Grass Biomass Yield as Influenced by Fertility

Purpose: The purpose of this publication is to compare grass biomass yields from commercial and organic fertilizer sources.

Introduction

Northern NY imports most of its energy and is therefore heavily reliant on these greatly fluctuating outside energy sources. Grass biomass for residential and light industrial heating has the potential to be a local closed-loop energy system, with the grass produced, densified and marketed locally. The energy content in pelleted grass is similar to premium wood pellets.

For economically viable grass production we need to maximize forage yield. Switchgrass (WSG) currently is the top warm-season grass of choice for biomass in much of the country. Reed canarygrass and tall fescue (CSG) were selected for their high yield potential, as well as their superior persistence under northern NY winters. The impact of organic matter application (manure or compost) on tradeoffs between grass biomass production, composition, and soil test N, P and K dynamics needs to be investigated.

Treatments

Switchgrass ('Cave-in-Rock'), 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. In 2011 and 2012, 3 of the 6 replicates were irrigated, based on potentiometer readings.

Switchgrass was sprayed with Roundup each spring and broadleaf weeds were controlled in CSG stands as needed. Stands were essentially free of weeds, except for reed canarygrass on the sandy site, which had significant grassy weeds. A few milkweed plants were present in plots, and neither Roundup nor harvesting was able to eliminate them.

Harvest

Maximum yield and persistence for warm-season grasses (WSG) occurs with one harvest per season, while cool-season grasses (CSG) have considerably more productivity with two harvests per season. Cool-season grasses were harvested in mid-summer and again in October after a killing frost. Switchgrass was harvested once each season after a killing frost.

Fig. 1. Manure application appeared to damage switchgrass stands, but stands recovered.

Manure applications occasionally showed visible damage to switchgrass stands (Fig. 1), however the stands appeared to recover without any noticeable damage to the stands at year's end. Manure application had no visible negative effects on CSG stands.

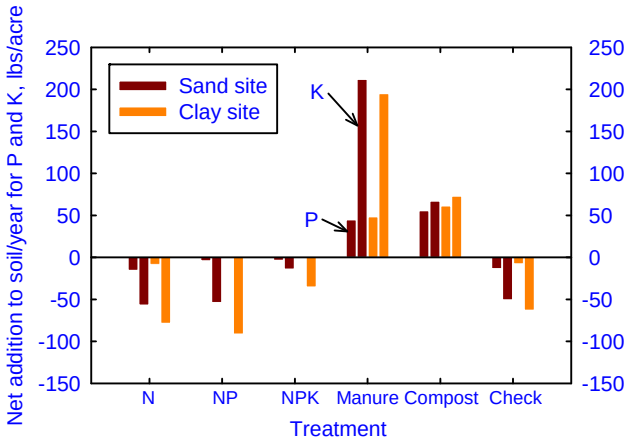

Fig. 2. Net annual addition of P and K to soil, subtracting P and K removed in the biomass from that applied by each fertility treatment.

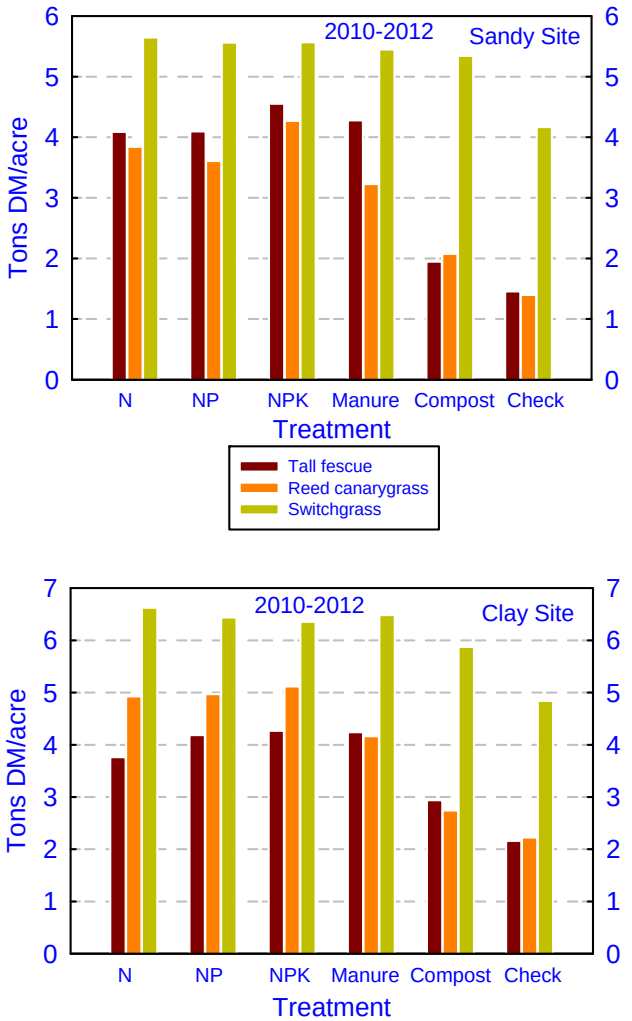

Fig. 3. 2010-2012 DM yields at two sites. First year yields (2009) were not included here, as there is a cumulative affect with organic treatments.

Results

P fertilizer application offset P removal in biomass, but K fertilizer application resulted in a small net soil K deficit annually (Fig. 2). Organic fertilizers resulted in an accumulation of P and K in soil, with a very large K accumulation from fresh manure.

Yields were higher on the clay site, with high switchgrass yields at both sites under all fertilizer regimes (Fig. 3). Check plots (no fertilization) were significantly lower in switchgrass yield, although switchgrass yields were still much higher than CSG check plots. Switchgrass fertilized with compost was lower yielding than all other fertility treatments on switchgrass on the clay site, but not the sand site. P and K fertilizer had essentially no effect on yields, with the exception of K on CSG at the sand site. Manure application resulted in switchgrass yields similar to NPK fertilizer, but yields were lower on the CSG manure treatment. Compost on CSG produced yields not greatly different than check plots.

Summary

Switchgrass yields were relatively high, regardless of any fertilization. 'Rival' reed canarygrass was not vigorous, uncharacteristic of the species in general. Dairy manure compost resulted in much lower yields than fresh dairy manure for cool-season grasses.

Additional Resources

Cherney, J.H. and K.M. Paddock. 2013. Overwintering Switchgrass in the Field in NYS. Bioenergy Information Sheet #10. www.grassbioenergy.org.

Cherney, J.H., K.M. Paddock, Q. Ketterings, M.D. Davis, and D.J.R. Cherney. 2013. Grass Biomass Composition as influenced by Fertility. Bioenergy Information Sheet #13. www.grassbioenergy.org.

Acknowledgments

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For more information

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