SwitchGrass Production

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INTRODUCTION

About 90% of the domestic ethanol feedstock supply is derived from corn grain (*Zea mays* L.). Reasons for having selected corn include: 1) corns' high starch content which can be rapidly distilled to alcohol, 2) corns' higher distillation efficiencies are greater than most other feedstocks, 3) most of the ethanol produced is in the mid-West where corn is widely grown, and 4) many refineries are located in the Gulf Coastal States, close to current ethanol distillation centers. Total dependence of the ethanol market on corn has inherent problems in sustaining feedstock supplies including: 1) as a warm-season crop, corn cannot be grown in all areas, such as those with short growing seasons or low rainfall, 2) corn requires high inputs of fertilizers, herbicides and insecticides to ensure high yields, 3) as an annual crop, corn grown under rain-fed conditions has yield potentials varying significantly from "bin busters to empty bins", making it risky to grow due to the uncertainty of shifts in rain fall as a result of global climate change, and 4) wind erosion of soils resulting from annual cropping is a major problem in the arid west.

Switchgrass is adapted to the warmer and irrigated regions of the Pacific Northwest (PNW) and therefore a viable alternative to corn. Switchgrass contrasts to corn in the west by: 1) being a perennial crop, eliminates the need for annual tillage, reducing soil loss from wind erosion, 2) having lower fertilizer requirements, and fewer pest issues decreases fertilizer and pesticide use, 3) ability to produce a harvestable biomass and becoming dormant if irrigation water is restricted compared to corn which would senesce and produce little harvestable yield, and 4) since 2001, switchgrass has proven to be productive and adapted to the lower Columbia Basin region of the PNW in exploratory WSU research trials. To be economical for the grower and local ethanol production facilities, a low-cost, high-return sustainable crop is required. Many questions surround the feasibility of switchgrass as an ethanol feedstock in the PNW.

BACKGROUND

- Switchgrass is a native, long-lived perennial, warm-season loving species. It starts as a bunchgrass but actually has short rhizomes and with proper management will develop a sod over time. It has a panicle seedhead with spikelets forming at the ends of long branches. The basic chromosome number is 9 and most varieties are either tetraploids or octoploids. Varieties are cross pollinated and largely self-incompatible.
- Switchgrass varieties are designated as either 'upland' or 'lowland' types. Upland types are more naturally adapted to upland growing areas. Lowland types then are more often found in flooded plain areas. Lowland types are normally taller and courser than upland types. Lowland types are more bunchy and tend to grow more rapidly than upland types. Three varieties are used in this research. Kanlow (2n=36) is a lowland type while Cave-in-Rock (2n=72) and Shawnee (2n=72) are both upland types.
- Some do's and don'ts in growing switchgrass. Do plant at 6 to 12 pounds PLS per acre in late May or early June. Don't plant deeper than ¼ inch, it is easy to plant with any drill. Do allow the first year for establishment and don't try planting a cereal crop over the top, graze or hay until after killing frosts in the fall. Do fertilize but don't over fertilize as it is a native plant and doesn't respond as well as most introduced plants to fertilizer. Do irrigate but don't over irrigate as the roots will go to deeps of 10 feet for water and nutrients. Do harvest for biomass but don't cut lower than 4 to 6 inches or this will retard re-growth and reduce stand life. Do a good job managing and switchgrass will be productive for a long time.

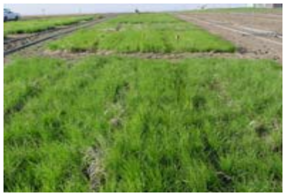
OBJECTIVES

- To determine adaptability of switchgrass based upon yield monitoring, fiber quality, cultivar selection, nutrient use efficiencies, weed control and irrigation requirements.
- To compare energy balances of ethanol produced from switchgrass silage and hay to that of corn silage or grain over seasonal accumulation.
- To determine the reductions in feedstock quality and ethanol yield from switchgrass hay stored under covered or uncovered storage facilities.
- To develop an economic analysis of costs and returns to switchgrass growers necessary to sustain feedstock supply to ethanol production facilities.

Emergence

2 months

6 months, Fall 2004



12 months, May, 2005

13 months, June 2005

First Harvest: June 24, 2005

Table 1. Yield data from biomass variety trials at Paterson, WA and estimates of land area needed to support a twenty million gallon ethanol facility.

Crop	Variety	Biomass Yield (lb ac^{-1})	†Ethanol Yield (gal ac^{-1})	Area needed to support 20-million gallon facility (ac)	% of Planted Crop Acreage
Corn (grain)		9,200	368	54,350	72.5
Corn (stover)		10,400	380	48,100	64.1
Corn (grain + stover)		19,600	748	26,800	35.7
Wheat (straw)		12,236	422	94,800£	52.4
Switchgrass	Shawnee	4,880‡	195	----	
	Kanlow	5,050‡	201	----	
	Cave'n rock	5,340‡	213	----	
	Est. Two Cuttings	10,180	407	49,120	15.4€

†Ethanol recovery from wheat straw is 69 gallons ton^{-1}, from corn and switchgrass biomass is 80 gallons ton^{-1} biomass. ‡Single harvest June 24, 2005. £Assumes 50% removal of residues. €Land area based on percentage of current forage and grass seed acreage.

RESULTS

Preliminary research plot yields of 6-7 tons/ac dry matter for switchgrass and grain corn, respectively, would require 50,000 acres to sustain a 20 million gal. per year ethanol facility. For field corn that would be When placed in context of the energy return balance of 4.4 and 1.2 (energy output:input ratio) for switchgrass and corn, respectively, corn will be a more expensive feedstock than switchgrass. Comparatively, irrigated corn producers currently grow high yields of grain while our preliminary switchgrass research indicates a significant potential for crop improvement and improved ethanol yields. To produce sustainable feedstocks as alternative energy supplies in the PNW we would likely see a shift from less profitable crops to those that meet feedstock demands while increasing grower returns.

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