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IS SWITCHGRASS A LOW NUTRIENT INPUT CROP OR NOT?

Switchgrass is being promoted as one of the primary candidates for cellulosic ethanol production. It is a warm-season, perennial grass that is projected to have good biomass yield potential (up to 10 dry tons/A), fairly high ethanol yield (about 100 gal/ton of hay), and good ecological suitability for many areas.

Switchgrass is also commonly cited as having relatively low nutrient input requirements. Popular articles describe switchgrass as a "thrifty" crop that can be grown with little or no additions of fertilizer, and still maintain productivity. However, several studies have demonstrated that switchgrass can be very responsive to nutrient additions (especially N) and also remove large quantities of nutrients (particularly K) from the soil.

Typical N recommendations for established switchgrass range between 50 and 100 lb N/A/yr. However, most of the published fertility recommendations for switchgrass are based on the crop being grown for grazing or hay production. In these situations, maximum forage yield is sometimes compromised in favor of improved forage quality. Research focused on maximizing biomass production is scarce and reported optimum N rates have varied. A study in Texas concluded that switchgrass production would be sustainable with N applications of 150 lb N/A/yr, while researchers in Alabama reported increasing forage yields up to 200 lb N/A/yr. Nitrogen removal for switchgrass averages 22 lb N/ton, which is less than the N removal reported for corn silage and several other warm-season forage grasses like hybrid bermudagrass, eastern gamagrass, and johnsongrass, but very similar to the amount removed in the grain from a 180 bu/A corn crop.

One ton of switchgrass will remove approximately 9 and 46 lb P_2O_5 and K_2O/A, respectively. Comparing a 6-ton switchgrass yield to a 180-bu corn crop, the P_2O_5 removal would be about 26 lb/A less for the switchgrass, but K_2O removal would be 224 lb/A greater for the switchgrass than the grain. Some of the nutrients taken up can be recycled back to the soil by delaying harvest until after senescence, when minerals can leach from the fallen leaves. However, a significant portion of these nutrients will need to be replaced through fertilization. Soil testing and estimated crop nutrient removal are the best methods for determining fertilizer needed to maintain productive levels of P and K in the soil, but mining of soil nutrients (particularly K) that leads to declining yields is not uncommon in major warm-season forage grass production regions. Some states indicate that over 50% of the soil samples tested for warm-season grass production are in need of K fertilization.

Sustainable production of switchgrass for the biofuel industry without fertilization will not likely be feasible. Whether switchgrass can be grown as a "low-input" crop remains to be determined. Harvesting for energy after senescence could conserve K and possibly reduce fertilizer inputs, but more research on production strategies is needed. More research is also needed to identify optimum N rates across diverse production areas.

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Abbreviations in this article: N = nitrogen; K = potassium.