NEWBio Energy Crop Profile: Switchgrass

Note: "NEWBio" is the Northeast Woody/Warm Season Bioenergy Consortium, a USDA-AFRI funded regional project promoting next generation bioenergy production in the Northeast US.

Switchgrass, *Panicum virgatum*, is a warm season bunch grass native to the tall grass prairie region. It is found across much of the eastern and southern U.S. Commonly grown as a conservation crop or for forage and wildlife benefits, in recent years it has gained importance as an energy crop because of its high yields, adaptability to marginal lands, and relatively low establishment and management costs.

Switchgrass harvest using hay mowing equipment

It is a hardy deep rooted perennial grass that grows to as high as 2 meters in a year (6 feet) and can produce an annual crop for up to 20 years. Switchgrass does well on a wide variety of soil types, including wet, shallow or rocky soils and is drought-tolerant. Its deep roots can break through tough soil layers improving long term soil structure. It is also excellent for wildlife habitat, providing seeds, browse, and shelter for a variety of species.

There are many varieties of switchgrass that are distinguished either as upland or lowland species based on the location from which they originate. Upland species can grow on drier landscapes and are naturally more cold tolerant and found in northern parts of the country in areas not subject to flooding. Lowland types come from the warmer floodplain regions in the south and are known to have better yields. Both types grow well in our region and the key is finding a cultivar that matches specific site conditions. Currently average yields are in the 10-15 metric tons per hectare (4-6 dry tons /acre) per year range, but there is substantial work on selecting and breeding improved cultivars. Common varieties in the Northeast include "Timber", "Cave in Rock", and "Kanlow".

Planting

Switchgrass is grown from seed and can be broadcast planted or drilled. Typically the seed is planted in late spring, after the soil has warmed, at a rate of 8 and 12 kg/ha (8 and 12 lbs/acre) when drilled and broadcast, respectively. Switchgrass seedlings are not aggressive. Therefore, weed control prior to planting is important.

Establishing the Crop

Switchgrass is slow to establish, taking 3 years to develop into a harvestable stand in most locations. In the first year, seedlings focus on root development, which means that above ground competition between it and weeds can be an issue. Switchgrass is a warm season grass, and it does not begin to grow until later in the spring. Weed control and/or mowing are important initially, and fertilization is not recommended since it benefits weed growth. Thereafter, it is generally maintenance free, except for occasional applications of nitrogen as needed. Switchgrass tolerates low fertility conditions but responds well to nitrogen applications after establishment.

Harvest

Conventional hay mowing and baling equipment is used for harvesting switchgrass. If the biomass is being used for bioenergy, harvesting is typically done in the winter after first frost or in the early spring before growth is initiated. Spring harvesting can reduce biomass yield significantly but stand vigor and yield consistency is better in subsequent years due to nutrients being returned to roots during the dormant season.

Uses of the Crop

Switchgrass biomass can be condensed into fuel pellets for combustion, or it can be used as a feedstock for cellulosic biofuel production. Bioenergy markets for switchgrass are emerging. Non-energy possibilities for switchgrass include use as a low grade feed, and for animal bedding.

Switchgrass pellets can be used as a fuel for heat, power, or liquid fuel production

Economics

Total costs for planting, annual maintenance and harvesting switchgrass average about $1,000 per acre over the first 5 years. Depending on the yield, breakeven prices can vary from $60 to $80 per ton at the farm gate. The largest expenses include one-time establishment costs and annual harvesting.

NEWBio Project Work

Switchgrass trials and breeding for the NEWBio project are now being carried out in the Northeast. Ernst Biomass, a NEWBio project partner, harvests and pelletizes over 1,000 hectares (2,500 acres) of switchgrass in Northwest PA.

Summary

Currently, switchgrass is the most commonly grown perennial grass energy crop in the U.S. It is adaptable to a wide range of conditions, and there are numerous cultivars to select from. Switchgrass requires little maintenance, no annual planting and only one harvest per year. Established from seed, it is less costly to plant than Miscanthus or willow, but once established provides attractive rates of return if a market is available for the harvested crop.

Prepared by Michael Jacobson, Penn State Department of Ecosystem Science and Management

References:

Switchgrass (Panicum virgatum) for Biofuel Production: http://www.extension.org/pages/26635/switchgrass-panicum-virgatum-for-biofuel-production

NRCS Technical Note # 3, Planting and Managing Switchgrass as a Biomass Energy Crop: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1042293.pdf

Consortium partner Ernst seed has an excellent guide to switchgrass production: http://www.ernstseed.com/files/general_images/biomass/nativewarm1.1.16.10.pdf

For more information on the NEWBio project, visit http://www.newbio.psu.edu

Visit the Penn State Extension renewable energy programs website: http://energy.extension.psu.edu