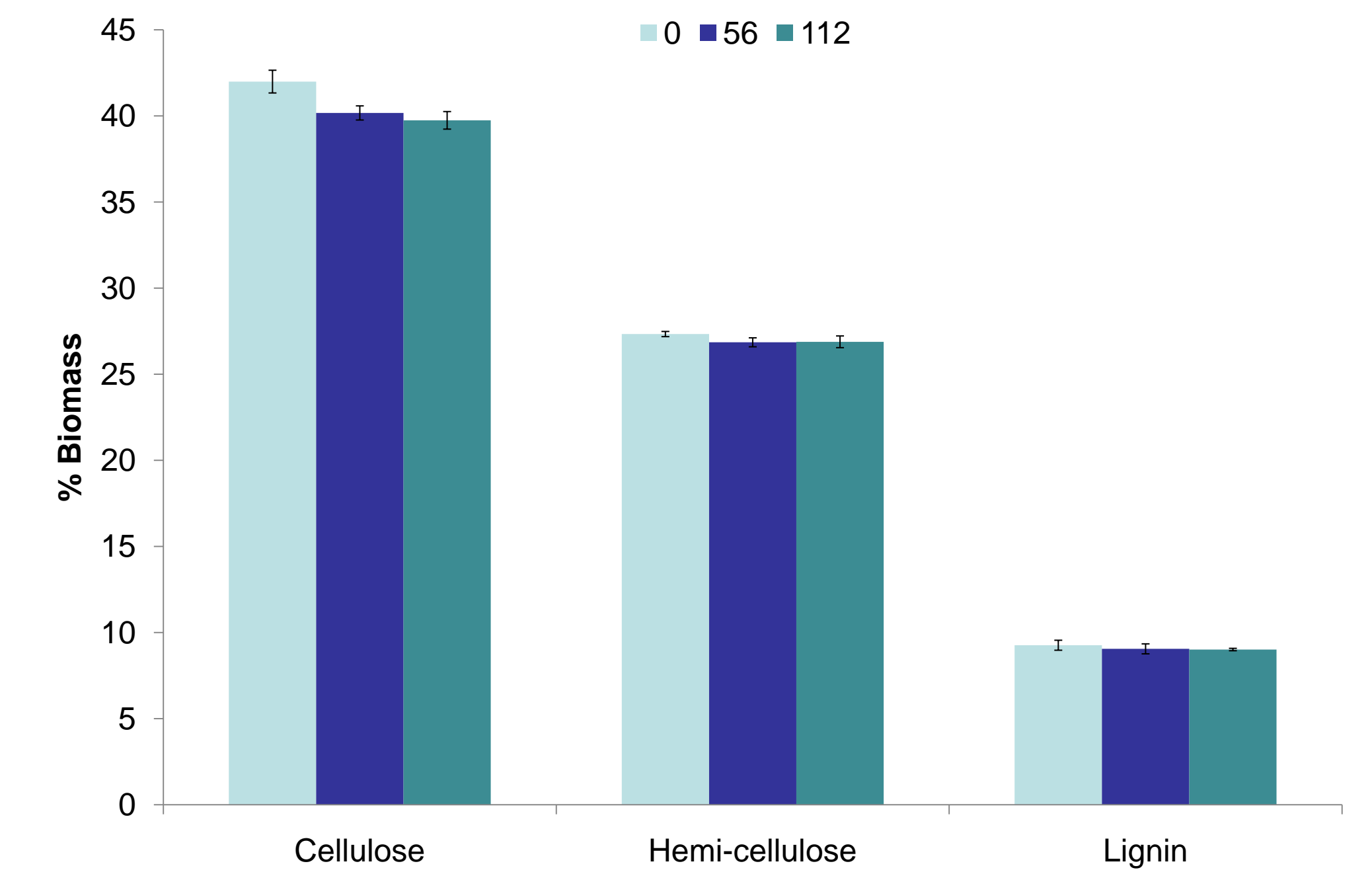
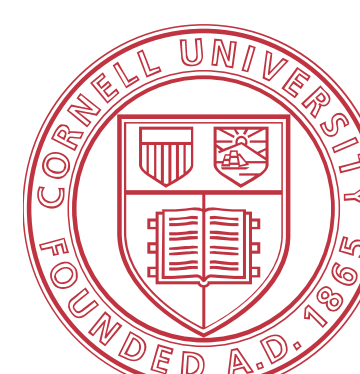


Figure 5. Cellulose, hemicellulose and lignin content of switchgrass biomass differentiated by N treatment harvested in 2010.

No significant yield response to N application was observed in 2009 (Figure 3). In 2010, the no N treatment had significantly higher yield than did the highest N treated plots. Average yield was 10.4 Mg/ha for the no N treatment versus 8.8 Mg/ha for the highest N treatment (112 kg/ha) in 2010 (Figure 3). Canopy height, measured at harvest, was also significantly higher in 2010 in the no N treated plots than the high N treatment (data not shown). Biomass quality analysis revealed no significant differences in non-fibrous and water soluble carbohydrates between treatments (Figure 4). The highest N treatment had higher crude protein than the 56 kg/ha and no N treatments (Figure 4). The no N treated plots had higher overall levels of cellulose than those receiving added N (Figure 5). Fertilization increased lodging and delayed maturity. Due to heavy weed competition multiple herbicide applications were applied. The approximate cost of establishment was \$800 per hectare or ~ \$400 per acre.

The field selected for this switchgrass trial is typical of the marginal soil types (Great groups – Fragiudepts and Fragiaquepts) with topographical land characteristics commonly found in the abandoned landscapes of NY. These fields are prone to saturation in the spring and fall and thus disrupt field operations at planting and harvest. However, because switchgrass can be harvested anytime after a killing frost without injury to the stand, these soils have the potential to be very productive. Abundant land resources, adequate rainfall and high density metropolitan populations make the Northeast USA an ideal region for the production and utilization of biomass as a renewable energy resource.

ACKNOWLEDGEMENTS



Cornell University
Agricultural Experiment Station

References

1) Further information regarding compositional analysis can be found at www.dairyone.com/Forage/FactSheet/ForageAnalysis.html