Economic Feasibility of an Energy Crop on a South Alabama Cotton-Peanut Farm

E. Todd Frank, Graduate Research Assistant
Department of Agricultural Economics & Rural Sociology, Comer Hall
Auburn University, AL 36849
franket@auburn.edu
(334) 844-5628

Patricia Duffy, Professor
Department of Agricultural Economics & Rural Sociology, Comer Hall
Auburn University, AL 36849
pduffy@acesag.auburn.edu
(334) 844-5629

C. Robert Taylor, ALFA Eminent Scholar
College of Agriculture, Comer Hall
Auburn University, AL 36849
rtyalor@acesag.auburn.edu
(334)-844-1957

David Bransby, Professor
Department of Agronomy and Soils, Funchess Hall
Auburn University, AL 36849
dbransby@acesag.auburn.edu
(334) 844-3935

Max Runge, Extension Specialist
Department of Agricultural Economics & Rural Sociology, Comer Hall
Auburn University, AL 36849
rungemw@auburn.edu
(334) 844-5603

Rodrigo Rodriguez-Kabana, Distinguished University Professor
College of Agriculture
Auburn University, AL 36849
rrodrigu@acesag.auburn.edu
(334) 844-1976

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Tulsa, Oklahoma, February 14-18, 2004.

Economic Feasibility of an Energy Crop on a South Alabama Cotton-Peanut Farm

Abstract

Linear programming and enterprise budgeting were used to analyze rotation options, including an energy crop (intercropped grain sorghum and velvet bean), for a representative south Alabama farm. The energy crop was priced beginning at $30.00 per ton, at which price it did not enter the solution. At prices of $41 per ton or higher, the energy crop was produced.

keywords: energy crop, linear programming, peanut rotation

Introduction

The U.S. Department of Energy (DOE) is seeking alternative fuel sources, such as energy crops, so that the United States can become less reliant on foreign fuel and also to reduce pollution associated with fossil fuels. The biomass from velvet bean production can be used as an alternative source of fuel. Also, because of velvet beans' effects on soil parasites and its soil building properties, a rotation with velvet beans can increase the yields of peanuts and cotton. Unfortunately, there is not currently enough information about the net returns of velvet bean biomass to allow producers to make educated decisions about including this crop in a rotation. The purpose of this paper is to find the prices at which velvet beans become economically attractive to south Alabama producers.

Background

The DOE has been seeking alternative energy sources since the energy crisis of the 1970's. Recently, the department has been looking at ways to meet the demands of electrical generation facilities. In early tests, waste biomass feedstocks -- such as logging residues, wood processing mill residue, urban wood wastes, and selected agricultural residues -- were used to meet some of the demand. Currently, certain locations have limited quantities of these biomass feedstocks available. To meet the demand of these electrical generation facilities and to expand the biomass industry, other sources of biomass must be considered. Biomass supply from crop residue could be used to meet these needs. Crop residue could potentially displace about 12.5 percent of petroleum imports or 5 percent of electricity consumption (Gallagher). One crop that could be used for its biomass qualities is velvet beans.

The velvet bean was first produced in the southern portion of the United States in the late 1800's. Its uses have included livestock feeding and grazing, and it has been recognized as having the potential to improve soil productivity and to have a depressive effect on soil parasites. Velvet beans suppress root-knot nematode (*Meloidogyne arenaria*) in cotton, peanut, soybeans, and other crops. The crop also provides some suppression of Southern blight, (*Sclerotium rolfsii,* also known as White mold), and it is the only known means of control of Reniform nematode (*Rotylenchulus reniformis*). Articles in old literature suggest that velvet beans can be used to control weeds such as bermudagrass and Johnson grass, but there are no current experiments in Alabama that back these claims (Taylor et al).

On average, velvet beans produce about 7 tons of dry biomass per acre. Recently southeastern producers have turned away from growing velvet beans since there is a limited market for the crop, strictly involving livestock feeding. Instead, producers exclusively grow conventional crops, such as peanuts and cotton, which have higher net returns at current prices. A peanut-cotton rotation is a fairly common practice in southeastern Alabama.

Under the Farm Security and Rural Investment Act of 2002, producers enjoy greater flexibility with respect to their planting decisions. Under the 1996 FAIR Act, cotton program payments were decoupled from planting decisions, but peanuts remained under a marketing quota system. The Farm Security and Rural Investment Act of 2002 substantially changed the farm policy for peanuts. Peanut quotas were eliminated, and the current program provides for payments to producers based on past production. Producers may now plant alternative crops on their historical peanut acreage without loss of farm program payments. Also, there are sections in the current farm bill that may benefit producers such as subsidies that promote soil conservation and environmental awareness. An alternative use for velvet bean, such as for a biomass feedstock, improved soil quality, and higher subsequent cotton and peanut yields, may help persuade producers to include this low-input crop in their current crop rotations. In addition, the 2002 Farm Bill contains a section that allocates funds for biomass research and development. Nineteen projects received $23 million in fiscal year 2003. A total of $22 million is offered for 2004.

Other legislation also affects the economic feasibility of energy crops. The Energy Policy Act of 1992 established a 10-year 1.5 cents per kilowatt-hour production tax credit (PTC) for privately owned as well as investor-owned wind projects and biomass plants using dedicated crops (closed-loop) brought on-line between 1994 and 1993, respectively, and June 30, 1999. In addition, the Act instituted the Renewable Energy Production Incentive (REPI), which provides a 1.5 cents per kilowatt-hour incentive, for generation from biomass and other forms of renewable energy, to tax-exempt publicly owned utilities and rural cooperatives. The credit has been adjusted upward for inflation, to reach 1.8 cents per kilowatt-hour. The Economic Security and Recovery Act of 2001 included a two-year extension of the credits, which are now due to expire in December 2003. The Energy Policy Act of 2003, which contains provisions affecting biomass sources for energy, is currently stalled in the Senate.

Energy subsidies, provided to plants for use of co-fired biomass, could raise demand for biomass to the point where velvet beans become economically attractive. An issue that has been studied on only a limited basis is how much electric plants would have to pay agricultural producers to ensure an adequate supply of this crop.

Data and Methods

Enterprise budgeting and linear programming were used to find the prices at which velvet beans become profitable crop alternatives on south Alabama cotton and peanut farms. Yield data for the enterprise budgets came from field tests performed from 1993 to 1998 at the Wiregrass Substation in Headland, Alabama. Rotations considered were: continuous peanut, velvet bean-peanut, cotton-peanut, velvet bean-velvet bean-peanut, and cotton-cotton-peanut. The experimental yields are reported in Table 1. Energy Crop yield data were not collected for many of the trials, as indicated.

For the purpose of the model, the experimental yields were adjusted downward to reflect farm condition yields. The adjusted yields are reported in Table 2. These adjusted yields were used to compute the percentage increase in yields resulting from crop rotation effects.

Alabama Cooperative Extension System enterprise budgets for south Alabama were used for the variable and fixed costs of producing cotton and peanuts, as well as for the base yields (without rotation) of these crops. Since there is no recent enterprise budget for velvet beans, one was developed using information provided by the Alabama Cooperative Extension System and from the Alabama Agricultural Experiment Station. A yield of 7 tons per acre was used in the budget, the approximate yield achieved in the experimental plots. Because velvet beans need some type of structural support to grow upright, they are intercropped with sorghum and the cost of sorghum seed is included in the budget. The velvet bean budget is reported in Table 3.

In the budgets, the expected price for peanuts was set at $400.00 per ton and price for cotton was $0.60 per pound. The price received for a dry ton of velvet bean biomass was parameterized, over the range $30 per ton to $45. The returns above variable costs from the enterprise budgets were imported into a linear programming model, which included the rotation restrictions under the assumption of equilibrium cropping patterns, and a land restriction. The land available for production was limited to 1000 acres, which is a representative, average-size, commercial cotton-peanut farm in the southeast region of Alabama. The linear programming model, for the "base" situation of $30 per ton biomass, is reported in Table 4.

In the model, the price for a ton of biomass began at the base level of $30.00 and increased parametrically until velvet beans entered the solution as part of a rotation, and then again until continuous velvet bean was found to be optimal.

Results

Model results are reported in Table 5. When the energy crop is priced below $41.00 per ton of dry biomass, the farm would select a cotton-cotton-peanut rotation. When the energy crop is priced between $41.00 and $44.00 per ton of biomass, a velvet bean-velvet bean-peanut rotation is selected. At or above $45.00, it would be optimal to plant velvet beans only. The increased energy crop prices were associated with increased returns above variable cost for the farm.

Results of this analysis support those found by De La Torre Ugarte et al. Using a market-level simulation tool (POLYSYS), they found that at a price of $40 per dry ton for switchgrass, 42 million acres of cropped, idled, pasture or CRP acres would be converted to biomass production. Our farm-level analysis discovered a similar energy price would be necessary to convert traditional cropland to biomass production.

Discussion

Velvet beans are not economically attractive in a rotation on a representative south Alabama cotton and peanut farm until the price reaches $41.00 per ton of dry biomass. Producers will have to be offered at least this price at the farm gate before they can consider the rotation above a cotton-cotton-peanut rotation. For producers to grow only velvet beans, the price must increase to $45.00 per ton of biomass. Depending on the distance of a farm from a power plant and the outcome of the pending federal legislation, which includes incentives for co-firing biomass, prices in this range could be realized in the near future.

References

Alabama Cooperative Extension System. 2003 Budgets for Major Row Crops in Alabama. Auburn, AL: Auburn University, Department of Agricultural Economics and Rural Sociology, AGEC BUD 5-1 May.

De La Torre Ugarte, Daniel G., Hosein Shapouri, Marie E. Walsh and Stephen P. Slinsky. *The Economic Impacts of Bioenergy Crop Production on U.S. Agriculture*. Washington, D.C.: USDA. February, 2003.

Gallagher, P., M. Dikeman, J. Fritz, E. Wailes, W. Gauther, and H. Shapouri. *Biomass from Crop Residues: Cost and Supply Estimates.* U.S. Department of Agriculture, Office of Chief Economist, Office of Energy Policy and New Uses. AgriculturalEconomic Report No. 819, 2003.

Taylor, C.R., R.R. Rodriguez-Kabana. *History of the Alabama Velvet Bean and Its Potential for the Future.* Auburn, AL: Auburn University, Farming Systems Research Forum, No. 2, 1998.

Taylor, C.R., R.R. Rodriguez-Kabana. “Optimal Rotation of Peanuts and Cotton to Manage Soil-borne Organisms.” *Agricultural Systems,* 61 (1999): 57-68.

Taylor, C.R., R.R. Rodriguez-Kabana. “Population Dynamics and Crop Yield Effects of Nematodes and White Mold in Peanuts, Cotton, and Velvet Beans.” *Agricultural Systems,* 59 (1999): 177-191.

Table 1. Actual Yields of Cotton, Peanut, and Velvet Beans Grown on Wiregrass Experiment Farm Located in Headland, Alabama

Plot Number	1993 Yield	1993 Crop	1994 Yield	1994 Crop	1995 Yield	1995 Crop	1996 Yield	1996 Crop	1997 Yield	1997 Crop	1998 Yield	1998 Crop
2	2565.2	P	4162.4	P	3605.8	P	3775.2	P	2202.2	P	2662	P
4	-	VB	4840	P	-	VB	4283.4	P	-	VB	3146	P
6	2274.8	CT	4646.4	P	3557.4	CT	4331.8	P	2589.4	CT	3242.8	P
8	-	VB	-	VB	4961	P	13686.4	VB	-	VB	3557.4	P
9	2371.6	CT	1911.8	CT	4985.2	P	2662	CT	2347.4	CT	3630	P

Yield in pounds per acre. P = peanuts. VB = velvet beans. CT = cotton.

Table 2. Yields from Experiment Farm Adjusted to Simulate Real Farm Conditions

Plot Number	1993 Yield	1993 Crop	1994 Yield	1994 Crop	1995 Yield	1995 Crop	1996 Yield	1996 Crop	1997 Yield	1997 Crop	1998 Yield	1998 Crop
2	2000.9	P	3246.7	P	2812.5	P	2944.7	P	1717.7	P	2076.4	P
4	-	VB	3775.2	P	-	VB	3341.1	P	-	VB	2453.9	P
6	455.0	CT	3624.2	P	711.5	CT	3378.8	P	517.9	CT	2529.4	P
8	-	VB	-	VB	3869.6	P	13686.4	VB	-	VB	2774.8	P
9	474.3	CT	382.4	CT	3888.5	P	532.4	CT	469.5	CT	2831.4	P

Yield in pounds per acre. P = peanuts. VB = velvet beans. CT = cotton.

Table 3. Enterprise Budget for Velvet Beans/ Grain Sorghum Mix

ITEM	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL PER ACRE
GROSS RECEIPTS				
VELVET BEAN/GRAIN SORGHUM	Ton	7.00	30.00	210.00
VARIABLE COSTS				
SEED (velvet bean)	ACRE	1.00	30.00	30.00
SEED (sorghum)	LBS.	5.00	1.20	6.00
FERTILIZER				
NITROGEN	LBS.	0.00	0.28	0.00
PHOSPHATE	LBS.	0.00	0.20	0.00
POTASH	LBS.	0.00	0.15	0.00
LIME (PRORATED)	TONS	0.33	22.50	7.43
HERBICIDE	ACRE	0.00	6.75	0.00
INSECTICIDE	ACRE	1.00	0.00	0.00
TRACTORS & EQUIPMENT	ACRE	1.00	42.86	42.86
LABOR (WAGES & FRINGE)	HOUR	5.49	6.50	35.71
INTEREST ON OP. CAP.	DOL.	61.00	0.075	4.57
TOTAL VARIABLE COST				126.57
INCOME ABOVE VARIABLE COST				83.43
FIXED COSTS				
TRACTOR & EQUIPMENT	ACRE	1.00	77.08	77.08
GENERAL OVERHEAD	DOL.	126.57	0.07	8.86
TOTAL FIXED COSTS				85.94
OTHER COSTS				
LAND RENT	ACRE	1.00	0.00	0.00
TOTAL OTHER COSTS				0.00
TOTAL OF ALL SPECIFIED EXPEN				212.51
NET RETURNS				-2.51

Costs of production drawn from Alabama Cooperative Extension System budgets.

Table 4. Linear Programming Model for Velvet Bean, Cotton, and Peanut Crops in South Alabama

	year 1			year 2		year 3			
	vb	conpt	ct	pbrot	pcrot	p2brot	p3c2c1		RHS
Objective	83.43	34.82	152.51	103.25	103.64	187.40	194.69	MAX	
bprotc	-1			1				LE	0
cprotcon			-1		1			LE	0
bbprotc	-0.5					1		LE	0
ccprotc			-0.5				1	LE	0
Land	1	1	1	1	1	1	1	LE	1000

Table 5. Results of LP Model for Parameterized Velvet Bean Prices

Price Per Ton of Velvet bean Biomass	Optimal Rotation	Optimal Gross Net Return on 1000 Acres
Less than $41.00	Cotton-Cotton-Peanut	$166,568.40
Between $41.00 and $44.00	Velvet bean-Velvet bean-Peanut	$169,418.60-183,418.60
$45.00 and above	Velvet bean-Velvet bean-Velvet bean	$188,568.40