Switchgrass Stand Establishment: Key Factors for Success

Successful establishment is critical to the long-term economic viability of a switchgrass (Panicum virgatum L.) stand. But switchgrass establishment is not difficult if precipitation is timely and four key management practices are followed. First, purchase certified seed with excellent seed lot quality. Second, develop a good firm seedbed. Third, plant the seed at the proper time, depth, and rate. Finally, control weeds during the planting year.

While money spent on good-quality seed and weed control will likely result in a higher per acre cost for establishment, the reward is rapid establishment of a productive stand with lower costs per ton of biomass over the life of the stand.

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**Why Establishment is Important**
Switchgrass is not difficult to establish given good management practices and favorable precipitation. Successful stand establishment is critical to the economic viability over the 10-year+ life of the switchgrass stand. Growers in regions with good soils and favorable precipitation should be able to harvest switchgrass after frost in the planting year.

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**CenUSA bioenergy, a USDA-funded research initiative, is investigating the creation of a sustainable Midwestern biofuels system.**

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While money spent on good-quality seed and weed control will likely result in a higher per acre cost for establishment, the reward is a more productive stand and lower costs per ton of biomass throughout the life of the stand.

Is Switchgrass Feasible for the Area?
First, determine if it is feasible to grow switchgrass in your area (Figure 1). A good rule of thumb is that switchgrass will be productive in areas where dryland corn production is suitable. Switchgrass is a warm-season grass native to most of the contiguous 48 states except Washington, Oregon, and California (Figure 1).

Next, determine which cultivars are best adapted to your area. Switchgrass is broadly adapted, and regionally specific cultivars are available for most of the United States. Lowland cultivars, such as Alamo and Kanlow, are best adapted to the southern and mid-latitude regions of the United States, while upland cultivars, such as Shawnee and Sunburst, grow best in the mid- and northern latitudes. Liberty is a high-yielding lowland bioenergy cultivar for the Central Great Plains and Midwest that produces 25 to 40 percent more biomass than forage-type cultivars. Check with your local Extension office to determine which cultivars work best in your area.

With good management, switchgrass can be grown on land that is marginally productive for most crops, but avoid poorly drained soils in the northern United States, where frost heaving can be a problem. West of the 100th meridian, irrigation generally is needed to grow high-yielding switchgrass.

Soil Conditions and Planting Dates for Switchgrass
Switchgrass establishes and grows best in warm conditions, requiring a soil temperature of 60 degrees or warmer for germination. Optimal dates for planting vary across the United States and depend on the region, soil temperature, and moisture. A general guideline is to plant switchgrass two to three weeks before or after the optimum corn planting date for your location, ranging from late March in the Southeast to late June in the northern Great Plains. Planting should be conducted with a grassland drill to place a specific amount of seed at ¼" to ½" below the soil surface to promote rapid and low-cost establishment and reduce risks of seeding failure.

Take a soil test in the fall before planting to determine fertility needs. Do not apply nitrogen (N) fertilizer or manure to switchgrass in the seeding year. Excessive N will encourage weeds that compete with the new seedlings, and increase the cost of establishment. A soil test will indicate whether to apply phosphorus and potassium before seeding for better root growth. Switchgrass can tolerate moderately acidic soils, but optimum seed germination occurs when soil pH is between 6 and 8.

Use a High-Quality Certified Seed
Switchgrass seeds are small and often have 250,000 to 400,000 seeds per pound. Choose high-quality, certified switchgrass seed from an adapted cultivar. Base your seeding rate on the number of Pure Live Seeds (PLS, or the percent germination of the seed lot multiplied by the percent purity of the seed lot) per pound, not pounds of seed per acre. A seeding rate of 30 PLS per square foot is best for most bioenergy seedlings.
Seed can have high levels of dormancy, so select seed lots that have high germination, high purity, and low dormancy, which results in seed lots with a high percentage of PLS. Switchgrass seed lots can vary widely in germination rates, number of seeds per pound and percentage of dormant seeds per pound. Remember to avoid seed lots with high dormancy.

To determine the pounds of seed required per acre, you need to know the seeding rate, the PLS of the seed lot, and the number of seeds per pound in the seed lot. An effective seeding rate is 30 PLS per square foot or 1,306,800 seeds per acre. A seed lot with 99.5% purity and 91% germination has a PLS of 90.5% or 0.905. The number of seeds per pound is not on the seed tag so it must be counted or estimated. As indicated earlier, switchgrass seed lots typically have between 250,000 and 400,000 seeds per pound. A common estimate is 389,000 seeds per pound, but is too high for cultivars like Liberty. A seed lot with a PLS of 0.905 and 250,000 seeds per pound will require 5.8 PLS pounds of seed per acre (1,306,800 / [250,000 x 0.905]).

Develop a Good Seedbed
The first requirement for establishment is to develop a seedbed that promotes good seed-to-soil contact, especially important because switchgrass seeds are small. When planting switchgrass after a crop that leaves a heavy residue, such as corn or sorghum, reduce residue by grazing, shredding, or baling and removing. If the soil is clean-tilled, pack firmly with a culti-packer to leave only a faint footprint when walked on. A seedbed as prepared for alfalfa is an excellent seedbed for switchgrass.

Planting Methods
Using a properly calibrated grassland drill, plant at a seeding rate of 30 PLS per square foot. Grassland drills with depth bands will place seeds at a consistent depth of 1/4” to 1/2”. Switchgrass seeds planted deeper will have trouble emerging. No-till seeding may be the most successful method, if the weeds and crop residue are managed before planting. Plant into stubble with a no-till drill with small seed boxes, followed by press wheels (Figure 2). Row spacing should be 6” to 10”.

Manage Weeds ASAP!
The main reason that switchgrass stands fail is because of competition from weeds; therefore weed control is essential. Don’t delay. Apply pre-emergent herbicides immediately after planting.

Determining a Successful Stand
Check the stand six to 10 weeks after planting, using a frequency grid. A stand is considered successfully established if seedling frequency of occurrence is greater than 40 percent, or three to six plants per square foot.

A stand that can be harvested in the planting year is essential to an economically viable switchgrass stand. Recent research in Nebraska determined that the total costs of growing switchgrass were nearly $30 per ton higher during a five-year period, if a switchgrass stand failed to be harvestable in the year it was seeded.
Harvest
Be sure to harvest only after a killing frost in the establishment year so the stand is not damaged, and leave a 4-inch stubble (Figure 3). A crop equal to about half of the stand’s potential production can be harvested after frost at the end of the planting year if there is proper weed control and favorable precipitation. Then, the first year after planting, expect 75 to 100 percent of full production.

For Additional Information
Switchgrass Establishment, Weed Control, Herbicides, Seed Quality, Rob Mitchell, Research Agronomist, USDA ARS

Farm-scale Production Cost of Switchgrass for Biomass, Richard Perrin, Kenneth Vogel, Marty Schmer and Rob Mitchell, 2008


Management Guide for the Production of Switchgrass for Biomass Fuel in Southern Iowa, Iowa State University.

YouTube: Switchgrass Cost of Production, Marty Schmer
Vimeo, No-till Drill Calibration Training Video, Rob Mitchell

Switchgrass Establishment, Weed Control, and Seed Quality

How to Measure Stand Establishment Using a Grid

Harvesting a Native Grass for Biofuel Production

CenUSA Project Resources - Information on the opportunities and challenges in developing a sustainable system for the thermochemical production of biofuels from perennial grasses grown on land marginal for row crop production. This Fact Sheet is part of the CenUSA Module on Feedstock Production.

Figure 3. Switchgrass can be harvested after frost and baled in large round bales for transport and storage. Photo: Rob Mitchell.