Grass Biomass Composition as Influenced by Fertility

Purpose: The purpose of this publication is to evaluate grass biomass composition when grown using various commercial and organic fertilizer sources.

Introduction

Northern NY is heavily reliant on outside energy sources. Grass biomass for residential or light industrial heating has the potential to provide energy security for thermal applications (Wilson et al., 2012). The energy content in pelleted grass is similar to premium wood pellets, but the composition is less desirable for combustion applications.

The primary elements of most concern for combustion are chlorine (Cl), nitrogen (N), potassium (K), and sulfur (S). Total ash content is also of concern, as it impacts the ash handling ability of combustion appliances. This study evaluated the impact of fertility treatments on grass biomass composition.

Fig. 1. Cornell Baker Farm, Willsboro, NY before the summer harvest of cool-season grasses.

Treatments

Switchgrass ('Cave-in-Rock'), and cool-season grasses (CSG) tall fescue (endophyte-infected 'KY-31') and reed canarygrass ('Rival') were established in replicated blocks on a sandy soil and a clay soil at the Cornell Baker Research Farm at Willsboro, NY. From 2009-2012, six treatments were applied in the spring: 1) N (100 lbs/a spring and 50 lbs/a after spring harvest for CSG; 75 lbs/a spring for WSG); 2) N+P (50 lbs/a 0-46-0); 3) N+P+K (100 lbs/a 0-0-60); 4) Dairy manure (40 ton/a, wet); 5) Dairy manure compost (20 ton/a, wet); 6) Check (no commercial or organic fertilizer applied). Spring application of N was at greenup for CSG and mid-May for switchgrass.

Fig. 2. Switchgrass is harvested in October after a killing frost.

Fertilization Issues

Commercial fertilizers (particularly those containing N, K and Cl) will increase concentrations of undesirable elements in biomass. Some form of N fertilization is required to produce meaningful yields in cool-season grasses. Fertilization with KCl may increase grass yield and persistence, but grasses will exhibit luxury consumption of both K and Cl. Phosphorus (P) fertilization may impact grass yield and persistence, but the P concentration range in grasses is relatively small, and P has much less impact on combustion than N, K, Cl, and S.

Harvest

Switchgrass was harvested in the fall after a killing frost, while CSG were harvested in July and again in late fall (Bioenergy Information Sheet #12). Samples were analyzed for N, fiber, minerals, gross energy content, and ash content. Composition of grass was very consistent from year to year, over the six fertility treatments, including the first year, so all graphs shown include data from 2009-2012.

Results

Elemental concentration patterns were similar between sites, and CSG regrowth treatment patterns were similar to primary growth. CSG were not significantly different from each other for any of the important parameters except BTU content. Fertilization with either KCl or organic fertilizer resulted in a large increase in Cl content, particularly in CSG (Fig. 3). The same treatment pattern occurred for K (Fig 4), but much less pronounced. Standard error of difference bars are shown on the graphs.

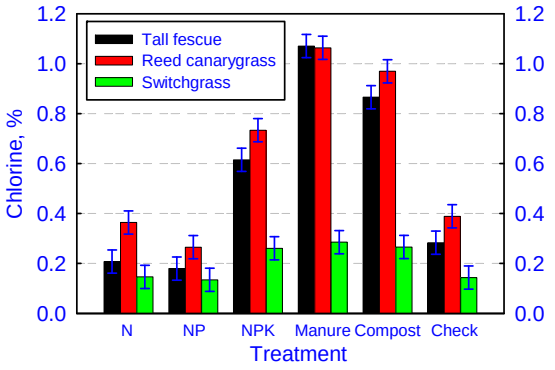

Fig. 3. Cl content of primary growth on sand site.

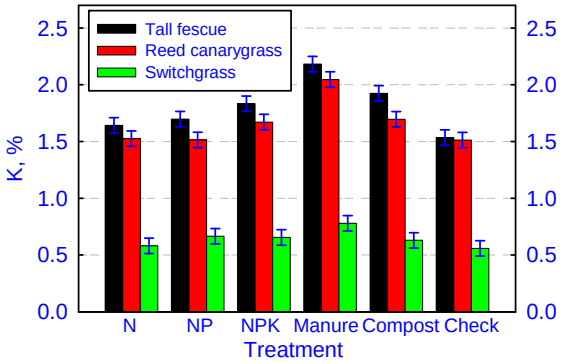

Fig. 4. K content of primary growth on clay soil.

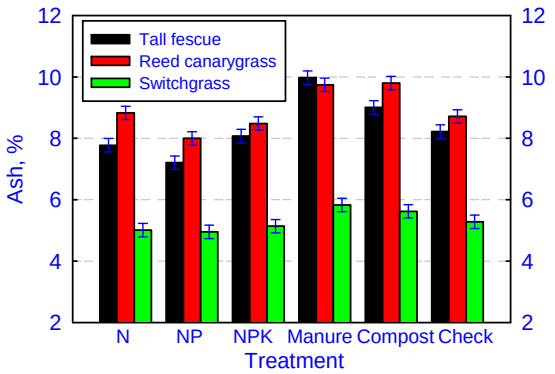

Fig. 5. Ash content of primary growth on sand site.

Ash content did not differ between manure and compost treatments, and both were higher in ash than other treatments (Fig. 5). Although energy content did not vary greatly, differences were very distinct (Fig. 6). Species were all different from one another, and manure and compost treatments did not differ, but had lower BTU than the rest of the treatments, averaged over species.

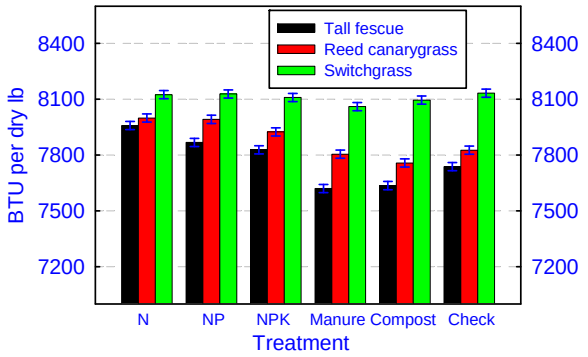

Fig. 6. BTU content of primary growth on clay site.

Summary

Manure or compost application increased concentrations of undesirable components for combustion and decreased energy content of cool-season grasses. Switchgrass elemental concentrations were much lower than CSG, and much less impacted by fertility treatments.

Additional Resources

Cherney, J.H., K.M. Paddock, Q. Ketterings, M.D. Davis, and D.J.R. Cherney. 2013. Grass Biomass Yield as influenced by Fertility. Bioenergy Information Sheet #12. www.grassbioenergy.org.

Cherney, J.H., et al. 2013. Mulch Hay as a Combustion Feedstock for NYS. Bioenergy Information Sheet #14. www.grassbioenergy.org.

Wilson T.O. et al. 2012. Environ. Sci. Technol. 46:1270-1277.

Acknowledgments

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For more information

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