Perfect Pair for Biofuel

Switchgrass and Trees

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Louisiana is one of the top energy-producing states in the nation because of its abundant reserves of fossil fuels like oil and natural gas. Thanks to its long growing season, diverse vegetation, central location and well-developed agriculture and forestry infrastructure, Louisiana has the potential to become one of the top biofuel-producing states as well.

Any fuel derived from plant biomass is considered a biofuel. Ethanol produced from corn and biodiesel produced from soybeans are the top biofuels produced in the United States. The U.S. biofuel market arose from economic and national security concerns. Nearly 2 percent of the nation's gross domestic product is used annually to import oil, and the world's oil supply is expected to decline by 80 percent in the next 50 years because of waning oil reserves and increasing use of oil.

The energy needs of the United States are too high to be met solely by corn ethanol and soybean biodiesel. For example, using the entire 2008 U.S. corn and soybean crops to produce biofuels would meet only 18 percent of the U.S. transportation fuel demand. Clearly, new types of biofuels will be needed to meet this goal.

Cellulosic ethanol can be made from nonedible parts of plants, unlike conventional corn- or sugar-based ethanol. Forest biomass and grasses such as switchgrass are promising feedstocks for cellulosic ethanol. Forestry contributes $3 billion to $4 billion to Louisiana's economy annually, making it the state's top agricultural commodity. Because of their abundance and high biomass growth potential, Louisiana's forests are logical biofuel feedstock sources. The contribution from forest biofuel production would be relatively sporadic, however, because the major contribution would be at harvest, which is generally when a forest stand is greater than 15 years old.

Switchgrass has many characteristics that make it a desirable cellulosic ethanol feedstock. Switchgrass can be grown with minimal fertilization, and it produces high yields even on marginal soils. It is highly tolerant of flooding and drought and has the potential to produce 1,000 gallons of ethanol per acre, which compares favorably with corn and sugarcane. However, growing a crop dedicated predominately to the relatively new biofuel market carries economic risk.

Agroforestry management systems can be developed to integrate switchgrass and forest production. In such systems, switchgrass would be grown as a biofuel feedstock within alleys between trees. Once switchgrass reaches a near-mature state by its second year, it can be harvested annually. The trees can be harvested occasionally as traditional forest products when they reach merchantable size, and the tree branches can be collected and marketed as biofuel feedstocks.

The diversity in products and vegetation offered by such systems would reduce economic risks associated with entering a new market, maximize yields by optimizing the use of growing space, and improve environmental services such as wildlife habitat, capturing carbon from the atmosphere and storing it in the soil and protecting water quality from nutrient pollution. Several projects are under way in the LSU AgCenter to develop the blueprint for this management system.

At the LSU AgCenter Hill Farm Research Station near Homer, La., studies were established in 2000 and 2008 to determine the feasibility of growing switchgrass in rows between loblolly pine trees. The purpose of these studies is to develop an agroforestry system for producing switchgrass for biofuel in an upland soil typical of north central Louisiana. Switchgrass was planted between rows of newly planted 2-year-old loblolly pine as

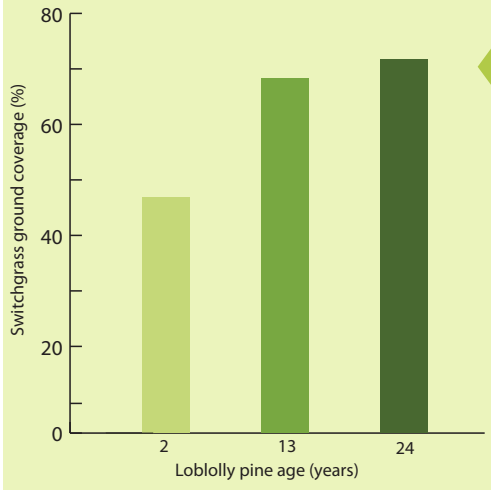
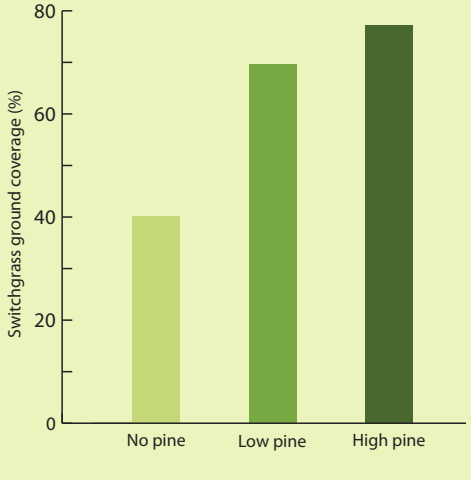


Figure 1. Percent of ground covered by switchgrass five months after planting under loblolly pine of diverse ages.

Figure 2. Percent of ground covered by switchgrass five months after planting under without loblolly pine, with a relatively low density of loblolly pine (300 trees per acre for a 2-year-old stand, 100 trees per acre for a 13-year-old stand, 25 trees per acre for a 24-year-old stand) and with a relatively high density of loblolly pine (600 trees per acre for a 2-year-old stand, 200 trees per acre for a 13-year-old stand, 50 trees per acre for a 24-year-old stand)..



well as between the rows of 13-year-old and 24-year-old loblolly pine soon after a thinning – or partial harvest – of the plantations. In all pine plantation ages, switchgrass was established between trees by first applying the herbicide glyphosate, then disking the soil and then broadcast-seeding Alamo switchgrass seed.

Significantly more switchgrass cover was found by the end of the first growing season beneath the older trees than between newly planted loblolly pine (Figure 1). Furthermore, the quantity of switchgrass cover increased with number of trees in the overstory (Figure 2). These results illustrate a beneficial influence of shading on switchgrass establishment. Competing vegetation is an impediment to successful switchgrass establishment because of relatively high variability in the dormancy period of switchgrass seed once in the soil, which allows competing vegetation to become established before the switchgrass germinates. At the Hill Farm site, crabgrass was much more abundant where pine shading was absent than in plots with pine shading, suggesting that the shading provided some competition control for the switchgrass.

The studies at the Hill Farm Research Station have shown that average switchgrass production without fertilization was 2.5 tons per acre per year, with a maximum of 3.5 tons per acre per year. Planting loblolly pine at 300 trees per acre, with row widths of 20 feet to facilitate switchgrass production, has yielded an average of 14 tons per acre of pulpwood by an age-13 thinning operation.

Research on agroforestry systems for Louisiana is expanding. In March 2009, a new study was established near the LSU AgCenter Macon Ridge Research Station in Winnsboro, La., to explore growing switchgrass in alleys between eastern cottonwood trees. The purpose of this study is to develop an agroforest system for producing switchgrass and cottonwood as biofuel feedstocks on a soil characteristic of the marginal-quality soils found within the lower Mississippi River alluvial valley. While the region has abundant soils well-suited to agricultural production, some soils require too much irrigation and fertilization to produce conventional crops profitably. Switchgrass and eastern cottonwood, however, can thrive on such soils with relatively little fertilization and no irrigation. Cottonwood can grow as much as 8 feet in height per year on such soils and can yield as much as 700 gallons of ethanol per acre. Cottonwood and switchgrass were successfully established, and energy yields, water quality and soil properties associated with this agroforestry system will be monitored in coming years. ■

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