Vermont Grass Biomass Energy

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CULTIVATING HEALTHY COMMUNITIES

Establishing Warm Season Grasses for Biomass Production

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There is a growing interest in utilizing perennial grasses for biomass energy in Vermont, particularly as a heat energy source. Grasses can be pelletized or densified into other forms (such as cubes, briquettes or pucks) in pure form or potentially mixed with wood to be burned. With an existing infrastructure and knowledge base for growing and harvesting hay in Vermont, the adaptation to biomass production and management should be rather straight forward provided the system is economical and there is a steady market.

Warm season grasses, also called "C4" grasses because of their specific four carbon pathway for photosynthesis, consist of many species of grasses that are mostly tropical in origin. However, the ones that appear to be most suited to Vermont are tall grass prairie species with origins of the North American geographical area. These would include switchgrass (*Panicum virgatum* L.), big bluestem (*Andropogon gerardii* Vitman), and Indiangrass (*Sorghastrum nutans* (L.) Nash). There are other grass species as well but have not been evaluated enough to recommend at this point. These grasses are suited for biomass production because of potential productivity and good fuel characteristics for energy conversion. They are also very efficient in utilizing soil nutrients and, therefore, require less nutrient supplementation than our more common forage grasses grown in Vermont.

Warm season grasses can be a challenge to establish. The seed is small, seedling growth is slow and weeds can severely affect success in establishment. The purpose of this publication is to provide some guidelines and recommendations as one prepares to plant a stand.

Site Selection and Soil Testing

It is important to select and assess a potential site way in advance of seeding. These warm season grasses will grow on a wide range of soil types but are best suited for well to moderate drained soils. Warm season grasses will grow on somewhat poorly drained soils, but yield potential is much lower. If the site is a poorly drained soil, especially clay, then other options such as reed canarygrass should be considered.

Sample the site for a soil test as soon as possible. Although these grasses will tolerate low fertile conditions, they are more vigorous and will yield better if soil nutrient levels are at an optimum level. Lime the soil if the pH is below 6.0 and use a liming recommendation similar to other forage grasses (up to 6.2). If soil P is low, adding phosphorus fertilizer during tillage is a good way to incorporate it into the rooting zone. Other fertilizers can wait until the year after establishment. In fact, it is best to avoid any nitrogen fertilizer in the seeding year since this primarily promotes weed germination and growth.

Pre-Seeding Weed Management

If the field has received a lot of manure in its recent past and if it has been in annual crops with a history of weed problems, then it would be best to delay a seeding for a year or two and use a combination of tillage, smoother crops and cover crops to suppress weeds. This is especially the

case if the major weed problems are summer annual grasses such as crabgrass, foxtails, or barnyardgrass. It is very difficult to control these grasses in an emerging stand of switchgrass or big bluestem and they are very competitive. A good example of a smoother crop would be one of the summer annual forages such as sorghum-sudangrass, sudangrass or millet. These crops grow rapidly and thick and are excellent at choking out weeds. They can be cut for forage or grazed. Whatever crops are grown, it will be very important to control weeds such that no new seed is added to the soil seed bank.

If the site is an old hay field or meadow, then fall tillage will be necessary to breakdown the sod in time for a seeding the following year. Before plowing, an application of glyphosate (Roundup) will help kill any perennial weeds that could become a problem in the seeding year. If a herbicide is not used, then multiple tillage the following spring may be necessary.

In the spring of the seeding year, a stale seedbed method can be used to flush out weeds that are near the surface. Since warm season grasses should not be planted until late May or early June, there is often time to prepare the site earlier and allow time for weeds to germinate. They can then be controlled with either cultivation or herbicides. Blind cultivation with a flex tine weeder is a good way to control annual weeds as long as it is done before the weeds emerge. Look for the "white thread" stage of the weeds.

Species and Cultivar Selection

Of the warm season grasses, switchgrass is probably the most versatile, productive and easiest to establish. It can be grown as a monoculture but a good option would be to grow a mixture of switchgrass with big bluestem and possibly Indiangrass. It is important to purchase a cultivar adapted for the Northern New England. There are many cultivars growing in the southern U.S. that are not adapted to our conditions and should be avoided. Fortunately, there are several adapted cultivars suited for the Northeast. In Vermont trials 'Cave-In-Rock' was found to be the highest yielding switchgrass cultivar across three locations. 'Blackwell' also yielded well but was only in one location so there is less information about this cultivar. 'Shawnee' is a cultivar selected for higher quality so if the goal is the have a combination of grazing and biomass, this cultivar may be a good choice. Of the big bluestem species, 'Niagara' big bluestem is a recommended cultivar for the NE. 'Prairieview' did well is Vermont evaluation trials.

For more cultivar recommendations, check with your local NRCS or Extension Office. For more information for cultivar evaluations in Vermont, refer to the UVM Extension Report at http://pss.uvm.edu/vtcrops/articles/EnergyCrops/Vermont_WSG_Biomass_Report4.2013revised.pdf

Purchasing Seed - Quality and Dormancy Considerations

Because these prairie grasses were mostly derived from ecotypes (collected from native stands) within the past one hundred years, they can still have a high degree of innate dormancy. This dormancy mechanism is a benefit under natural conditions because it prevents the grass plant from germinating at an improper time such as in the fall after seed drop. This type of dormancy does decline over time, referred to as after ripening, allowing the seed to then germinate.

When seed it purchased, it should come with a seed tag that provides current information purity, germination and dormancy. Purity refers to genetic purity and is the percentage of the seed (by weight) that is the actual named specie and cultivar. The rest would be inert matter (leaves and stems) and weed or other crop seed. Germination should refer to the percent of the seed that will

germinate when exposed to conditions that promote germination. Dormant seed is based on a pre-chill test that determines the percentage of the seed that will eventually germinate as dormancy declines. Together, the germination plus the dormant seed are considered the percent viable seed. Since seed viability and dormancy can change over time, it is important that the lab tests are conducted as close in time to when the seed is purchased and used. Therefore, the test date on the seed tag is also very important to note. If it is more than six months old, the data on the tag may not be very accurate.

It is best to purchase seed with high a purity, high germination and low dormancy. It may also be possible to purchase seed that has been pre-stratified to increase initial germination rates. This may cost extra but it is worth asking. Another strategy would be to purchase seed the year before using it. This allows time for after ripening and then, most of the seed would be in a non-dormant state when seeded. It would be critical to store the seed in a cool, dry area to reduce losses in seed viability.

Calculating Seeding Rate

A successful seeding should result in about 40 to 50 live seeds per square foot when using proper seeding techniques; therefore, seeding rates are based on the average number of seed per pound and on the quality of the specific seed. Table 1 provides the recommended rates of seed for the three major grasses. These are based on "pure live seed", PLS, which is the amount of seed that will actually germinate.

To calculate pure live seed:

%PLS = %Purity x (% Germination + % Dormant Seed)/100

Adjust the seeding rate by dividing the recommended rate by %PLS. For example, if the seed tag states the following – 90% Purity, 60% Germination and 30% Dormant. Then,

%PLS = 90% x (60 + 30)/100 = 81%

and at a 10 lb recommended rate

10 lbs per acre / 81% (or 0.81) = 12.3 lbs per acre

If the seed has less than 40% germination with a higher amount of dormant seed, it is recommended to increase the seeding rate by 20 to 30 percent.

Table 1. Seeding rates of warm season grasses when seeded alone

	Recommended Seeding Rate			
	Lbs PLS	Adjusted Seeding Rate:		
Species	per acre	90 % PLS	80 % PLS	70 % PLS
Switchgrass	8 - 10	9 - 11	11 - 14	16 - 20
Big bluestem	10 - 12	11 - 13	14 - 17	20 - 24
Indiangrass	10 - 12	11 - 13	14 - 17	20 - 24

Site Preparation and Seeding

Warm season grasses can be planted in a clean seedbed or no-tilled following a field crop or into a killed sod. But regardless of seeding method, it is critical that the seed makes good contact with the soil. This assures that moisture becomes available to the seed to promote germination. A tilled

seedbed should be fine-textured and firm. To test the firmness of a seedbed, step on it and your foot should sink no more that ¼ inch. If it sinks more, then rolling the field another time is recommended.

Seed should be planted no more than a ¼ inch deep. A conventional drill or a cultipack seeder like a brillion seeder works well with switchgrass because its seed is hard and smooth. Big bluestem and Indiangrass seed are chaffy and usually required a specialized hopper with an agitator and may do best with a native grass drill. Regardless, it is important to pay attention to seeding depth.

Broadcast seeding can also be used but it is advisable to increase the seeding rate by 20% and go over the field with a cultipacker twice afterward.

Seeding Date

Warm season grasses should not be planted until the soil is warm enough to promote germination. A general recommendation is to start about one week before normal corn planting and end by the middle of June. Planting later than this increases the risk of immature plants going into the winter.

Post Seeding Weed Control

Weeds are very competitive with warm season grass seedlings, so it is important to try and reduce their impact. Mowing with a sicklebar or rotary mower can help reduce shading of tall weeds. Mowing should be made just above the height of the warm season grass seedlings. Annual grasses should not be allowed to grow over 18 inches in height or they will become too competitive.

There are no pre-emergence herbicides labeled for warm season grass use in Vermont but check with the VT Agency of Agriculture for updates of registration of any new products. Broadleaf weeds can be controlled with selective herbicides like 2,4-D; however, warm season grass seedlings need have reached the 4 to 5 leaf stage or serious injury can occur.

If cool season creeping perennial grasses such as reed canarygrass or bluegrass become a problem following the establishment year, they can be controlled with a dormant treatment of glyphosate in April before the warm season grasses begin their regrowth.

Harvest Management in the Seeding Year

Often warm season grasses are not harvested in the seeding year; however, if the grass has four or more feet of growth and seedhead, it could be harvested. Wait until late October and leave a six to eight inch stubble.

References

Parish D. J. and J.H. Fike. The biology and agronomy of switchgrass for biofuels. 2005. Critical Reviews in Plant Sciences. 24:423-459.

USDA-NRCS Big Flats, New York. Establishing Native Perennial Warm-Season Grasses for Biofeedstocks.

For More Information on Grass Biomass, go to: http://pss.uvm.edu/vtcrops/?Page=energycrops.html

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