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## Water Quality and Production Potential Effects of Cellulosic Biofuel Crops Grown on Marginal Land

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With an increasing global demand for fossil fuels, the potential for shortages is increasing. Concurrently, interest in alternative sources of energy, including bioenergy has increased considerably in the recent years. The Energy Independence and Security Act of 2007 mandates that 136.3 billion liters of biofuels must be produced, with 60.5 billion liters coming from cellulosic biofuel crops by 2022. Potential sources of cellulosic biomass are: crop residue, sorghum, switchgrass, *Miscanthus*, and woody crops. The increase in biofuel crop production required to meet the mandate raises questions regarding the additional amount of agricultural land area needed, as well as the potential competition with food and feed production for land. The utilization of marginal lands, lands not suitable for crop growth due to infertility, slope, degradation or poor yields, is an alternative, but could come at a higher environmental cost due to the same factors that make them marginal. There has been little field research investigating the environmental consequences of using marginal land for biofuel crop production. The objectives of this research were to quantify surface and subsurface nutrient losses and determine production potential of six crops (*Miscanthus*, switchgrass, maize, sorghum, poplar, and native prairie) when grown on marginal lands with varying rates of nitrogen (N), phosphorus (P), and potassium (K) fertilizers. This study used previously-established research plots at the Throckmorton Purdue Agricultural Center, in West Lafayette, IN. Switchgrass plots were established in 2007, *Miscanthus* in 2010, and corn and sorghum plots were established in 2011 at TPAC West. All TPAC East plots were established in 2011. Yields were assessed in 2013 and 2014. Suction cup lysimeters permitted soil profile leachate to be sampled at a depth of approximately 30.5 cm. in a small subset of plots, and nutrient loading in surface water runoff was captured during 2014. Subsurface water samples were analyzed for nitrate-N ( $\text{NO}_3\text{-N}$ ) concentration and soluble reactive phosphorus (SRP) concentration, while surface runoff water samples were analyzed for  $\text{NO}_3\text{-N}$ , SRP, total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS). Subsurface leachate concentrations of  $\text{NO}_3\text{-N}$  from the perennial grass plots were significantly less compared to the annual row crops, indicating higher losses may have occurred from annual row crop plots. Within the plots treated with phosphorus fertilizer, *Miscanthus* had greater leaching of phosphorus to subsurface waters. One year of surface monitoring data indicated that surface nutrient loads were not significantly affected by crop. However, switchgrass had significantly lower nitrate loads than sorghum and *Miscanthus*. Many of the nutrient and TSS loads are higher at the start of the growing season (May) when planting and fertilization occur. *Miscanthus* yield was significantly higher than all other crops in this study, averaging  $22.6 \text{ t ha}^{-1}$  on the dry weight basis. Fertilizer rate did not make a significant difference in biomass production within crop treatment on the plots at TPAC West. This study indicates perennial grasses may have markedly lower nutrient losses and can help reduce soil erosion, while also producing a significant biomass yield when grown on marginal lands.