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SP701-A-Growing and Harvesting Switchgrass for Ethanol Production in Tennessee

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UTBiofuelsInitiative

Growing and Harvesting Switchgrass for Ethanol Production in Tennessee

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Switchgrass is a warm-season perennial grass native to North America. The plant can reach heights up to 10 feet with an extensive root system. Once established, switchgrass well-managed for biomass should have a productive life of 10-20 years. Within the stand, switchgrass is an extremely strong competitor. However, it is not considered an invasive plant. Switchgrass adapts well to a variety of soil and climatic conditions. It is most productive on moderately well to well-drained soils of medium fertility and a soil pH at 5.0 or above. The high cellulosic content of switchgrass makes it a favorable feedstock for ethanol production. It is anticipated that switchgrass can yield sufficient biomass to produce approximately 500 gallons of ethanol per acre. While the Tennessee Biofuels Initiative includes a demonstration plant to make ethanol from switchgrass, the market for switchgrass as an energy crop remains limited. Producers will likely need to be located within 30 to 50 miles of a cellulosic ethanol plant. Producing switchgrass for energy generally occurs under some form of contractual arrangement with the end-user. To reap potential benefits from using switchgrass for cellulosic ethanol production, the system of production must be profitable for farmers and energy producers, as well as cost effective for consumers.

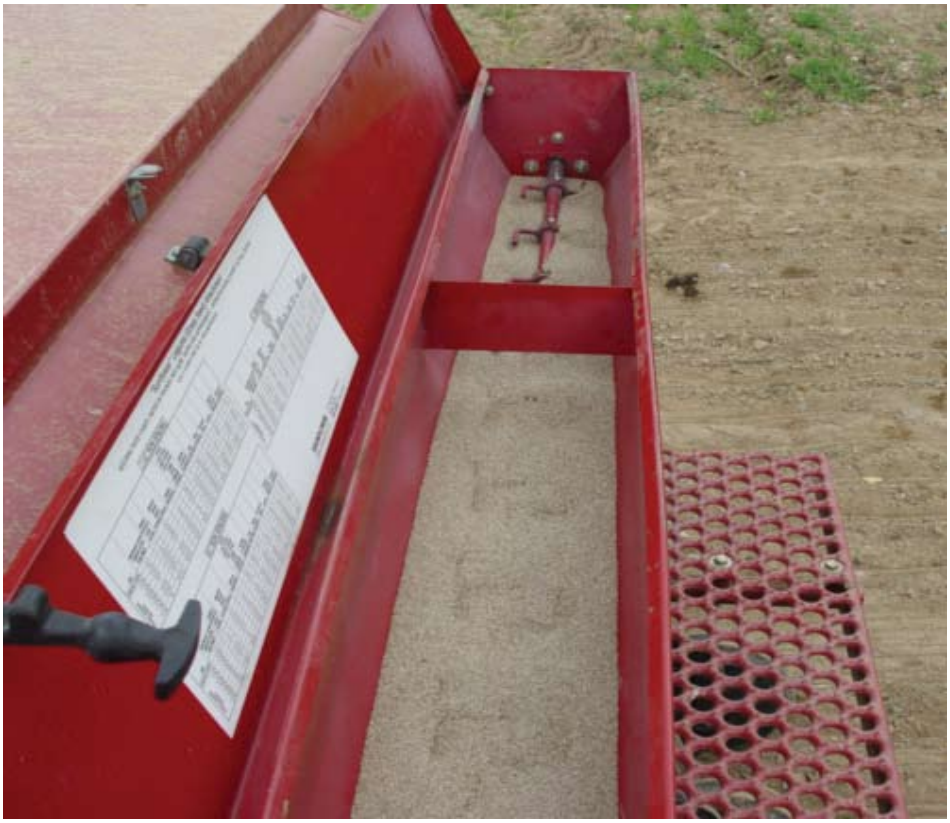
Henry County Extension Director, Ken Goddard (at left), discusses switchgrass production with farmers.

Recommended Varieties

There are two main types of switchgrass. The upland varieties usually grow 5 to 6 feet tall and are adapted to the Midwest. Lowland varieties are most adapted for the South and grow from 7 to 10 feet tall. The most common lowland varieties adapted to Tennessee are Alamo and Kanlow and both are currently recommended by UT. Alamo has been used in the majority of recent research conducted by the University of Tennessee on switchgrass for biomass.

Recommended Seeding Rate

Switchgrass seed is very small and much of it will not germinate right after it is harvested. However, aging, treating with water and chilling temperatures (stratification) or storing it in warm conditions will break dormancy. When establishing switchgrass, buying quality seed is an important consideration. Switchgrass seed are normally sold on the basis of pure live seed (PLS). The germination rate will vary. Therefore, it is critical to plant according to the PLS. In calibrating seeding equipment, take into account the percentage of pure seed and the germination rate. UT recommends 6 pounds of PLS per acre.



Alamo Switchgrass seeds are quite small with more than 400,000 seeds per pound.

Fertilizer and pH Recommendations

Although switchgrass is adapted to nutrient-deficient soils, soil fertility is important and soil testing is recommended to determine pH and nutrient availability. If soil test values are medium or high in phosphorous (P) and potassium (K), no additional P205 or K20 is recommended. If the soil test is low in P, an annual application of 40 pounds of P205 per acre is recommended. If the soil is low in K, an annual application of 80 pounds of K20 should be applied per acre. If the soil pH is 5.0 or above, no lime is recommended. These recommendations are for long-term reasonable yields of switchgrass for biomass, with switchgrass harvested after a killing frost over a period of 10 years. Being a perennial, switchgrass is thought to translocate much of the aboveground nutrients back into the crown root system, resulting in very low input needs after establishment.

Nitrogen should not be applied until the stand is established and weeds controlled. In the first year, **do not** apply nitrogen. It increases competition from annual grasses and broadleaf weeds. Beginning in the spring of the second year, 60 pounds of nitrogen per acre are recommended (Table 1).

Table 1.
Soil Test Recommendations for Establishment and Maintenance of Switchgrass for Biomass

	Nitrogen	Phosphate (P_2O_5)			Potash (K_20)		
	Soil Test Levels*						
Practice	(NT)	L	M	H	L	M	H
1. Establishment Year	0	40	0	0	80	0	0
2. Maintenance Year	60	40	0	0	80	0	0

*NT = Not Tested L = Low M = Medium H = High

Planting Date

Planting dates can range from late April to mid June. Switchgrass is a warm-season grass and establishes and grows best under warm conditions.

Planting Methods

Switchgrass can be planted into a tilled seedbed or no-tilled. It appears no-till planting with a no-till drill in fields not bedded from past row crops is the ideal way to plant. Switchgrass should be planted when sufficient soil moisture is available for emergence of the seeds. A planting depth of ¼ to no deeper than ½ inch is critical with good seed coverage at that

depth. This is usually easier to achieve in no-tilled soil conditions. The drill should have small seed boxes suitable for accurately metering switchgrass.

Weed Control

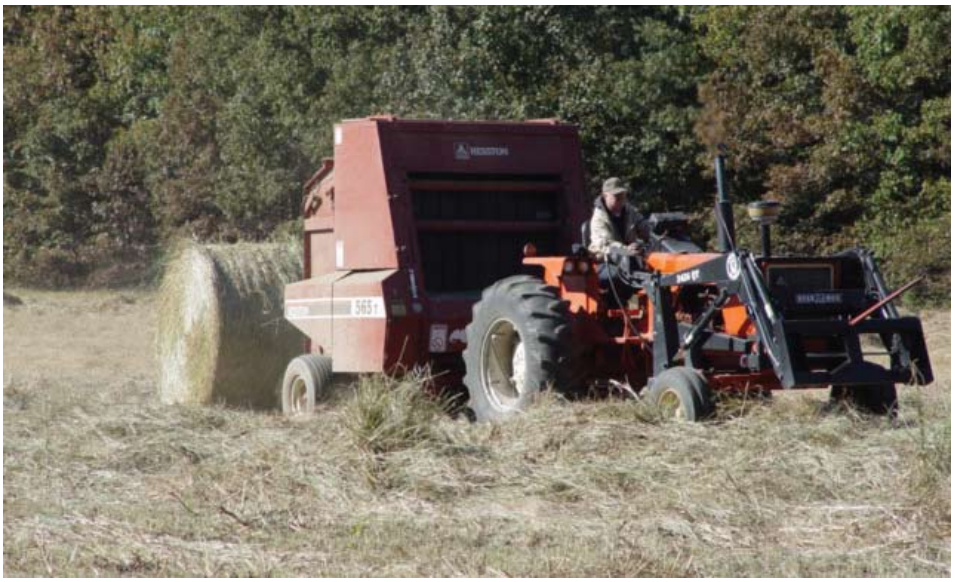
In the establishment year, switchgrass does not compete well with grasses such as fescue, crabgrass, johnsongrass, etc. and broadleaf weeds. Appropriate weed control measures vary greatly according to previous cropping history and specific weed varieties. Carefully evaluate fields before and after planting and check with an Extension agent for control options.

Few herbicides are labeled for weed control in switchgrass on non-Conservation Reserve Program (CRP) land in Tennessee. Therefore, it is critical to control weeds prior to planting. Most often, a glyphosate herbicide (e.g., Roundup®, Gly-4 Plus®) is used to kill existing cover. The guideline switchgrass budgets include two burndowns with a glyphosate herbicide. The preferred method to establish switchgrass in a pasture or hay field is to spray in the fall prior to planting with a glyphosate herbicide. Before the sod is sprayed, the field should be grazed, mowed or hayed and regrowth allowed to reach 6 to 10 inches. This ensures the herbicide comes into contact with an actively growing plant.

Cimarron®, formerly named Ally® from Dupont™, is labeled for post-emergence application on switchgrass for control of broadleaf weeds. Efforts are currently being made to gain regulatory approval for the use of an additional herbicide for grass suppression in Tennessee.

Observations in Tennessee on weed control in switchgrass indicate grass competition is much more severe than broadleaf competition. Once switchgrass is well-established and properly managed, it is very competitive against weeds.

Month-old switchgrass in East Tennessee.



Conventional equipment can be used to harvest switchgrass. Large rectangular bales are easier to handle, store and transport.

Reseeding Switchgrass

Switchgrass establishment will not always be successful in the first year. Weed pressure, seed quality, incorrect planting procedures, level of soil moisture within the first four to five weeks of planting and other factors can contribute to not achieving an acceptable stand of switchgrass. The expected probability of needing to reseed is assumed to be 20 percent. Guideline expenses for establishment include the reseeding costs.

Harvesting

Switchgrass can be harvested as a one- or two-cut system. When cut twice, the first cutting would occur when switchgrass is in late boot to very early seedhead emergence, which is usually in late June or early July. The second cutting would be at the end of the season and can occur when the plant goes into dormancy (usually after the first killing frost).

In the one-cut system, the switchgrass is harvested once after

November 1 or the first killing frost, whichever comes first. Total biomass yield for the year is similar in the one- and two-cut system. The choice should be influenced by management timing, costs and needs of the buyer relative to cutting time. Single harvest of switchgrass after the aboveground growth is killed by frost will reduce nutrient removal and fertility needs.

Switchgrass should be cut at least 6 inches high. The taller stubble will help reduce punctured tires by allowing equipment tires to push over the stubble. Furthermore, switchgrass stand survival, vigor and yield consistency in later years is greatly impacted by the cutting time and height. Switchgrass can be harvested with conventional hay equipment. Many farmers have large round balers and prefer to use their existing equipment. Round bales are acceptable. However, large rectangular bales (3 x 4 x 8 feet and 4 x 4 x 8 feet) are easier to handle, store and transport.

Yields

In test plots, switchgrass has frequently produced more than 10 tons of dry matter per acre/per year. However, on a commercial scale, it is more reasonable to expect 6 to 8 tons per acre. In the first year of production, yields are estimated to run 30 percent (2 tons) of the full yield potential. Second year yield is normally 70 percent (5 tons) of full production. In the third year, yields should be at the 100 percent yield level of 7 tons. Over the first 5 years of an anticipated contract period, yields are estimated to average 5.5 tons per year. Obviously, land quality, weather conditions, stand vigor, weeds and overall management will impact yield levels for a given switchgrass field.

Pest and Disease Management

Switchgrass has resistance to a wide variety of insects and diseases. Researchers and farmers have not experienced significant insect and disease problems in switchgrass trials conducted in Tennessee. As switchgrass acreage expands, it is not unreasonable to expect problems to develop over time.

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Factsheet adapted from publications developed by the University of Tennessee, Iowa State and Auburn University.

Developed by Biofuels Farmer Education Team: Gary E. Bates, Christopher D. Clark, Deloras A. Dalton, Delton C. Gerloff, John J. Goddard, Ken J. Goddard, Laura Howard, Patrick D. Keyser, Melvin A. Newman, David R. Perrin, Lawrence E. Steckel, Finis Stribling, Donald D. Tyler, Michael D. Wilcox and James B. Wills, Jr.

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