SS AGR 291

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Production of Biofuel Crops in Florida: Switchgrass [1]

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Introduction

Switchgrass (*Panicum virgatum*) is a warm-season, perennial grass native to North America. Although commonly associated with the American tallgrass prairie, switchgrass is also part of Florida's natural ecosystem. Nationwide, numerous switchgrass cultivars have been developed for forage, but most of them do not grow well in Florida because they were developed from northern populations. Only one cultivar, Alamo, is recommended for Florida. Alamo was developed from a native population found at 29° north latitude in east Texas and has proven to be well adapted to the lower southeastern US.

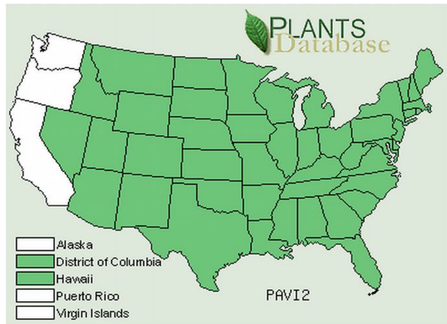

Figure 1. Occurrence of Panicum virgatum L. in the US. Credits: http://plants.usda.gov/java/profile?symbol=PAV12

Current Potential for Use as Biofuel

Because of its wide range of adaptation and high dry matter production potential under low fertility conditions, switchgrass was identified by the U.S. Department of Energy as a potential bioenergy feedstock in the 1990s. Most of the research with switchgrass has been directed toward biomass production as a combustion fuel to supplement coal for generation of electricity, but switchgrass is also a potential feedstock for lignocellulosic ethanol production.

Biology of Switchgrass

Switchgrass is an erect, warm-season perennial grass that ranges between 1.5 and 6 feet tall. It produces a flush of new tillers each spring with a high ratio of reproductive to vegetative tillers, most of which will produce a seedhead under adequate moisture conditions. It is drought tolerant with a deep root system that can reach up to 10 feet in depth. The

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Figure 2. Lowland type switchgrass in full flower at the USDA, NRCS, Brooksville Plant Materials Center in Brooksville, FL

general appearance of the plant is that of a loose bunchgrass, but it has short rhizomes and stands can thicken to form a sod. Two general morphological types are recognized. The lowland type has tall, coarse stems and is adapted to poorly drained soils, while the upland type has short, fine stems and is more drought tolerant.

Production

Switchgrass has a wide range of soil adaptation, growing well in sands to clay loams with pH values of 4.5 to 7.6. In Florida, switchgrass should be planted from February through April with 2 to 4 lb pure live seed/acre using a Brillion seeder or other drill at a planting depth of 1/4 inch. It grows from February/March through November, but it is photoperiod sensitive and, as days get short, it will start flowering. If winters are mild it may grow year round in Florida. To keep dry matter production high and maintain vigorous stands, only one harvest per year in the fall is recommended. Stands should be fertilized with P, K, and micronutrients according to soil test prior to planting. No nitrogen should be applied during the establishment year to minimize weed growth. In subsequent years, stands should be fertilized after spring growth begins with between 100 to 150 lb of N; and P and K according to soil test. Stands do not reach full yield potential until the third year.

Potential Yields

Switchgrass biomass production depends on location and cultivar. In the US, yields from best adapted cultivars have ranged from 10,000 to 20,000 lb/acre/year. In Florida, yields range between 4,000 to 8,000 lb/acre/year. If switchgrass is fertilized and adequate moisture is present, yields in Florida have been as high as 12,000 lb/acre/year.

Production Challenges

In Florida, less is known about switchgrass production than other biofuel crops such as sugarcane, sweet sorghum, elephantgrass, energycane, etc., which have been more widely studied for biomass production in the state. An advantage of switchgrass for biofuels production in Florida is that stands can be established from seed. Compared to most of the commonly planted pasture grasses in Florida, though, switchgrass stands can be hard to establish due to weed competition, too much depth of planting, and low quality or dormant seed. Another challenge is that stand persistence and production of all commercially available switchgrass cultivars is poorer in Florida than other areas of the country. Stands may need to be renovated every 5 to 10 years to maintain commercially acceptable yield. Studies of native Florida switchgrass lines have shown that Florida material is more persistent and higher yielding than even Alamo, but its seed production is not reliable. Florida switchgrass lines can be planted vegetatively, but the cost of establishment makes their use questionable. An additional issue associated with biofuels production, either for direct combustion or lingnocellulosic ethanol production, is the moisture content of the feedstock. Field drying conditions in Florida, even in the fall, are not usually favorable to decrease moisture concentration in warm-season grasses. In the case of standing switchgrass crops, field drying conditions may be an issue. Compromises may have to be made between maximum dry matter yield and moisture content that would allow for drying.

Estimated Production Costs

Switchgrass has not been commonly planted in Florida, even for forage production, so production costs are not well known. It can be reasonably assumed that site preparation costs and establishment herbicide costs should be similar to those for planting warm-season perennial grasses such as bahiagrass or bermudagrass. Fertilizer costs would be similar to any crop receiving similar levels of inputs, while harvesting and transportation costs will depend on yield.

Environmental Concerns

Properly managed switchgrass stands have few disease or weed issues. This, combined with low fertility requirements, suggests that long term, widespread production of switchgrass should have little environmental impact on lands currently in improved pasture, citrus groves, or row crops. Even though switchgrass removes relatively low levels of phosphorous (5 lb/acre/year) compared to bermudagrass (35 lb/acre/year), some positive benefit could be expected from continuous production on sites with high phosphorous levels.

Summary

Nationwide, switchgrass is recommended for biofuel production because of its wide range of adaptation and high potential dry matter yield with relatively low fertility input. It can be used for both lignocellulosic ethanol production and in electricity generation, complementing coal as a co-firing agent supplement. Less is known about switchgrass production in Florida than other biofuels crops.

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