



west virginia department of environmental protection

BIOMASS Production on Mined Lands

West Virginia Department of Environmental Protection
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Switchgrass has the potential to be a widely used reclamation species in West Virginia. High levels of switchgrass production can be achieved with minimal levels of fertilizers and other agricultural inputs on marginal soils like reclaimed mine lands. Switchgrass is known to be tolerant of soils from pH 5.0 to 8.0 and from sandy to clayey textures. Additionally it is drought tolerant and has only moderate fertility needs once established. Switchgrass production makes an attractive post mining land use because of the economic and environmental returns that can be realized from the high amount of biomass production.

What is Switchgrass?

Switchgrass, *Panicum virgatum*, is a tall-growing grass native to North America east of the Rocky Mountains. As a warm-season grass, it grows during the warm months of the year and is dormant during autumn and winter, unlike cool-season grasses which actively grow during spring and fall. Warm-season grasses usually take longer to establish than cool-season grasses but have the potential to last much longer with less maintenance.



What Can Switchgrass be used for?

Biomass - Well established varieties suitable for mine land reclamation can be expected to produce from 3-6 tons per acre annually. This biomass can be harvested as a nutritious livestock forage or for biofuel production. Switchgrass biomass can be converted to ethanol for use as a transportation fuel or it can be pelletized and burned for heat production.

Carbon Sequestration - If properly measured and verified, the plant's ability to sequester atmospheric carbon in the soil can offer another economic opportunity through the trading of carbon credits used to offset industrial carbon emissions. As the crop grows, it pulls carbon dioxide from the atmosphere for developing a deep and dense root structure forming long-term soil organic carbon.

Wildlife Habitat - Switchgrass stands offer valuable wildlife habitat. They provide spring ground nesting habitat, summer forage and winter cover for song birds and other upland wildlife such as wild turkey, quail pheasant, rabbits and whitetail deer.



Considerations for planting

Site Conditions

Although established stands of switchgrass are tolerant of droughty conditions and poor soils, the seed itself is very small and offers only limited resources for a new seedlings to become established. Accordingly, it is crucial to provide as good a soil environment as possible that provides water and nutrients in which seedlings can grow and take root. If biomass production is planned, then the stand should have few rocks and be level enough to safely operate agricultural machinery. Soils should have a pH between 5.0 and 8.0 with the optimal range for nutrient availability between 6.0 and 7.0. The site should also have moderate levels of phosphorus and potassium. Both of these conditions are frequently naturally present in most of West Virginia's mine soils. However, most mine soils lack organic matter and nitrogen. Organic matter can provide a steady supply of nutrients to growing plants as well as increase the soils ability to hold and supply moisture.

Considerations for planting (continued)

While established switchgrass plants can tolerate drought, new seedlings cannot because their root structures are still immature. Mine soils that are overly coarse textured and rocky may not be able to hold and supply water for new seedlings. Restoring original topsoil or applying organic materials such as municipal biosolids, paper mill waste or poultry litter can help to ensure nutrient availability and water holding capacity. In trials conducted by West Virginia University researchers, switchgrass plots that were reclaimed with biosolids greatly outperformed plots that consisted mostly of mine spoil.

Choosing the Correct Variety

It is important to select a switchgrass variety suited for your purposes as well. There are two general types of switchgrass; lowland varieties developed in more moist conditions and upland varieties which are more suited to droughty conditions. Most reclaimed mine lands are suited more for upland varieties. Be sure to buy and apply seed in terms of pure live seed (PLS), or seed that is considered viable upon planting. It is determined by a germination test and is calculated as the percent purity of the seed multiplied by the percent of seed that germinates divided by 100. In the case of switchgrass, most seed requires a long period of cool wet conditions to break the seed's inherent dormancy and allow germination. Accordingly it is recommended that stratified or cold-treated seed be purchased. There are a number of varieties of switchgrass that are well suited for biomass or wildlife plantings and any reputable seed dealer will be able to match a variety to your needs and growing location.

Planting Method

Switchgrass can be successfully planted by a variety of methods from traditionally drilling into a prepared seedbed, to broadcasting seed with a hydroseeder or spinner spreader. Regardless of the method chosen, ensuring good seed to soil contact is the most important factor for successful germination. Drilling seed into a well prepared, smooth and firm seedbed at a depth of one quarter inch ensures that all the seed is placed in optimum germination conditions. With this planting method, 2-6 pounds of pure live seed per



acre is adequate to produce a successful stand. If the site is already in grass vegetation, switchgrass can be successfully established with a no till drill into an herbicide-killed sod.

However, using an agricultural drill on improperly reclaimed mine soils is impractical or impossible so a broadcast method over a tilled soil can be employed. The objective of tilling is to break up the soil to provide places for seed to fall and germinate. Care must be taken to avoid pulling up rocks during tillage that could hamper equipment operation if biomass production is intended. Ideally, seed will fall into small holes in the soil and then rain water will lightly cover the seed with soil to initiate germination. Using a cultipacker or applying hydromulch after seeding will also promote seed to soil contact. Broadcasting does still leave individual seed placement to chance and some will fail to germinate. Accordingly, it is necessary to increase the amount of seed used in these situations. In WVU trials, 10 pounds of pure live seed per acre was enough to create a viable stand upon germination with a broadcast spinner spreader and a hydroseeder. Be aware that poorer soil conditions will require a higher seeding rate to create a viable stand.





Managing switchgrass post planting

Switchgrass in general requires little fertilization or other inputs once established. It is not recommended that any nitrogen be applied in the first year to reduce the chance of weed competition. In subsequent years, 50 pounds of nitrogen per acre can be applied. Phosphorus and potassium fertilization levels should be based on soil test results and may not be necessary. Weed competition can be a significant problem while switchgrass is becoming established. While there are many herbicides that offer weed control solution in switchgrass, very few are labeled for use in switchgrass. The weed specialist at WVU can be consulted for the most up to date information regarding herbicide use in switchgrass. Annual clipping through harvesting, mowing or even burning can also control weeds once stands are established.

It can take as much as three years for a switchgrass stand to become established and produce full yields. If harvesting biomass for biofuel production we recommend that harvest be delayed until after the killing frost in the fall. While this may slightly reduce yields compared to a biannual harvest system it allows nutrients in the plant to leach from the plant back into the soil which in turn reduces fertilizer needs and it reduces the cost for drying the harvest. Harvest can be conducted with traditional hay making equipment. It is recommended that a stubble height of at least six inches be left after cutting to allow some protection to the plant and soil over winter.

How Can I Get More Information?

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