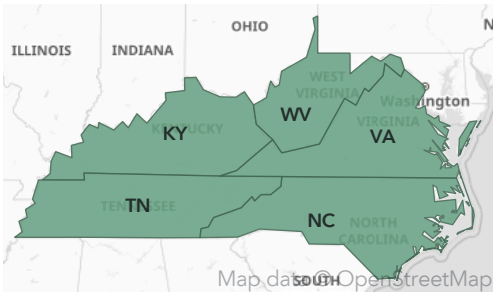
QUICK START GUIDE

Switchgrass in Appalachia

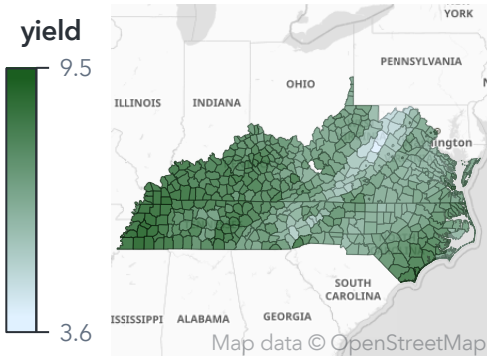
Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Appalachia



Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 4.9-12.2 tons/acre. Yields rise during establishment and stabilize around 6-8 tons/acre, with favorable sites reaching 12 tons/acre.

Equipment and Harvest

Standard hay equipment used throughout the region. One post-frost harvest per year is common. KY uses large square bales for transport efficiency; TN uses both round and square bales. Tarping or sheltered roof storage is important due to the humidity of the region to prevent dry matter loss and biomass quality degradation.

Fertilizer

Apply between 30-80 lb N/acre after establishment, with no nitrogen applied in the seeding year to limit weed competition. Split applications are sometimes recommended on well-drained soils, though response is limited on poorly drained sites. Soil testing should guide P, K, and lime application to correct deficiencies and maintain pH 5.5-6.5.

Pest and Weed Control

Weed pressure during establishment is a key challenge. Glyphosate and atrazine are commonly used. Smut, rust, and pigweed are mentioned in the literature but generally not yield-limiting. Insect pressure is minimal across the region.

Market Opportunities

Larger fuel markets favor higher-yielding VA and TN sites, while smaller-scale uses (i.e. co-firing, livestock bedding, erosion control, pellet blending, long-term heating) are more feasible in NC, KY, and WV. Mine land and marginal soils could be repurposed for biomass production, aligning economic and ecological goals.

Costs

Establishment costs of $154-453/acre, reseeding costs of $40-73/acre, production costs of $50-77/ton, and harvest costs of $72-109/ton, with site quality and logistics driving the largest cost differences.

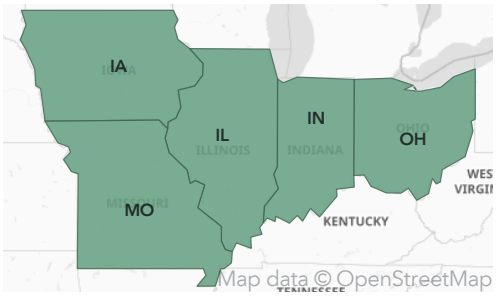
Authors: Daniela Jones, North Carolina State University; Tasmin Hossain, Idaho National Laboratory; Haley Casper, North Carolina State University. **Acknowledgement**: Supported by the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Bioenergy Technologies Office (BETO), the Feedstock-Conversion Interface Consortium (FCIC), under DOE Idaho Operations Office with Contract No. DE-AC07-05ID14517.

QUICK START GUIDE

Switchgrass in Corn Belt

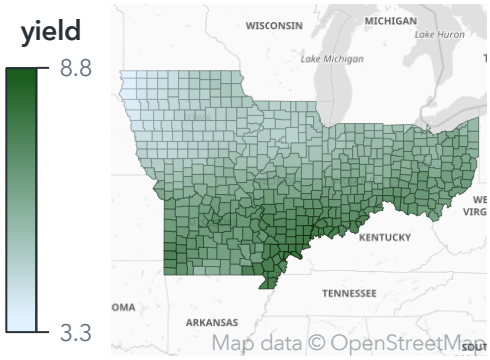
Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Corn Belt



Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 2-10 tons/acre. Yields rise after establishment and average 4-6 tons/acre under typical management, stabilizing near 5-7 tons/acre, with favorable sites and improved varieties reaching 9-10 tons/acre.

Equipment and Harvest

Conventional hay equipment (mowers, rakes, balers) is used for harvest. A single annual cutting, typically after a killing frost or at seed maturity, is standard. Mower-conditioners may be necessary for heavy biomass in some areas. For steep slopes, equipment like tracked, self-leveling harvesters or tethered system should be used which can operate on inclines.

Fertilizer

In year 1, no N is applied to reduce weed competition. In later years, 50-100 lb N/acre is recommended depending on yield goals. Phosphorus and potassium are added only as indicated by soil tests and harvest removal.

Pest and Weed Control

Weed control is critical during establishment, with glyphosate used for pre-plant burndown, and atrazine and 2,4-D/dicamba for post-emergence/ first-year control. Established stands need minimal weed control. Pest pressure is low in most states, though IL reports plant-parasitic nematodes. MO explores prescribed fire as an alternative weed suppression method.

Market Opportunities

States in this region share overlapping interest in co-firing, cellulosic ethanol, and pellet fuels, but face hurdles with limited commercial-scale markets. However, they have strong agricultural capacity and institutional support that could enable expansion if policy or demand shifts.

Costs

Establishment costs of $300-500/acre, reseeding costs of $40-70/acre, production costs of $45-75/ton, and harvest costs of $65-100/ton, with yield potential and logistics driving the largest cost differences.

Authors: Daniela Jones, North Carolina State University; Tasmin Hossain, Idaho National Laboratory; Haley Casper, North Carolina State University. **Acknowledgement**: Supported by the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Bioenergy Technologies Office (BETO), the Feedstock-Conversion Interface Consortium (FCIC), under DOE Idaho Operations Office with Contract No. DE-AC07-05ID14517.

QUICK START GUIDE

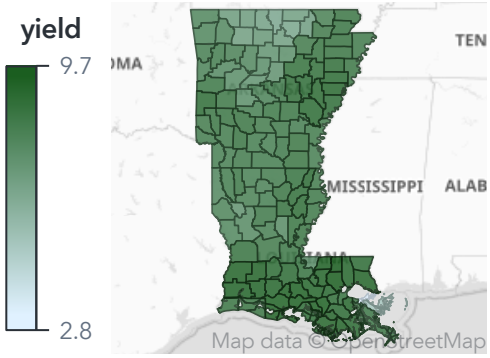
Switchgrass in Delta States

Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Delta States

Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 2.5-10 tons/acre.Yields average 3-6 tons/acre under typical conditions, with marginal lands producing 3-5 tons/acre and favorable sites reaching up to 10 tons/acre.

Equipment and Harvest

Conventional hay equipment (disc mowers, balers) is used. One annual harvest post-frost is standard. Fall rains necessitate tarping or barn storage to avoid dry matter loss and degradation in biomass quality from microbial activity. Existing hay and sugarcane infrastructure may be adapted.

Fertilizer

50-80 lb N/acre applied after the first year. Poultry litter or other organic sources used widely for cost-effective nutrient delivery. P and K follow soil-test recommendations, and returns diminish above 100 lb N/acre.

Pest and Weed Control

Weed control critical during establishment (glyphosate, imazapic, atrazine). Shade from interplanted trees (e.g., pines in LA) may aid suppression. Pests and diseases are minimal post-establishment with occasional rust, armyworms, and grasshoppers.

Market Opportunities

In LA, switchgrass markets may link directly to sugarcane processing, with potential for co-firing alongside bagasse and use in combined heat and power systems. AR shows promise for poultry house heating, litter incineration, and community-scale bioenergy applications. Both states benefit from a central location that supports pellet export, and switchgrass also adds value through conservation and wildlife habitat programs.

Costs

Establishment costs range $150-200/acre. Production costs average $55-65/ton, with profitability depending on yield levels, proximity to buyers, or participation in incentive programs (e.g., Biomass Crop Assistance Program (BCAP), Conservation Research Program (CRP)). Adoption has been limited without guaranteed contracts.

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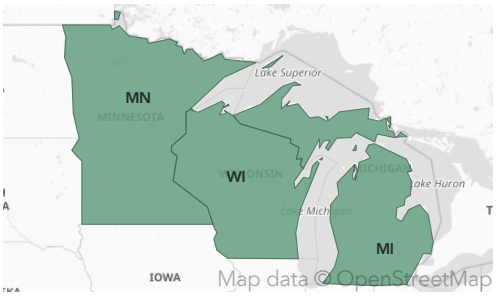
QUICK START GUIDE

Switchgrass in Lake States

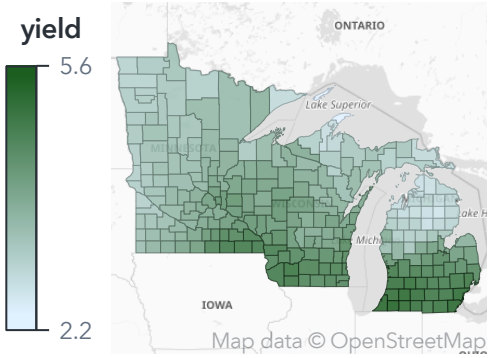
Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Lake States



Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 2-10 tons/acre. Yields rise after establishment and average 3-5 tons/acre under typical conditions, stabilizing near 5-7 tons/acre with good management, while favorable sites and varieties reach 8-10 tons/acre.

Equipment and Harvest

All state use standard haying equipment (mowers, balers). Fall harvest common in MI with post-frost timing for nutrient recycling. Fall or early spring harvests are tested in WI with spring bales having lower ash which is ideal for combustion. Post-frost harvest is typical in MN. Baling densification trials show promise to reduce transport cost.

Fertilizer

Between 50-75 lb N/acre applied annually after establishment is typical, with no N during the seeding year. P and K are added only when soil tests show depletion. Over-fertilization is discouraged to protect water quality.

Pest and Weed Control

Weed control typically relies on atrazine during establishment in MI and WI, supplemented by 2,4-D for broadleaf weeds. Pest and disease issues are minimal, though voles (MI) and rust (WI) are occasionally noted. In MN, atrazine has been phased out in some areas, with mowing and selective herbicides used instead; leaf rusts appear but have little effect on yield.

Market Opportunities

MI targets renewable gas and bioproducts supported by MSU research and fiber demand. WI shows potential in pellet heating, biogas, and fiber for pulp and livestock. MO explores biomass heating, gasification, and pellet exports, aided by conservation and policy incentives.

Costs

Establishment costs $150-200/acre, production $55-65/ton. MI profitability needs high yields, $60/ton price, or carbon incentives. WI and MN show similar economics, with BCAP and CRP programs aiding viability. Adoption remains low without buyers or secure contracts.

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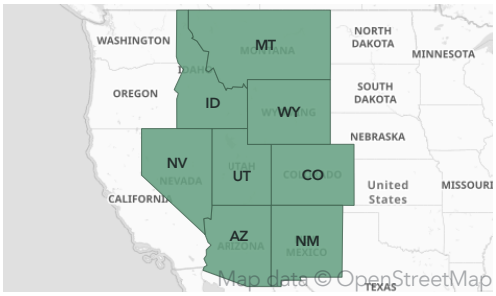
QUICK START GUIDE

Switchgrass in Mountain States

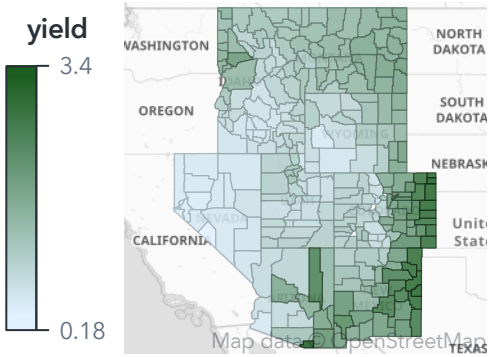
Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Mountain States



Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 1-5 tons/acre. Dryland sites yield 1-3 tons/acre, while irrigated or moist valleys reach 4-5 tons/acre. Yields are generally modest, with reliable production limited to favorable sites.

Equipment and Harvest

Frost-timed harvest is typical to aid nutrient recycling and dry-down in the field. Wind in MT necessitates timely baling. Equipment practices are expected to mirror standard haying equipment based on trials in CO, AZ and NM. Seed is drilled at 5 lb/acre and is firmed into the soil using a cultipacker based on NV trials. Harvest consists of swathing, raking, baling, and picking up bales.

Fertilizer

No N is applied in the first year. After establishment, 50-100 lb N/acre is applied depending on yield targets and irrigation. Phosphorus and potassium follow soil test results, with limited benefit on low-yield and dry land sites.

Pest and Weed Control

Weed control varies across the Mountain States. ID and WY commonly use glyphosate, quinclorac, imazapic, or atrazine; MT relies on fallowing, burndown, and occasional burning; CO uses atrazine and 2,4-D; NV applies mowing and 2,4-D; while AZ, NM, and UT depend on mowing and labeled herbicides. Pest pressure after establishment is generally minimal.

Market Opportunities

Markets are limited but could grow with conservation programs such as Conservation Research Program (CRP). Expanded infrastructure and policy support would be needed to make production viable. Possible markets include pellets, co-firing, local heating, cattle bedding, restoration-linked biofuels and habitat.

Costs

Extension budgets for the northern Mountain/High Plains show establishment costs of about $150-200/acre, with annualized total production costs around $110-113/acre over a 10-year stand. In arid or irrigated systems (e.g., NV and similar basins), extension budgets and logistics analyses indicate higher cost /acre and per ton, often requiring incentives or premium markets to be viable.

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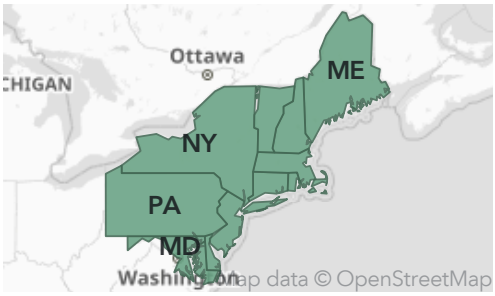
QUICK START GUIDE

Switchgrass in Northeast

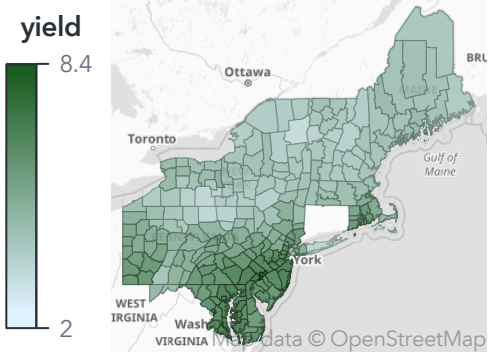
Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Northeast



Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 2-7 tons/acre. Yields increase with establishment and N inputs, averaging 3-5 tons/acre and stabilizing near 5-6 tons/acre, with favorable sites reaching 7 tons/acre.

Equipment and Harvest

All states would use conventional hay equipment (mowers, balers). Late fall or post-frost harvest is preferred to allow for drying and nutrient recycling. States like ME, VT, NH may harvest over winter on frozen ground. Smaller farms in MA, VT, CT may benefit from shared/mobile harvest systems.

Fertilizer

No nitrogen is applied during establishment. Once stands mature, 40-70 lb N/acre supports consistent yields. Lime is used to maintain pH > 5.5. Phosphorus and potassium applications are based on soil test and removal rates.

Pest and Weed Control

Weed control during establishment is essential, typically using glyphosate, 2,4-D, or atrazine where permitted, with mowing as an alternative in restricted areas. Pest issues are minimal, though fungal leaf diseases occur sporadically (NY, MD, DE), and prescribed fire has been explored in some locations (e.g., ME).

Market Opportunities

In the Northeast, near-term potential lies in thermal heating markets, with additional prospects in bedding-to-energy systems. Dual-use scenarios, such as conservation plus energy production, can strengthen economic returns, while regional collaboration and supportive policies will be key to scaling adoption.

Costs

Establishment costs are often in the $150-200/acre range (and can rise under difficult soil or preparation conditions). After establishment, annual maintenance and input costs tend to be modest. Some states experiment with shared infrastructure or cooperative pellet processing (especially under regional initiatives like NEWBio), though widespread commercial pelletizers remain limited.

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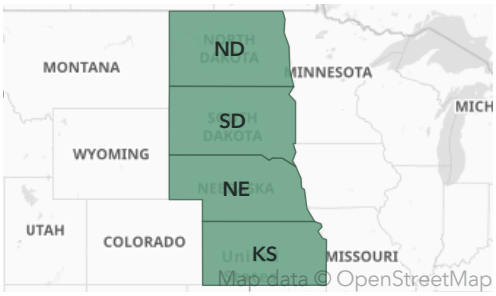
QUICK START GUIDE

Switchgrass in Northern Plains

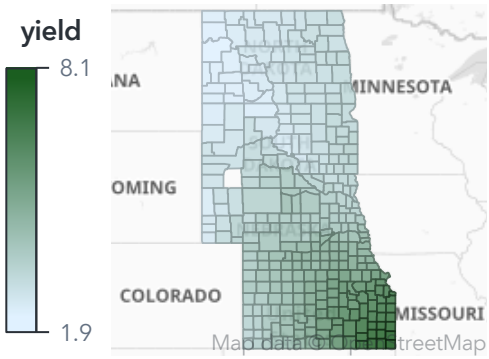
Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Northern Plains



Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials in SD report 2-5 tons/acre, with typical ranges of 2-4 tons/acre and favorable sites reaching 5 tons/acre. Data are limited for KS, NE, and ND.

Equipment and Harvest

All states use conventional haying equipment with a single-cut system. ND harvests in early fall; NE cuts in late summer or after frost. SD and KS harvest once yearly after senescence. Mowers such as rotary disc or sickle-bar are used, and bales-round or square-are stored under cover.

Fertilizer

No N is applied in the first year. Between 45-75 lb N/acre is generally sufficient after establishment with higher rates uneconomical. Phosphorus and potassium are rarely required unless repeated biomass removal causes depletion. Tolerates moderately acidic soils (pH 5.0-7.5) with optimal establishment at pH 6-7.

Pest and Weed Control

All states emphasize clean, well-prepared seedbeds and use no-till planting. Weed control is most critical during establishment, using herbicides such as 2,4-D, atrazine, or metolachlor, along with mowing as needed; mature stands generally require minimal weed management.

Market Opportunities

The Northern Plains could scale up quickly given farmer experience, land availability, and research support. Adoption will hinge on the build-out of regional bioenergy or biofuel processing facilities and clear market signals to drive demand such as co-firing initiatives, and growth in pellet fuel demand for heating.

Costs

Establishment costs in the Northern Plains have ranged from $35-160/acre in on-farm trials, averaging about $75/acre in historic USDA Agricultural Research Service (ARS) and University of NE-Lincoln (UNL) work. Realistic breakeven farm-gate prices typically span $40-80/ton, depending on yield, input intensity, and land rental or opportunity costs.

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QUICK START GUIDE

Switchgrass in Pacific

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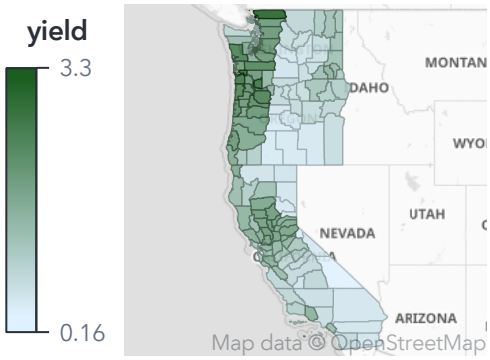
USDA Region Pacific

Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials in CA report up to 17 tons/acre in the establishment year, though results are site-specific. Data are limited for WA and OR.

Equipment and Harvest

All states rely on conventional hay and forage equipment. Harvest occurs in late August or early September to avoid fall rains in OR. CA harvests late summer/fall before rains and timing dictated by irrigation schedules. West-side of WA harvests before heavy autumn rains and east-side based on irrigation using multi-cut. For steep slopes, equipment like tracked, self-leveling harvesters or tethered system should be used.

Fertilizer

No N in establishment year. Between 0-100 lb N/acre depending on irrigation and soil fertility after maturity. Salinity management and soil testing are essential for irrigated or alkaline sites. Phosphorus and potassium are added only as needed.

Pest and Weed Control

Weed pressure high in all three states, especially during establishment.OR and WA has historic grass seed industries which result in aggressive weed seed banks and possible use of imazapic. CA has limited pesticide options with possibility of rodent issues (e.g. gophers) with restrictions on atrazine. No major insect issues reported in any state.

Market Opportunities

Pacific markets depend on infrastructure and policy. OR could connect switchgrass to biofuel plants, digesters, or pellet exports. CA may benefit from dairy digesters, biomass power, and nitrate capture. WA's pulp, aviation, and pellet sectors offer entry points if infrastructure grows.

Costs

Establishment costs of $200-300/acre, production costs of $60-70/ton. Higher site costs in CA and WA due to irrigation and land competition. Viability often depends on incentives or specialized applications.

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Switchgrass in Southeast

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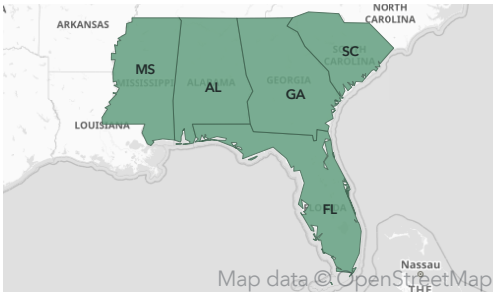
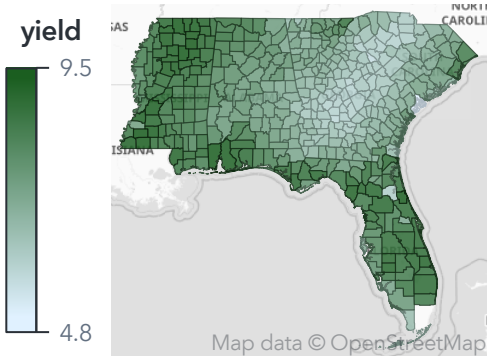
USDA Region Southeast



Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 2-15 tons/acre. Typical yields range 5-8 tons/acre under good management, with FL averaging 2-6 tons/acre and AL reaching 15 tons/acre under high inputs and rainfall. Data are limited for SC.

Equipment and Harvest

All states use standard hay equipment. GA drills no-till in spring with one winter cut. SC harvests late fall with heavy stems. MS uses shallow no-till seeding (1/4 in) as deep planting hinders germination. One- or two-cut systems yield similarly. Baling occurs below 30% moisture. FL and AL use no-till or conventional tillage with one post-frost harvest.

Fertilizer

No N should be applied in the first year, or until weeds are controlled and the stand is fully established. 50-100 lb N/acre in the later years, split between spring and midsummer if rainfall allows. Phosphorus and potassium are applied per soil test. Soils often require lime to maintain pH of 6.0. Organic amendments (e.g., manure) can substitute for synthetic N.

Pest and Weed Control

GA applies glyphosate before planting, atrazine pre-emergence, and 2,4-D post-emergence once plants reach 6 inches. No routine insecticides used. SC manages high weed pressure in year 1 with herbicides, cover crops, and tillage. MS, FL, and AL use glyphosate pre-plant with limited post-emergence control and mowing.

Market Opportunities

In the Southeast, switchgrass can support both small-scale on-farm heating and large-scale integration into regional energy systems. Its role in economic diversification adds value beyond energy markets. FL and AL have infrastructure in place for future scaling. SC has co-firing and pellet blending prospect.

Costs

Establishment costs of $200-450/acre, annual operating costs of $60-150/acre, and production costs of $55-75/ton, with viability strongly influenced by yield levels, transport distance, and access to local buyers or incentives.

Authors: Daniela Jones, North Carolina State University; Tasmin Hossain, Idaho National Laboratory; Haley Casper, North Carolina State University. **Acknowledgement**: Supported by the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Bioenergy Technologies Office (BETO), the Feedstock-Conversion Interface Consortium (FCIC), under DOE Idaho Operations Office with Contract No. DE-AC07-05ID14517.

QUICK START GUIDE

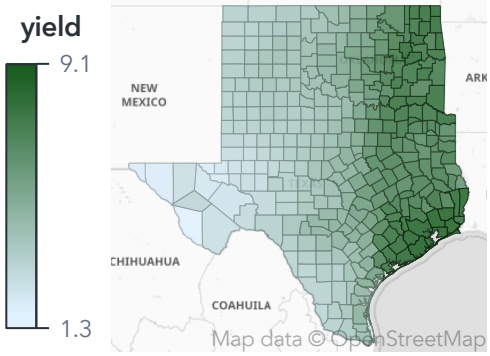
Switchgrass in Southern Plains

Switchgrass is a low-input perennial bioenergy crop with strong energy returns (5–10:1), typically harvested once annually using standard hay and forage harvesting equipment. This crop requires minimal inputs, such as no-till seeding, moderate fertilization, and low irrigation, making it an efficient choice for farmers. It lowers greenhouse gas emissions (up to 94% vs. gasoline), enhances soil carbon and erosion control, and consistently delivers high energy yields across regions.

USDA Region Southern Plains

Yield

County yields (dry tons/ acre) in map below are estimates derived from regional field trials and do not account for competition with other crops.



Field trials report 1-12 tons/acre. Marginal sites average 1-3 tons/acre, while well-managed fields typically yield 5-8 tons/acre, with favorable lowland ecotypes in TX and OK reaching 10-12 tons/acre.

Equipment and Harvest

Standard hay equipment is used. One annual cut post-senescence (September-November), occasionally two in TX. Faster drying is observed in arid regions. Humid areas require protected storage with tarping or roof-covered to avoid dry matter loss and prevent biomass degradation. TX uses swathers. OK has tested direct chopped biomass for power plants.

Fertilizer

No nitrogen in the first year is applied. Between 50-100 lb N/acre annually after establishment, with lower rates sufficient on fertile or irrigated soils. Manure or poultry litter may be substituted for synthetic fertilizer. Phosphorus and potassium are applied per soil test, especially on alkaline soils prone to micronutrient deficiencies (e.g., Fe, Zn).

Pest and Weed Control

Aggressive weed control critical in year 1 (glyphosate, atrazine, quinclorac, cover crops). Post-establishment weed suppression due to dense stands. Pests are rare and occasional rust or aphid in TX and smut/rust in OK. Cultural controls dominate.

Market Opportunities

In the Southern Plains, infrastructure and research are in place, but growth depends on demand signals. TX benefits from extensive energy infrastructure, ports, and land area that position it well for future biomass markets. OK has tested co-firing at a power plant and explored small-scale biomass power, showing readiness to expand if market conditions improve.

Costs

Establishment costs of $150-200/acre, annual operating costs of $100-150/acre, and production costs of $40-60/ton. Transport limit economic radius (50 miles).

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