IOWA STATE UNIVERSITY
Department of Agronomy
Crop, Soil, and Environmental Sciences

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Switchgrass

Switchgrass *(Panicum virgatum)*

Switchgrass is a perennial grass native to the tallgrass prairies once found across much of the U.S. including Iowa. Today it is grown mainly as a forage crop or as ground cover to control erosion. Switchgrass is grown and distributed throughout North America and is frequently used in the Conservation Reserve Program and wildlife habitat programs. Its rapid growth rate and winter hardiness make it an attractive biomass crop for biofuel production. The crop can be burned as an energy source for producing grain ethanol or fermented into biofuel.

Soil and Site Adaptation:

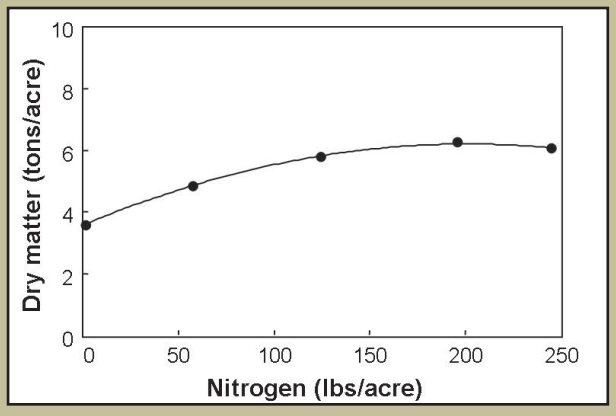
- Switchgrass is most productive on moderately-well to well drained soils of medium fertility and at a soil pH range of 5.5 to 7.0. It can tolerate wet sites and survive short-term flooding.
- Switchgrass is adapted for a wide range of soil conditions, but varieties originating from a particular latitude have greater productivity and survival when planted near that latitude.
- Southern, 'lowland' varieties have greater yield potential, but are more susceptible to cold injury in the Northern Plains and Northeast U.S.
- 'Cave-in-Rock' and 'Shawnee' are currently the highest yielding varieties in Iowa. Other commercially available and experimental varieties exist, but more research is needed to identify which are best for sustainable lignocellulosic fuel production in the state.

Establishment:

- Switchgrass is established from seed.
- Switchgrass is slow to establish, often requiring two to three growing seasons to become fully established as a dense and vigorous stand.
- Weed competition, seed dormancy, and poor seedling vigor are the most frequent limitations to rapid establishment.
- Because switchgrass seedlings place most roots near the soil surface, it is very vulnerable to dry soil conditions for several weeks after germinating.

Lifecycle and Growth Habit:

- Switchgrass is a perennial crop; it does not need to be reseeded each spring (as do corn and soybean).
- Switchgrass is a warm-season species that fixes carbon through photosynthesis (C4 photosynthetic pathway).
- Regrowth begins each spring in early May in Iowa, and its primary growth period follows through the warm months of June, July, and August. Frost in the autumn stops its annual growth.
- Switchgrass grows as a bunchgrass and will spread slowly with short rhizomes. Its erect stems grow to be two to five feet tall.
- Varieties adapted for the Northern U.S. are very winter-hardy once established.
- Biomass production increases throughout the early growth stages. Maximum biomass production occurs in late July and early August. Seeds mature in late summer.



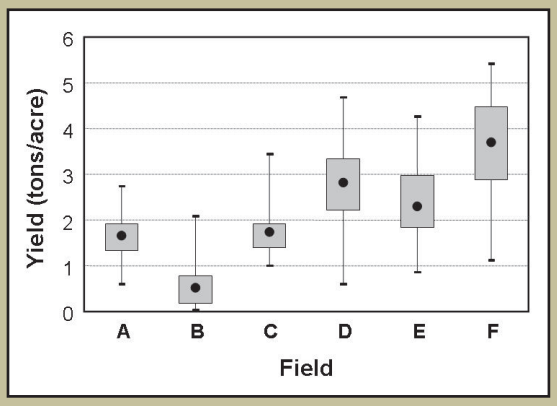
Yield response of switchgrass to nitrogen fertilizer near Ames, Iowa in 2006. (Source: A. Heggenstaller, unpublished)

Fertility Needs:

- Switchgrass does not fix nitrogen; it is not a legume.
- Fields in multi-year switchgrass biomass research studies often received maintenance applications of 77 to 150 lbs. of nitrogen per acre.
- Plant nitrogen and protein are highly desirable in switchgrass harvested for forage.
- Plant protein and nitrogen content is less desirable in switchgrass used for biomass.
- Switchgrass requires less phosphorus and potassium than corn.
- Fertilization needs for long-term, annual biomass removal have not yet been determined, but applications of phosphorus and potassium may become a maintenance practice.

Yield:

- Switchgrass production is limited during the first two to three years following seeding.
- Systems managed for fewer or later harvests using improved management or cultivar choices have seen higher, more sustained yields in recent years.
- Nationwide switchgrass yields have been highest in the southern and mid-latitude U.S. due to long growing seasons and use of high-yielding varieties.
- Switchgrass yields tend to decrease from the eastern to western U.S. due to more consistent and higher rainfall patterns in the East.
- Switchgrass yields harvested from production fields in southern Iowa averaged from 1 to 4 tons per acre in a one-cut system harvested after frost. Switchgrass yields harvested from research plots in central Iowa ranged from 2 to 6.4 tons.



Yields of 'Cave-in-Rock' switchgrass harvested from six production fields in the Chariton Valley Biomass Project in 2002 are shown in the above graph. The dots represent the average yield for the field, the enclosed box represents the range of the 50 percent of observed yields closest to the average, and the tails represent the total range. (Source: K. J. Moore unpublished)

Harvest Considerations:

- Several harvest strategies exist for switchgrass biomass ranging from one to multiple harvests.
- Total seasonal biomass yield is similar in one- and two-cut systems.
- Research for switchgrass biomass harvest focuses on a single harvest in November or later, rather than multiple harvests during the growing season as is done in switchgrass forage production.
- Single harvests of switchgrass taken four to six weeks or more after its above-ground growth is killed by frost removes less nutrients and reduces fertility needs.
- There may be a 10 to 20 percent decrease in biomass yield by delaying past peak late-summer biomass accumulation, but stand vigor and yield consistency in later years is better maintained.

Pest Management:

- Weed control is very important to rapid switchgrass establishment. Labeled herbicide choices are limited. For example, atrazine is not currently registered for use on switchgrass.
- Planting switchgrass with corn as a nurse crop has proven to control weeds effectively during establishment through the benefit of herbicide early in the season and late-season weed control provided by the corn canopy. Not all corn herbicide programs will be suitable.
- Controlled burning in the spring is a common way to control weeds in switchgrass grown for conservation.
- Insect damage has not been a great concern for Iowa switchgrass producers. However, switchgrass is susceptible to localized feeding by non-selective feeders such as grasshoppers and armyworms.

Disease Management:

- Leaf and stem fungal diseases are occasionally present on switchgrass in years with high humidity during the growing season.
- Yields of both switchgrass biomass and seeds in southern Iowa in the late 1990s declined due to smut caused by *Tilletia maclagani*. There is a close relationship between percent of stems infected with smut and overall yield reduction.

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