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Economic Feasibility of Biofuel Crops in Florida: Energycane on Mineral Soils [1]

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Introduction

Florida has caught the attention of several firms that have developed technologies to convert crop biomass into energy. Many proponents of renewable energy see a comparative advantage in the "Sunshine State" in terms of energy crop production. University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) is currently involved in a multitude of research projects in this area under the leadership of the Florida Institute for Sustainable Energy (http://www.energy.ufl.edu).

Florida sugarcane producers and processors have accumulated nearly a century of experience with growing sugarcane for processing and refining into sugar. Although there has been interest relative to harvesting the crop for energy, early evaluations have been limited to field experiments at the Everglades Research and Education Center (EREC), funded by the Battelle Institute in the 1980s, and some variety work under the joint plant germplasm development program between the University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) and the United States Department of Agriculture's Agricultural Research Service (USDA/ARS) at the U.S. Sugarcane Field Station at Canal Point, Florida.

The purpose of this fact sheet is to explore the economic feasibility of growing "energycane" as a biofuel crop. Energycane is a cross of commercial sugarcane (*Saccharum officinarum L.*) with *Saccharum spontaneam L.*, but unlike sugarcane, it is higher in fiber and lower in sucrose. A similar fact sheet analyzes growing commercial sugarcane for energy (http://edis.ifas.ufl.edu/SC090). This fact sheet provides estimates of costs and returns to sugarcane farmers and determines whether energycane can provide sufficient economic returns to warrant further research into energycane as an energy crop.

Assumption of the Study

A six-year cycle of energycane is assumed to be grown on a 640-acre (usually referred to as a "one section") farm. The farm is broken down by section for management decisions. Because the hypothetical farm is already established, there are no development costs to defray. The soil is classified as mineral (sand). There are 16 blocks of 40 acres each. There

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are 14 ditches 0.5 miles long (7 miles total), and 2 one-mile long seepage canals. Total area on roads, canals, and ditches equals 65 acres. Therefore, net acreage equals 575. The net acreage is equally distributed in 7 parts (1 fallow land, 1 plant cane, and 5 stubble crops) of 82 acres each, except for the plant cane acreage, which has 8 acres devoted to seed cane, and the remaining 75 acres to regular production.

Methodology and Data Source

An enterprise budget was developed with agronomic and cost data, with the objective of estimating production costs and projecting gross and net returns. Data were obtained from several sources: interviews with sugarcane producers, complemented with a recent enterprise budget published by UF/IFAS (Roka, Alvarez, and Baucum 2009), and information on prices, including custom rates charges, provided by local dealers of agricultural inputs and services.

Energycane production for this study is assumed to take place on mineral soils (sand lands) in and around the Everglades Agricultural Area (EAA) not currently being used for sugarcane or other high-value crops. Production potential of these soils is generally lower than the land currently in sugarcane production. Based on preliminary research results and grower opinions, biomass yields from these soils can range from 25 to 35 net tons per acre. We assume a base yield of 30 net tons per acre, per year from a six-year crop cycle (1 plant cane plus 5 ratoon crops). As part of our economic analysis, a range in biomass production from 26 to 34 tons per acre will be considered. A “dry” ton is assumed to be 30 percent of a net ton. Each net dry ton of energycane is assumed to produce 90 gallons of ethanol (Frosch 2008). We assumed in this evaluation of energycane that ethanol would be produced through a process of cellulosic conversion as developed by Dr. Ingram at the University of Florida (Ingram 2009).

Production Costs

The enterprise budget for energycane is presented in Table 1. Preliminary results show that it costs about $965 per year to produce one acre of energycane for energy in a six-year crop cycle. This total cost figure includes variable ($765) and overhead costs ($200). The break-down of variable costs includes $6.31 for fallow land maintenance and $37.87 for land preparation. Planting activities account for $47.34 per acre. The former costs have been prorated for a six-year crop cycle. All cultural activities performed represent $309.33, to which $82.26 are added for miscellaneous expenses (assumed 10% of variable costs) and $72.39 for interest of the capital used (8%) in the previous activities. Harvesting activities (cutting, loading, and hauling to the mill) total $210.

The relative magnitude of the total costs associated with energycane production is as follows: fertilizer costs represent 39 percent of the total costs, followed by 36 percent for land preparation and planting, 22 percent for harvesting activities, 21 percent for overhead, and 10 percent for chemical expenses (Table 2). The table from which these percentages were computed shows a sensitivity analysis with increases and decreases by activity at 5 percent intervals.

The stubble replacement decision in energycane production (when to plough out and replant a field) is perhaps the most important economic question facing an energycane grower due to the high cost of replanting. When one considers the total expenses of the planting operation, and not just the prorated cost per year, the overall cost to plant includes $38 for fallow land maintenance, $228 for land preparation, and $285 for planting, for a total of $551. The actual cash outlay of the replanting activity represents 57 percent of total costs, hence the importance of extending the crop cycle (i.e., the number of ratoon crops allowed before yields decrease intolerably). Also higher were the fertilizer costs, and as energy prices rise, these will likely continue to be significant costs, thus suggesting that research on nutrient efficiency or alternative sources would have a direct effect on the success of energycane production efforts.

Ethanol from Energycane

The relative profitability of energycane produced for ethanol at three levels of biomass (and corresponding dry yields), three levels of ethanol prices, and two levels of processing costs ($1.65 and $1.07 per gallon of ethanol are believed to encompass the current high and potential low cost) is presented in Table 3. When the processing cost is $1.65 per gallon, net returns of $154 per acre are obtained with 34 net tons of energycane if the price of ethanol is $2.90 per gallon. At that level of processing cost, the other only net returns are $47 per acre if 30 net tons of energycane are obtained when the price of ethanol is also $2.90 per gallon. More opportunities for positive profitability are shown when the cost of processing ethanol is $1.07 per gallon: $687 per acre, with 34 net tons of sugarcane and $2.90 ethanol price; $90 per acre, with 34 net tons of sugarcane and $2.25 ethanol price; $517 and $348 per acre, with 30 and 26 net tons, respectively, at $2.90 per gallon of ethanol in both cases.

Break-even prices at different levels of biomass yield (from 25 to 40 net tons per acre) and two processing costs of ethanol ($1.07 and $1.65) are shown in Figure 1. There is a wide range of potential outcomes. Obviously, the higher the yield and lower the cost of processing ethanol, the lower is the resulting break-even price. Figure 2 shows a comparison between sugarcane and energycane when the processing cost of ethanol is assumed at an average of $1.35 per gallon for the energycane and $.50 per gallon for ethanol processing from sugarcane. In these cases, break-even prices of ethanol are much lower for ethanol from sugarcane than from energycane.

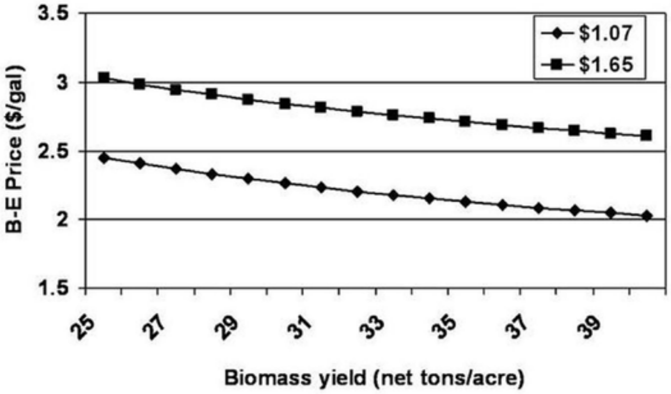

Figure 1. Break-even prices at different levels of yield and two levels of processing cost

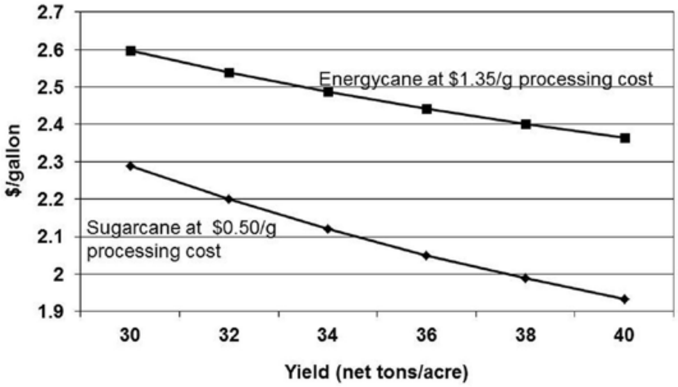

Figure 2. Break-even prices of ethanol from sugarcane and energycane at different levels of yield

Final Considerations

There is evidence that energycane may become a potentially useful bioenergy crop on the unmanaged mineral soils in south-central Florida. The success of this endeavor will be predicated on UF/IFAS, USDA/ARS, and other partners continuing to develop new energycane varieties with higher biomass and longer-lived stands, and more efficient management practices, particularly fertilizer nutrient inputs, along with the Florida Institute for Sustainable Energy improving the cellulosic ethanol conversion process to lower per gallon processing costs.

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Table 1. Estimated per acre costs of cultural activities performed on a one-section (640-acre) energycane farm on mineral (sand) soils of southern Florida, 2010

Activity	Unit	# Years	Rate	# Times	Price	$/Acre/Year
Fallow land maintenance						
Herbicide + surfactant	quart	1	2	2	7.50	30.00
Herbicide application	dollar			2	4.00	8.00
Total						38.00
Prorated total		0.166				6.31
Land preparation						
Soil testing and consulting	dollar	1		1	1.11	1.11
Disking	dollar	1		3	15.00	45.00
Lime (dolomite) application	dollar	1		1	5.00	5.00
Lime material	ton	1	1.00	1	28.00	28.00
Laser leveling[a]	dollar	1		1	60.00	60.00
Calcium silicate slag	ton	1	1.50	1	56.00	84.00
Slag application	dollar	1		1	5.00	5.00
Total	dollar					228.11
Prorated total	dollar	0.166				37.87
Planting						
All related activities[b]	$/acre	1		1	170.00	170.00
Seed cost	$/acre		3.00	1	25.00	75.00
Insecticide[c]	lb/acre	1	15.00	1	2.00	30.00
Micronutrients[d]	lb/acre	1	20.00	1	0.51	10.20
Total	dollar					285.20
Prorated total	dollar	0.166				47.34
Cultural activities						
Nitrogen[e]	pound	6	44.00	4.17	0.60	110.09
P2O5[f]	pound	6	50.00	1	0.60	30.00
K2O[g]	pound	6	45.00	4.17	0.60	112.59
Chemical applications	dollar	6	1.00	2	4.00	8.00
Herbicide (pre-emergence)[h]	quart	6	3.00	1	3.00	9.00
Herbicide (pre-emergence)	gallon	6	1.00	1	16.50	16.50
Herbicide (post-emergence)[i]	quart	6	3.00	1	3.00	9.00
Herbicide (post-emergence)	pint	6	2.00	1	3.00	6.00
Oil (surfactant)	quart	6	1.00	1	1.65	1.65
Mechanical cultivation[j]	dollar	6	1.00	1	6.50	6.50
Total	dollar					309.33
Miscellaneous[k]	dollar					82.26
Interest[l]	dollar					72.39
Harvesting activities						
Harvest, load, and haul[m]	gross tons	6	30.00	1.00	7.00	210.00
Total variable costs	dollar					765.50
Overhead activities						
Supervising and vehicles	gross acre			1	10.00	10.00
Road and ditch maintenance	gross acre			1	5.00	5.00
Pumping and water control	gross acre			1	40.00	40.00
Taxes and assessments	gross acre			1	70.00	70.00

Activity	Unit	# Years	Rate	# Times	Price	$/Acre/Year
Land charge	gross acre			1	75.00	75.00
Total	dollar					200.00
TOTAL COSTS	dollar					965.50

[a] Done to one-half of the 82 acres on fallow every year.

[b] It includes cutting seed cane ($30/new planted acre); furrowing, dropping, chopping, and covering ($130/acre); and fuel costs provided by the farmer ($10/planted acre), which equals $170/planted acre.

[c] 15 pounds of phorate (Thimet®) applied in the furrow at plant covering (no application cost is charged).

[d] 20 pound applied only once during the crop cycle.

[e] 200 pounds in plant cane in 5 splits; 4 splits of 45 pounds each for each of the 5 stubble crops, for an average of 183.33 pounds per year.

[f] 50 pounds in plant cane and 50 pounds in the first split in each ratoon crop.

[g] 225 pounds in plant cane in 5 splits; 4 splits of 45 pounds each for each of the 5 stubble crops, for an average of 187.5 pounds per year.

[h] Pre-emergence every year: 1 gallon of pendimethalin (Prowl®) and 3 quarts of atrazine.

[i] Post-emergence every year: 2 pints of 2,4-D and 3 quarts of atrazine plus 1 quart of oil surfactant.

[j] One per year.

[k] At 10% of above variable costs.

[l] At 8% of total variable costs before harvesting.

[m] Biomass yield assumed in the basic case equals 30 net tons per acre. Since there are no official statistics for Florida's energycane, the figure was adapted from experimental results and grower inputs. Acres harvested per year: 410 (82x5) + 75 = 485/6 = 80.83

Table 2. Sensitivity analysis of costs per activity of the basic case (biomass yield of 30 net tons per acre), excluding those belonging in another category to avoid double-counting

Variation	Land Prep	Planting	Fertilizers	Chemicals	Harvest	Overhead	Total
20% +	127	294	450	123	252	240	1159
15% +	122	282	431	117	242	230	1110
10% +	117	270	412	112	231	220	1062
5% +	111	257	394	107	221	210	1014
Basic case	**106**	**245**	**375**	**102**	**210**	**200**	**966**
5% –	101	233	356	97	200	190	917
10% –	95	221	337	92	189	180	869
15% –	90	208	319	87	179	170	821
20% –	85	196	300	82	168	160	772

Table 3. Relative profitability of energycane produced for ethanol at three levels of biomass yields, three levels of prices of ethanol, and two levels of processing costs

Biomass Yield[a]	**Dry Yield**[b]	**Gallon Ethanol / dry ton**[c]	**Price / Gallon**[d]	**Gross Returns**	**Total Costs** ($/acre)			**Net Returns**	
(ton/acre)	(ton/acre)		($/gallon)	($/acre)	Grower costs[e]	Processing		($/acre)	
						$1.65/g[f]	$1.07/g[g]	$1.65/g	$1.07/g
34	10.2	90	2.90	2662	993	1515	982	154	687
34	10.2	90	2.25	2065	993	1515	982	-442	90
34	10.2	90	1.80	1652	993	1515	982	-855	-323
30	9	90	2.90	2349	965	1336	867	47	517
30	9	90	2.25	1822	965	1336	867	-479	-9
30	9	90	1.80	1458	965	1336	867	-843	-374
26	7.8	90	2.90	2036	937	1158	751	-59	348
26	7.8	90	2.25	1579	937	1158	751	-516	-109
26	7.8	90	1.80	1264	937	1158	751	-8322	-424

[a] The basic case plus and minus 4 tons (see Table 1 for sources of data).

[b] From the assumption of biomass yields with 70% moisture content.

[c] Figure used the most (Frosch 2008).

[d] Calculated from http://e85prices.com/florida.html.

[e] Grower costs, taken from Table 1. Harvesting costs adjusted to yields.

[f] Total costs, including feedstock, amounts to $2.65 per gallon; we have deducted the latter to arrive at a processing and capital cost of $1.65/gallon (Collins 2007; Coyle 2010: 11).

[g] The United States Energy Department in 2006 set a goal of reducing production costs for next-generation biofuels to about $1.07 per gallon by 2012.