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Five warm season perennial grass species were established in 2006 in New York State for evaluation as potential bioenergy feedstock. Two field trials were planted with a total of 15 entries per trial. Trials included eight switchgrass cultivars, three big bluestem, one indiangrass, one coastal panic grass and two eastern gamagrass cultivars. The objectives of the study were to measure yield response and assess chemical compositional characteristics important for energy conversion under different N management systems. Ammonium nitrate (33% N) was applied at a rate of 74 kg/ha in 2007 and 2008. In 2009, ammonium sulfate (21% N) was applied at 74 kg/ha. Plots were harvested once in the fall of 2008 and 2009 and were sampled for quality prior to harvest each year. Biomass samples were scanned on a Foss NIR Systems spectrophotometer (Foss NIRSystems, Model 5000, Silver Spring, MD). All three big bluestem cultivars (‘Goldmine’, ‘Bonanza’ and ‘Niagara’) had the highest overall yields under the no N treatment. The one indiangrass entry ‘Holt’ also had significantly higher yields in the no N treatment for both harvest years. The coastal panic grass cultivar and both cultivars of eastern gamagrass showed a positive response to N applications in 2008 and 2009. The N response for the switchgrass cultivars was variable with most cultivars showing some increase in yield, particularly in 2008. Upland switchgrass cultivars ‘Carthage’, ‘Shawnee’, and ‘Cave-in-rock’, had higher yields in the N treated plots than no N treatments in both years. The lowland cultivar ‘Kanlow’ showed the most significant response to N in both years. It was also the highest overall yielding cultivar in both harvest years. Nitrogen management had some influence on compositional chemical characteristics but overall trends and rankings for plant species and cultivars remained similar.