Public Abstract
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Majority of the global energy supply depends on fossil fuel sources such as coal, petroleum, and natural gas. However, energy production by these sources has significant environmental impacts such as air and water pollution, global warming, and environmental degradation. These issues have become the driving forces of searching for cleaner burning fuels. Bioenergy is a form of renewable energy, produced from plant and animal based materials which are called biomass feedstocks. Switchgrass, Big bluestem, and Indian grass are perennial (C4) warm-season grasses native to North America with great potential as bioenergy crops. They are highly adapted to growing under diverse growing conditions with low inputs, particularly on marginal lands. Improving water and nutrient retention ability of marginal lands could potentially increase biomass yield of crops on degraded landscapes. Biochar is a carbon-rich solid material, which is a product from pyrolysis of biomass under limited supply of oxygen (O2), and at relatively low temperatures (<700 °C). It can be applied as an organic soil amendment, for improving water and nutrient retention in marginal sandy soils. I expected that N fertilization with biochar application to low fertile soils would increase biomass production for switchgrass, big bluestem, and Indian grass. I conducted two greenhouse experiments as one in 2014 and one in 2015, to evaluate the effects of biochar amendments with different N rates on growth and biomass production of warm-season grasses. In the first study, potting media was prepared by homogenously mixing Promix® starter mix and sand at the volume ratio of 3:1, and 0, 5, 20, 35 Mg per ha rates of biochar. In the second study, the potting mix and sand (1:9 by volume) were mixed to create sandy marginal soils found along floodplains of major rivers. Four nitrogen (NH4NO3 fertilizer) application rates (0, 60, 120, 180 kg N per ha) were used in both experiments. Above and belowground biomass yield, net photosynthetic rate, and water holding capacity of the potting media were measured in both years. Aboveground biomass and photosynthetic rate was not increased for any of the species in both years with biochar addition. However, biochar by nitrogen fertilizer increased the belowground biomass of switchgrass in 2014 where 20 Mg per ha biochar and 60 kg N per ha resulted the highest belowground biomass. Root:shoot ratio of both switchgrass and Indian grass declined significantly with increasing N rates in 2015. Further studies should include long-term experimentation in marginal sandy soils to explore the benefit of using biochar for herbaceous biomass grass production at field and regional scale.

Key words: Big bluestem, biomass energy, Indian grass, marginal sandy soils, switchgrass