United States Department of Agriculture

Natural Resources Conservation Service — Plant Guide

SWITCHGRASS

Panicum virgatum L.

Plant Symbol = PAVI2

Figure 1. Switchgrass is an upright warm-season bunchgrass with large, open seed heads that can appear pink or light purple. Photo by GAPMC.

Alternative Names
Common Names: tall panic grass, tall prairie grass, wild redtop, thatchgrass

Description
General: Switchgrass is a warm-season perennial bunchgrass native to North America and parts of Central America. Switchgrass has fibrous roots that can grow more than 10 feet deep (Weaver, 1954). Plant height varies widely depending on the habitat but is generally 3–10 feet tall. Scaly rhizomes slowly extend from the main plant, anchoring it in place and expanding the plant crown (see Figure 2a). Leaves grow up to 30 inches long. They are erect and flat with a prominent midrib. The leaves are green to blue green. A few ornamental cultivars have red foliage or red tips. The leaves are glabrous (hairless) but have densely hairy ligules (see Figure 2b). Flower spikes are borne on stiff round stems or culms. The 8–16-inch-tall inflorescence is paniculate, pyramidal, and finely textured (Gleason & Cronquist, 1991). A small, brightly colored flower is found at the end of each 1/4-inch spikelet. Flowers are yellow, orange, red, or purple. These colors fade to a light brown when mature (Still, 1994). Early in the maturation process, seeds are pink or light purple. This gives the seed plumes an attractive creamy hue. Mature seeds are light tan to brown, shiny, narrowly ovate, and are very small—seldom exceeding 1/8-inch long and 1/16-inch wide (Deam, 1929).

Due in part its large natural range, two distinct forms exist—upland and lowland ecotypes (Porter, 1966). Lowland ecotypes are typically taller in height, found in wet soils, and are less cold-hardy. Upland ecotypes are generally shorter in height, found in drier soils, and are more cold-tolerant. Both ecotypes are reproductively compatible, and hybrids proliferate along environmental gradients (Lowry et al., 2014; Casler et al., 2015). An example of this is the newly identified coastal ecotype that has intermediate characteristics between lowland and upland ecotypes (Zhang et al, 2011; Childs et al., 2014; Lovell et al., 2021).

Figure 2. Switchgrass identifying characteristics include scaly rhizomes(a) and a ligule of silky hairs(b). Photo by MIPMC.

Distribution: Switchgrass is found throughout most of the United States, parts of Canada, and extends south through Mexico and into Central America (Hitchcock & Chase, 1951). It is found in all U.S. states except California, Oregon, and Washington. For current distribution, please consult the Plant Profile page for this species on the PLANTS Website (http://plants.usda.gov/).

Habitat: Switchgrass was a dominant species in tallgrass prairies and savannas of the Great Plains and eastern United States (Ghimire et al., 2011). Less than 1% of the native range remains (Rowe et al., 2013). Switchgrass is now most often used in its native range as feed, biofuel, and in soil conservation (Casler, 2012). Switchgrass is found on prairies, in open oak and pine woodlands, along shores, riverbanks, and high brackish marshes in maritime forests. It has an expansive native range and can be grown on marginal lands as well.

Adaptation

Switchgrass will tolerate partial shade but does best in full sun locations. It is adapted to a wide range of soil types and soil moisture conditions. Many switchgrass varieties exhibit moderate salt tolerance (Sun et al., 2018; Hu et al., 2015). Some selections, such as High Tide (NJ) germplasm, have been developed specifically for tidal shorelines and are more tolerant of salts (NRCS, 2014). The optimal soil pH for switchgrass ranges from 6–8 but it can perform well in soils outside of this range (Hanson & Johnson, 2005). Switchgrass is cold-hardy and grown throughout temperate regions worldwide. It thrives in USDA Plant Hardiness Zones 3–9.

Uses

Forage: Switchgrass is one of the earliest maturing warm-season grasses. Established stands can be grazed or hayed in late spring to early summer before seedhead emergence (at boot stage). Switchgrass forage at this stage provides 14–20% crude protein levels and yields up to 2 tons per acre (Bates et al., 2011). Harvesting later in the season can produce yields of 2–5 tons per acre but forage quality will be reduced as mature plants become stemmy and tough (Keyser et al., 2015). When actively grazing switchgrass stands, begin grazing when plants are 24 inches tall and remove animals when plants are grazed to 12 inches (Keyser et al., 2015). Regrowth typically takes about 4–6 weeks and stands can be grazed again if early enough in the season. Late-season grazing is discouraged as the plants need time to store carbohydrates for the winter. Leaving a residual stand of at least 8 inches, and preferably as high as 12 inches, will result in quicker regrowth in the spring (Vogel et al., 1985; Bates et al., 2011). While switchgrass can be used as a forage or bedding for cattle, it should not be used for small ruminants (sheep or goats) or horses (Bates et al., 2011; Lee et al., 2001; Stegelmeier et al., 2005). Saponins may be present in switchgrass and, if consumed, may be toxic to small ruminants and horses causing photosensitization and liver damage.

Wildlife: Switchgrass provides habitat for birds and small mammals such as meadowlarks, sedge wren, red winged blackbird, pheasants, quail, turkeys, doves, and rabbits, among others (Murray et al., 2003; Harper & Keyser, 2011). Deer and other ungulates will use switchgrass stands for cover and bedding. It is not a significant food source for deer. However, white-tail deer in the southeastern part of the U.S. have been observed scraping at and eating switchgrass rhizomes in later winter when other food resources are limited (Uchytil, 1993). Switchgrass is a host plant for the dotted skipper (*Hesperia attalus*), Leonard's skipper (*H. leonardus*), Hobomok skipper (*Lon hobomok*), Delaware skipper (*Anatrytone logan*), and northern broken-dash (*Wallengrenia egeremet*). Switchgrass provides habitat for ground nesting bees (Gardiner et al., 2010). In addition, switchgrass fields can harbor both beneficial and harmful arthropods including a diversity of spiders, ants, beetles, mites, flies, grasshoppers, crickets, thrips, stilt bugs, damsel bugs, and assassin bugs among others (Holguin et al. 2010).

Erosion Control: Switchgrass is used on slopes, gullies, and other critical areas to stabilize soil, reduce sheet and rill erosion, manage water flow, and trap sediment (NRCS, 2021). Its deep fibrous roots hold the soil in place, reducing wind and water erosion. The large, flat leaf blades intercept rain, sleet, and hail, preventing surface runoff. The dense nature of the switchgrass crown effectively traps sediment.

Figure 3. Stiff-stemmed 'Kanlow' *switchgrass used by poultry farms on Maryland's Eastern shore. The switchgrass buffers ventilation fan emissions such as ammonia, dust, and odors.*

Buffer/Barrier: Switchgrass is used in riparian buffers. The expansive root systems, stiff stems, dense clumping habit, and broad adaptability make it useful for trapping sediment, absorbing excess nutrients, slowing runoff, and allowing water to infiltrate the soil (Lee et al., 2003). Switchgrass is an effective living snow barrier (Sanderson et al., 2004). It is also suitable for low windbreak plantings in crop fields (Wright & Townsend, 1995). Switchgrass can be used in combination with other salt tolerant plants to reduce the effects of saltwater intrusion in coastal areas (de Barros et al., 2025).

Air Quality: Switchgrass effectively buffers filter emissions (dust, odors, and ammonia) from poultry and swine farm ventilation fans, improving air quality for workers and neighbors (see Figure 3) (Belt, 2015; Ajami et al., 2019). Switchgrass improves air quality by capturing and storing atmospheric carbon deep in the soil. Its expansive root system moves carbon below the plow line, where the soil acts as a repository for the carbon and reduces mineralization (Liebig et al., 2008).

Biofuel Source: Various characteristics make switchgrass a useful renewable energy crop. It is relatively easy to seed, establish, manage, and harvest with conventional farming equipment. In addition, commercial seed is available for high yielding cultivars adapted to different geographical regions (Douglas et al., 2009). Switchgrass has a large native range, is adaptable to a variety of soil conditions, and can produce moderate to high biomass yields on marginal lands (Fike et al., 2006). It can be used in various bioenergy conversion processes including cellulosic ethanol production, biogas, and direct combustion for thermal energy applications.

Phytoremediation and Phytoextraction: Switchgrass has been used for pollutant phytoremediation and phytoextraction due to its high biomass, extensive root system, and tolerance of xeric, low nutrient and contaminated soils (Hart et al, 2022; Shrestha et al., 2019).

Ethnobotany
The Caddo Indian tribe of Louisiana, Texas, Oklahoma, Arkansas, and Missouri used switchgrass to construct their houses and some ceremonial structures (see Figure 4). These buildings could last for 50 years or more (Allen et al., 2006).

Figure 4. Caddo Indians use switchgrass to build houses and ceremonial structures. Photo by ETPMC.

Status
Threatened or Endangered: Switchgrass is not listed as threatened or endangered (USFWS, 2017).

Wetland Indicator: According to the U.S. Army Corps of Engineers National Wetland Plant List (V3.1), switchgrass is listed as a facultative wetland plant (FACW) or a facultative plant (FAC) depending on the region it is located (USACE, 2020).

Weedy or Invasive: Switchgrass is not considered to be weedy or invasive. However, lowland switchgrass ecotypes can produce more biomass and seeds than local wild ecotypes. There is a greater risk of lowland ecotypes spreading due to their increased vigor (Palik, 2017). Please consult the PLANTS Website (http://plants.usda.gov/) and your state's Department of Natural Resources for this plant's status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Planting Guidelines
Switchgrass averages approximately 390,000 seeds per pound, but this can vary greatly depending on the cultivar, seed source, or growing conditions. Switchgrass seeding is most successful in the spring after soil temperatures are above 60°F. In northern states, it may be necessary to plant switchgrass seed before soils reach 60° F. This gives the seed adequate soil moisture, time for root development, and additional natural stratification for breaking dormancy. Seed can be planted with most seed drills or with a broadcast seeder. The seedbed should be firm and free of competing vegetation. Seed should be planted no deeper than ¼ – ½ inch.

Plantings have been successful in prepared and no-till seedbeds. In no-till seedbeds, manage residue to provide proper planting depth and seed-to-soil contact. Switchgrass seeding is best done by drilling 4–6 pounds per acre (lbs/ac) of pure live seed (PLS) into a well-prepared conventional seedbed or no-tilled into killed sod. If broadcasting, seed at 8–10 lbs/ac PLS, lightly rake, and cultipack to provide good seed-to-soil contact. The seeding rate for a mixed seeding with other warm-season grasses is 1–3 lbs/ac PLS.

Switchgrass is planted in solid stands or rows for seed production. To optimize seed production, plants should be drilled and maintained in 36–40 inches rows. Row spacing can be adjusted to meet operational needs. However, plants are prone to lodging when row spacing is less than 12 inches and yields are reduced when row spacing exceeds 45 inches. Mechanical weed management can be an effective management strategy in row-based systems. Cultivators should not disturb soil deeper than 1½ inches to reduce seed bank turnover.

If early cool-season weeds are a problem, suppress weed competition and plant toward the end of the seeding window (late spring to early summer). On sites where weeds are not a problem, spring seeding is best. When mowing weeds, timing should not interfere with ground-bird nesting season. In general, the application of nitrogen (N) fertilizer is not recommended during the first year because it encourages weed competition. Additional fertilizer needs should be determined by a soil test. During the second growing season, 30–50 lbs/ac of N can be applied when the plants begin actively growing.

Seeding rate and cultivar recommendations vary across regions of the United States. For example, the switchgrass cultivar 'Dacotah' (ND) was developed for the Northern Great Plains and has a seeding rate of 3½–4½ lbs/ac PLS. However, the cultivar 'Shelter' (NY), developed for use in the Northeast, is recommended at 8-10 lbs/ac PLS. Consult your local NRCS field office or Extension Service for specific seeding rates, planting dates, and cultivar recommendations.

Management

Establishment year: Weed control is vital for establishment because switchgrass can be slow to germinate and develop. Weeds can outcompete newly established switchgrass plantings for resources such as light and water. Chemical weed management can be highly effective when timed well. Consult with the Cooperative Extension Service in your state or area for herbicide recommendations.

Weeds can also be controlled by mowing. This can reduce weed canopy and prevent weeds from producing a seed crop. However, switchgrass should not be grazed or cut during the seeding year unless weed density is high or growth is exceptional. If mowing is needed, mow no lower than 6 inches to avoid removing all leaves or cutting below the growing point (Renz et al., 2009).

Grazing is not recommended during the first year as plants become established. A vigorous stand may tolerate being grazed for short periods of time late in the season, provided the stand is able to rest for at least 30 days between rotations. If harvesting biomass during the establishment year, harvest after the plants have reached maturity and at least 60 days before a killing frost. Alternatively, if conditions allow, biomass can be harvested after senescence and a killing frost.

Post Establishment: Fertilizer applications should be determined by a soil test. Rates will depend on yield goals and climatic conditions. Nitrogen fertilization may promote lodging and reduce stand density. Phosphorus and potassium levels should be monitored. If needed, top-dress in spring before regrowth.

Once a switchgrass stand reaches full maturity, weeds are generally not an issue. Prescribed burns conducted every 3-5 years will help to maintain plant vigor, manage weeds, and reduce plant residue (Uchytil, 1993). In switchgrass wildlife plots, management of residue through regular prescribed burns improves habitat quality and navigability by hatchlings and other wildlife (Van Dyke et al., 2005).

If herbicide is needed in an established stand, consult your local Cooperative Extension Service for recommendations.

Pests and Potential Problems

Switchgrass pests include aphids, leafhoppers, blister beetles, chinch bugs, grasshoppers, stem borers, wireworms, and gall midges (Hegge, 2012; Boe & Gagné, 2010). Beneficial insects include ants, rove beetles, ground beetles, parasitoid wasps, and spiders (Caddel et al, 2009).

Switchgrass can be affected by rusts, smuts, leaf spots, and crown and root rots (Gustafson et al., 2003; Gravert et al., 2000). Most of these diseases are not of economic importance (Caddel et al., 2009.). However, because of intensive cropping of switchgrass in biofuel production systems, disease pressure is increasing from such pathogens as *Claviceps clavispora* (ergot) and *Colletotrichum navitas* (anthracnose) (Rijal et al, 2024; Crouch et al., 2009). These diseases may result in significant yield losses if not managed.

Environmental Concerns

Switchgrass is considered a desirable plant, but more competitive lowland ecotypes may spread to adjacent areas (Palik, 2017). Lodging can occur with high winds, rain, and dense switchgrass stands.

Control

If switchgrass control is warranted, systemic herbicide applications should be made in late summer or fall. Plants are actively translocating carbohydrates to the roots for winter during this time and the herbicide will move with the carbohydrates to the roots. Attempts to control perennial grasses with herbicide applications in the spring are less successful (Brown et al., 2014). Please contact your local Cooperative Extension specialist or county weed specialist for herbicide recommendations and safety practices. Always read the label and safety instructions for each chemical control method. The label is the law.

Seeds and Plant Production

Propagation: Seed should be harvested in the hard dough stage either by hand, combine, or thresher to optimize germination and storage. Switchgrass seed ripens from the top of the seedhead, progressing downward. The seed is ready for harvest when the seed at the top of the seedhead begins to shatter. This indicates that the remaining seed is ready for harvest. Harvested seed should be air dried for 2–3 days or until it feels dry. It can be cleaned with a fanning mill or air-screen. Additional cleaning cycles may be needed to remove unwanted debris.

Seeds stored in a cool, dry place may remain viable for many years. Some research suggests that germination improves with time in cold storage (Row & Wynia, 2010). This may be due to the reduction of dormancy mechanisms over time (Grabowski et al., 2002). In uncontrolled storage environments, switchgrass seed germination rates begin to decline after 3–5 years (Row & Wynia, 2010).

Switchgrass seeds are highly viable but may exhibit physiological dormancy. A 14-day period of cold moist stratification at 33–42°F can be used to break dormancy and improve germination rates. Once dormancy is broken and soil temperature requirements are met, seeds have a high germination rate. Seeds can germinate at 60°F but germination is optimized when temperatures fluctuate between 60–85°F. This fluctuation mimics day/night cycles (Duclos et al., 2014). Despite good seed viability, germination rates are variable and depend on many factors including variety, seed size, temperature, and origin.

Tissue culture is increasingly being explored as a method for switchgrass propagation. This method is largely driven by the biofuel industry to overcome the variability in seed propagation methods (Sanderson et al., 1996). In addition, tissue culture allows for the development of transgenic lines that increase yields, improve drought tolerance, reduce time to maturity, and mitigate losses from disease or pests (Lin et al., 2017). Switchgrass tissue culture can produce approximately 500 plantlets from one node cutting (Alexandrova et al., 1996).

Cultivars, Improved, and Selected Materials (and area of origin)

There are many switchgrass varieties available from commercial sources. They are sold as seeds, plugs, and plants either for conservation or ornamental/landscape uses. Late summer or fall red ornamental varieties include ‘Shenandoah’, ‘Red Sunset’, and ‘Red Flame’. Switchgrass varieties like ‘Thundercloud’ and ‘Cloud Nine’ are 8 feet tall, have blue-tinted leaves, and an upright form. Smaller ornamental cultivars include ‘Heavy Metal’ (metallic blue foliage with pink-tinted blooms), ‘Northwind’ (showy golden fall color), and ‘Cape Breeze’ (salt tolerant, compact switchgrass).

Switchgrass has undergone extensive improvement for conservation purposes. The NRCS Plant Materials Program (PMP) has developed cultivars to meet specific conservation needs. Some examples include ‘Carthage’ (NJ), ‘Cave-in-Rock’ (MO), ‘Blackwell’ (KS), ‘Shelter’ (NY), and ‘Alamo’ (TX), among many others. These cultivars are used for a variety of conservation needs including forage and haying, habitat enhancement, and erosion control. In addition to cultivar releases, NRCS PMP has regional germplasm collections that are highly adapted to specific areas and are used for a myriad of conservation needs. Some of these germplasm collections include High Tide Germplasm switchgrass (NJ), Penn Center Germplasm switchgrass (GA), and Southlow Germplasm switchgrass (MI).

Switchgrass varieties should be selected based on the local climate, resistance to local pests, and intended use. Consult with your local land grant university, local extension, or local USDA-NRCS office for recommendations on adapted cultivars for use in your area**.**

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