Logistical Challenges to Switchgrass (Panicum virgatum L.) as a Bioenergy Crop

There's more to producing a crop like switchgrass for bioenergy than just growing it. Harvesting, storing, transporting, and selling perennial grass feedstocks must be taken into consideration to make it a successful venture.

Table of Contents

Although switchgrass (*Panicum virgatum L.*) and other perennial grasses such as Indian grass and big bluestem offer producers the potential of a crop that can make marginal crop lands profitable and sustainable, several challenges besides production need to be addressed to make growing these crops viable. Logistical factors such as harvest, storage, transportation and marketing, discussed below, need to be considered as perennial grasses move from research and development to farmers' fields.

Transporting Biofuel Feedstocks with Current Crop Transportation Systems

Despite the fact that transportation systems have been refined over the years to improve the efficiency of moving grain and forage products across the nation, there are still challenges to moving the biomass crop from the field to refinery plant. The supply chain for biomass feedstock will require the transportation of significantly greater volumes of material than current systems. For example, the supply chain required to transport the 800 million tons of agricultural residues identified in the Department of Energy's 2005 billion-ton study would need to handle roughly 10 times the volume of grain than that of the current grain logistics system in the United States. Handling this volume of material will require the development of efficient biomass handling and loading systems and additional vehicles for transporting biomass.

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Biomass Harvesting Technology

Current hay-crop harvesting technology will be useful for perennial grasses, but each type of equipment presents certain limitations because they were not designed to handle such high yields of biomass. For example, a round baler is less expensive than a square baler, but round bales do not stack on trailers as efficiently as square bales and require a much greater area for storage than large square bales. A square baler may lead to more efficient transportation and storage, but may not be an economically sound decision for every producer as they are more expensive to purchase and require the use of a 200-horsepower tractor or larger.

Biomass Storage Systems

Significant dry matter losses can occur (up to 25%) during storage. To minimize losses, care needs to be taken during storage. Large round bales tend to have a minimum of 1–4% loss while large square bales lose 2–8% even in ideal conditions. Anaerobic storage options such as bulk silo, Ag-Bag, and bale wrap result in 2–5% losses, as reported in research findings.

Of course, the cost of these storage options must be weighed in conjunction with other options. Buildings cost an average of $10–$12 per square foot to build, and anaerobic storage options cost approximately $9 per ton. A new baler, new building, or silo storage may actually cost more in the end than accepting a certain amount of loss due to the current storage options available in a particular farming operation. Each producer should weigh these costs carefully before purchasing new buildings or equipment.

Selling the Energy Crop

Even after producers address the challenges of growing, harvesting, and storing a perennial grass crop for biofuels, there is still one challenge left: selling it. Research has determined that pyrolysis is one of the best ways to refine perennial grasses for biofuels. Just having a process identified to convert these feedstocks into biofuels, however, is not enough. Producers must also be able to provide consistent supplies to refiners and their customers in order to encourage reliable, profitable markets.

Drought and other environment conditions can pose a threat to supply. Furthermore, these feedstocks are not easily transported across the nation, making it more difficult to bring in an outside material when a local shortage occurs. The refining process is also complicated by the fact that the quality of the feedstocks may vary a great deal between producers. Variation in quality requires adjustments in the refining process for the most efficient conversion of the grass to biofuels. Since on-the-fly adjustments may not be feasible, variations in feedstock quality could significantly affect conversion efficiency during the refining process and therefore make it harder to market such feedstocks.

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Conclusion

Perennial grasses as feedstocks for biofuels offer producers a long-term, sustainable, and potentially profitable solution for marginal crop land. Each producer, however, must consider how this perennial grass crop will fit into their existing operation. To maximize profitability of perennial grass feedstocks, producers will need to determine how best to get the crop from the farm to the processing plant using the resources at hand. Before these practices can be implemented on the farm, however, processing plants and storage facilities will need to adopt the idea and offer the necessary accommodations for handling large volumes of feedstock material.

For Additional Information

- **CenUSA Project Resources** - Research-based information on the opportunities and challenges in developing a sustainable system for the thermochemical production of biofuels from perennial grasses grown on land marginal for row crop production is available at www.cenusa.iastate.edu
- **CenUSA Bioenergy Overview Video:** https://youtu.be/NqxbF8-F8lc
- Planting and Managing Switchgrass as a Biomass Energy Crop, USDA Natural Resources Conservation Service, Plant Materials Program. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1042293.pdf

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