Switchgrass Establishment

by James Rogers and Bryan Nichols

Switchgrass Establishment

Introduction
Switchgrass (*Panicum virgatum* L.), is a native, warm-season (C₄) perennial grass that can be found growing over the eastern two-thirds of the United States, Central America and southern Canada (Fig. 1). Interest in switchgrass propagation has increased over the past few years due to its potential as a bioenergy feedstock, high yields and ability to provide early season high quality forage to grazing animals (NF-AS-12-03).

Switchgrass can be divided into two major ecotypes: “upland” and “lowland.” Lowlands are taller, higher yielding, possess coarser leaves and tend to be more rust resistant than upland types (Fig. 2). Lowland types can have a very strong bunch-type growth habit if left unharvested and tend to be very rapidly growing. Lowland switchgrass is often found on floodplains and similar areas with high moisture availability. Upland types are shorter and tend not to be as rapidly growing as lowlands, but are more cold tolerant and are often found as a component of the native grass prairies in more northern latitudes (Rogers et al., 2012). In general, lowland types are adapted from the northern edge of the transition zone and south, while upland types are adapted from the southern edge of the transition zone and north (Fig. 3). In Oklahoma, lowland types are best suited from I-40 south and I-35 east, while the northwest portion of the state is best suited for the upland types. Maximum production will occur in regions receiving annual precipitation in excess of 35 inches. Switchgrass can grow on a wide range of soil types.

**Fig. 1.** Switchgrass adaptation areas in North America. (McLaughlin and Walsh, 1998)

**Fig. 2.** Lowland switchgrass on the left and upland switchgrass on the right. Photo from Michael D. Casler, USDA.

The Samuel Roberts Noble Foundation
from sands to clay loams, but is best suited to well drained, finer textured soils with a pH range of 5 to 8.

**Considerations Prior to Establishment**

In ideal planting conditions, switchgrass can emerge in as little as three to seven days. In less than ideal conditions, switchgrass can be a slow and difficult crop to establish due to several factors. Weed competition is the factor under producer control that most commonly causes stand failures. Switchgrass is a weak seedling and is not very tolerant of weed competition, especially grassy weeds. Planting switchgrass in a field that is known to have high levels of crabgrass or johnsongrass can cause establishment failures unless these are controlled. Planting depth is another consideration. Planting at depths greater than ¾ inch can result in delayed or failed emergence due to small seed size (Fig. 4) and low seedling vigor. Switchgrass can also have a high percentage of naturally dormant seed. In general, seed that is two to three years old will have lower levels of seed dormancy than new seed. Approaches to manage seed with high dormancy include storing the seed for at least a year, wet-cold stratification prior to planting, dormant season planting or using a planting rate based on percent germinable seed. Germination tests must be performed in order to determine the proper course of action. Because of seed dormancy issues, producers need to be patient with a developing stand. What may look like a poor stand in year one can develop into a vigorous stand by year three. Switchgrass stands are typically fully developed by year two or three.

**Site Preparation**

Research at the Noble Foundation has shown that stand establishment...
is much higher when a seedbed is prepared with tillage versus using no-till methods. A two-year study was conducted where switchgrass was planted into a site that had previously been bermudagrass. Switchgrass planted into a tilled, prepared seedbed resulted in a 62 percent first-year stand compared to a 14 percent first-year stand no-tilled into terminated bermudagrass residues.

The amount of time required for preparation depends on the current state of the intended site. Preparing a retired crop field that has been left fallow over winter is fairly simple. Begin site preparation at least six months in advance with a soil test and initial tillage. Avoid planting into areas that have a high weed seedbank. Switchgrass was chosen as a potential biofuel due to its ability to grow in marginal soils. It can withstand slightly acidic soils with a pH of 5.5, but an optimal pH range is 6.0 to 7.0. Soil fertility requirements for switchgrass establishment are low compared to many other crops. A Mehlich III soil phosphorus (P) index of 20 and potassium (K) index of 125 should be sufficient for switchgrass establishment. If P and K are needed, apply prior to seeding and incorporate with tillage. Avoid nitrogen application at establishment as this tends to increase weed competition. If using conventional tillage, begin initial tillage in the late fall. In the spring, tillage can again be used to eliminate weeds and create a firm seedbed. Another option if additional spring tillage is not required is to apply a burn-down herbicide to eliminate existing weeds, then plant. If switchgrass is being established into warm-season perennial pastures such as bermudagrass, multiple years may be required to eradicate the existing vegetation.

Planting
Switchgrass seed is small (280,000 seeds/pound), slick and tends to flow through planting equipment very well (Fig. 4). Seeding rate is 5 to 6 pounds pure live seed (PLS)/acre in high rainfall areas and 5 to 10 pound PLS/acre in low rainfall areas. Because switchgrass seed flows very well, it can be planted using conventional seeding equipment such as conventional grain drills, Brillion seeders or no-till drills, or by broadcasting. Prior to planting, make sure that the equipment you are using is in good working order, drop tubes are free of obstructions and the planter is calibrated for the target seeding rate. Successful stands have resulted from planting dates from December to May. Dormant season plantings should be done from December through February. Spring plantings should occur from April 1 through May 1 or when the average soil temperature reaches 58° F to 60° F at 2 inches. Switchgrass seed germination occurs at 60° F and higher. Planting later than early May does not allow time for adequate root system establishment before the hot and dry periods of summer. Seed should be planted ¼ inch to ½ inch deep, into a firm seedbed and with good seed-to-soil contact. Planting equipment should be checked regularly to ensure that it is functioning correctly and that the correct seeding depth and soil coverage is being achieved.

Stand Evaluation
Switchgrass stands can be evaluated two to three weeks post-planting. It is important that switchgrass seedlings are identified correctly when evaluating the stand (Fig. 5). The easiest way to identify switchgrass seedlings is to pull the plant while leaving the root structure intact. The seed coat should still be attached to the primary root in young seedlings. Seedlings will also
be smooth in appearance and have a lower stem that is purplish in color.

One easy way to evaluate the stand is by using a 5-foot by 5-foot cattle panel with 1-foot squares. Place the panel on the ground in a random location and count the number of squares where switchgrass seedlings are present. Repeat this process four times. The sum of the number of squares with switchgrass seedlings present is equal to the stand percent-age. Percent stand will change over time. Stands with an initially high stand may thin over time while a thin initial stand may thicken over time until stand equilibrium is reached. An initial stand count of 50 percent or higher is considered successful.

Weed Control
Switchgrass stands in the establishment year may have high weed competition. These weeds may be managed by either mowing or applying herbicides labeled for use in switchgrass. If mowing to reduce weed cover, do not mow into the tops of the switchgrass. Avoid mowing once switchgrass stems begin to elongate. There are few labeled herbicides for use in switchgrass. Glyphosate or paraquat may be used for preemergence burn-down applications, but care must be taken to make sure that switchgrass has not begun to emerge at the time of application. In no-till plantings, glyphosate can be used within three days of planting to kill emerged weeds prior to the emergence of switchgrass. Several postemergence herbicides, such as 2,4-D, can be used on switchgrass, but should not be applied until three or four leaves are present or plants are 3 to 4 inches tall to avoid injury. Note that switchgrass is not necessarily tolerant of all herbicides labeled for use on native or range grasses. Be sure to consult the label or a local authority for switchgrass tolerance to a particular herbicide. For example, herbicides containing the active ingredient imazapic are labeled for weed control in range grasses, but are very hard on switchgrass. Follow all herbicide label directions.

Summary
Successful switchgrass establishment requires adequate preparation, time and patience. Good stands result when seedbeds are prepared well, good seed is planted at the correct seeding rate and depth, and, as always, weather conditions are favorable. Producers need to keep in mind that a successful stand may not result in one year; full stand development may not be reached until year three.

References

Acknowledgments
This research and publication was partially funded by a Conservation Innovation Grant from the Natural Resources Conservation Service.