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Information Sources and Farmers' Attitudes Toward Switchgrass Production as a Biofuel Feedstock

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Abstract: *Farmers' use of information sources about switchgrass, a potential cellulosic ethanol feedstock, and interest in growing switchgrass are examined. Data are from a 2009 survey of farmers in 12 southern states. Farmers familiar with switchgrass production for energy tend to be younger, more highly educated, have larger farms, have higher farm incomes, and attend more Extension workshops than farmers unfamiliar with switchgrass. Farmers familiar with switchgrass tend to use multiple sources of information and use certain types of sources to formulate various opinions about switchgrass. Familiarity with switchgrass and using multiple information sources may build farmer interest in growing switchgrass.*

Introduction

The Energy Independence and Security Act of 2007 specifies that 36 billion gallons of U.S. fuel must come from biofuels by 2022 and that 16 billion of these gallons must come from cellulosic ethanol (U.S. Congress, 2007). This policy, along with the market forces that have placed upward pressure on corn prices, including demand from the biofuels sector, have rekindled the so-called "food-versus-fuel" debate (Elam, 2010; Harrison, 2009) and highlighted the need for non-food, non-feed biomass feedstock sources, such as switchgrass. Switchgrass is a grass that is native to North America, needs relatively low inputs, and can serve as a cellulosic feedstock for biofuels (Bransby, 2005).

As the market for cellulosic feedstock emerges, Extension educators will be asked to provide information about biofuels market development to farmers and to help interested farmers serve as successful suppliers of biomass feedstock to this market. Questions that are likely to influence these efforts include: a) Which farmers are already familiar with switchgrass, and which are not? b) What sources of information have farmers been using to learn about switchgrass and switchgrass production? c) What factors influence a farmer's decision to produce switchgrass? d) How do information sources shape farmers' views about switchgrass production? and, e) How does interest in growing switchgrass vary across producer

familiarity with switchgrass and use of a variety of switchgrass information sources?

A number of studies have examined how farmers obtain information and adopt new technologies. In general, farmers and forest landowners rely on a variety of sources for information (Licht & Martin, 2007; Radhakrishna, Nelson, Franklin, & Kessler, 2003; Vergott & Mayo, 2005) to manage their farms and land resources. However, many farmers prefer one-on-one interaction with Extension agents to obtain information (Suvedi, Lapinski, & Campo, 2000). Published theories on how technologies are diffused and adopted have been around for more than five decades (Rogers, 2003; Rogers, 1963) and have been used to guide Extension programming (Hubbard & Sandman, 2007).

Lack of information about biofuel crop production is a potential barrier to adoption of these crops by farmers (Kelsey & Franke, 2009). Several prior studies have examined farmers' attitudes toward the potential adoption of switchgrass as a biofuel feedstock (Bransby, 1998; , et al., 2007; Velandia, Lambert, Fox, Walton, & Sanford, 2009; Wen, Ignosh, Parrish, Stowe, & Jones, 2009). However, these efforts have been limited in their geographic scope. Recognizing that much of the southern U.S. has a comparative advantage relative to other regions in switchgrass production (English, La Torre Ugarte, Walsh, Hellwinckle, & Menard, 2006), the research presented here uses data from a mail survey of farmers from 12 southern U.S. states (AL, AR, GA, KY, LA, MS, NC, OK, SC, TN, TX, VA) to ascertain familiarity with switchgrass, use of information sources about switchgrass, attitudes toward switchgrass, and how use of information sources influence these attitudes.

Methods

The mail survey was sent to a random sample of 7,000 farmers with at least \$10,000 in sales as identified from the 2007 Census of Agriculture (NASS, 2007) by the USDA National Agricultural Statistics Service. A total of 1,301 completed surveys were returned for a response rate of 18.7%. The survey included questions asking farmers about their familiarity with switchgrass as an energy crop, sources they had used to obtain information about switchgrass, the importance of various factors that might influence their decision to produce switchgrass, interest in growing switchgrass if profitable, farm characteristics, and farmer demographics. Using data from the survey responses, we address a variety of issues relevant to education programs related to the production of switchgrass as a biofuel feedstock. More specifically, we:

- a. Identify profiles of farmers who are familiar or unfamiliar with switchgrass by comparing the mean or frequency of farm characteristics or farmer demographics across familiarity with switchgrass using t-tests for continuous variables or chi-square tests (χ^2) of association for discrete variables (Table 1).
- b. Examine which information sources farmers use by calculating frequencies of use of various types of information sources about switchgrass (Figure 1).
- c. Ascertain which factors may be of most importance in influencing farmers' decision to grow switchgrass by calculating mean importance ratings of factors influencing the decision to grow switchgrass and then comparing these means with t-tests (Table 2).
- d. Evaluate how information sources influence farmers' opinions about switchgrass by comparing the importance ratings of the factors influencing the decision to grow switchgrass across sources of switchgrass information using t-tests at the 95% confidence level (Table 3). We also create a variable indicating the number of information sources used by the farmer (0=three or fewer and 1=greater than three) and compare the mean importance ratings of the factors across this variable using t-tests at the 95% confidence level (Table 3).
- e. Assess how familiarity influences interest in growing switchgrass by comparing the frequency of level of interest in growing switchgrass across the frequency of familiarity (Figure 2). We test for association between these two variables using a chi-square (χ^2) test of association. We also compare frequency of interest in growing switchgrass across the variable representing the number of information sources (Figure 3) and test for association between the two variables using a chi-square (χ^2) test.

Results

Familiarity with Switchgrass as a Potential Biomass Feedstock

Overall, about 41.95% of the farmers consider themselves to be somewhat or very familiar with switchgrass as a crop to

be used in energy production (n=1,137). Results from one prior study showed greater familiarity with switchgrass (Wen et al., 2009), while another showed less (Jensen et al. 2007). Table 1 contains comparisons of farm characteristics and farmer demographics across familiarity. On average, farmers who are familiar with switchgrass farm more acres, are younger, have higher farm incomes, and are more educated. In addition, these farmers attend more Extension workshops or field days and are more likely to own a computer. No statistical association between sole proprietorship and familiarity is found.

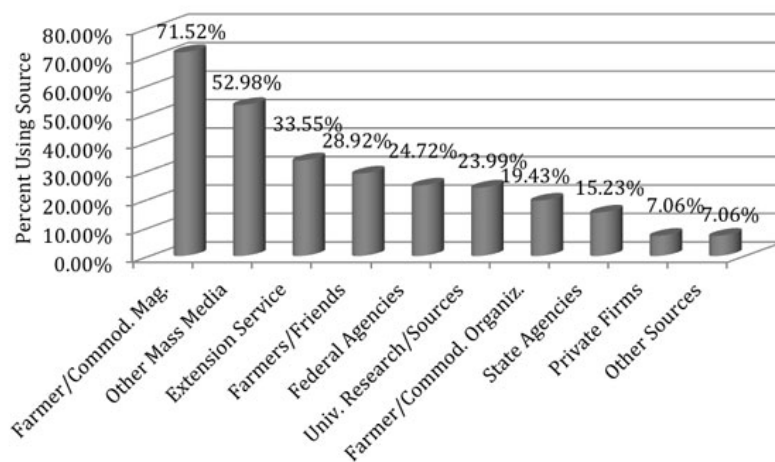
Table 1.
Farm Characteristics and Farmer Demographics Across Familiarity with Switchgrass

Farm Characteristic or Farmer Demographic	Number of Obs.	Mean or Frequency of Farm Characteristics or Farmer Demographics			
		Familiar with Switchgrass ^c			
		No	Yes	t	
Acres Farmed	1,042	302.81	483.90	-4.33	*
Age of Farmer	1,089	62.61	57.63	6.90	*
Farm Income ^a	1,000	4.27	5.57	-5.06	*
Education Level ^b	1,098	3.97	4.42	-6.27	*
Extension Workshops or Experiment Station Field Days Attended in 2008	1,049	.70	1.55	-6.73	*
		No	Yes	χ^2	
Own a Computer	1,100	67.35%	81.88%	29.17	*
Sole Proprietorship	1,137	73.18%	73.38%	0.01	
<p>a Net farm income for 2008 is categorized as 1= Negative (less than \$0), 2=\$0-\$9,999, 3=\$10,000-\$14,999, 4=\$15,000-\$19,999, 5=\$20,000-\$24,999, 6=\$25,000-\$29,999, 7=\$30,000-\$34,999, 8=\$35,000-\$39,999,, 9=\$40,000-44,999, 10=\$45,000-49,999, 11=\$50,000-\$74,999, 12=\$75,000-\$99,999, 13=\$100,000-\$149,999, 14=At least \$150,000.</p> <p>b Education level attained is categorized as 1=Elementary/Middle school, 2=Some high school, 3=High school graduate, 4=Some college, 5=College graduate, 6= Post graduate.</p> <p>c * indicates significance at the 95% confidence level.</p>					

Use of Information Sources

Farmers familiar with switchgrass obtain information about switchgrass from a variety of sources. The percentages of farmers using various sources to obtain information about switchgrass are displayed in Figure 1. The most commonly used sources are farmer or commodity magazines (71.52%) and other mass media (52.98%). About 33.55% of farmers rely on Extension, while 28.92% use other farmers or friends. Private firms and other sources are cited least often. Other sources listed by farmers included the power companies, other non-profits, and wildlife organizations. On average, farmers who are familiar with switchgrass use a total of 2.84 different types of information sources (n=453).

Figure 1.
Sources Used by Farmers to Obtain Information About Switchgrass



Attitudes About Switchgrass Production

In the survey, we asked farmers to rate the importance of various factors to their decision to produce switchgrass. A summary of these responses is provided in Table 2. We compared the mean importance ratings of these factors. Means that are not significantly different (at the 95% confidence level) are indicated by letters in the column of mean ratings. Concerns about profitability of switchgrass and lack of market development are rated among the most important (i.e., somewhat to very important). Farmers also rate the potential for lower fertilizer and herbicide applications than with other crops as important influences on their decision to grow switchgrass. No significant difference in importance is found among these three reasons based upon t-tests at the 95% confidence level. Farmers rate concern about planting a perennial crop, such as switchgrass, on land that is leased as least important (i.e., not very to somewhat important).

Table 2.
Importance of Factors Influencing Farmers' Decision to Grow Switchgrass

Factors Potentially Influencing Adoption	Mean Rating of Importance ^{1,2} (n=899)
a) Profitability of growing switchgrass compared with other farming alternatives (<i>SWITPROF</i>)	3.54 ^a
b) Concern that the market for switchgrass as an energy crop is not developed enough yet (<i>MKTCON</i>)	3.49 ^a
c) Possibility of lowering fertilizer and herbicide applications as compared with crops currently growing (<i>LINPUT</i>)	3.47 ^a
d) The three year lag between planting and switchgrass reaching its full yield potential (<i>LAGPOT</i>)	3.33 ^b
e) Ability to use switchgrass as a feed for livestock (<i>LFEED</i>)	3.32 ^{b,c}
f) Concern about having the financial and equipment resources needed to produce switchgrass (<i>CONCAP</i>)	3.25 ^{b,c}
g) Potential to help the environment by producing switchgrass for fuel (<i>ENVIRON</i>)	3.23 ^{b,c}
h) Potential to contribute to national energy security by producing switchgrass for fuel (<i>SECURE</i>)	3.21 ^c
i) Potential for switchgrass to provide habitat for native wildlife on your farm (<i>HABITAT</i>)	2.97 ^d
j) Opportunity to diversify your farming operation (<i>DIVERSE</i>)	2.91 ^d

k) Your knowledge about growing switchgrass compared with your knowledge about growing other crops (<i>KNOW</i>)	2.90 ^d
l) Potential for creating jobs in your community (<i>JOBS</i>)	2.87 ^d
m) Potential for switchgrass to reduce erosion on your farm (<i>EROSION</i>)	2.70 ^e
n) Whether acreage converted to switchgrass would qualify for CRP payments or not (<i>CRPQUAL</i>)	2.62 ^e
o) Possible conflicts between planting/harvest period for switchgrass and planting/harvest period for your other crops (<i>CONFLICT</i>)	2.45 ^f
p) Possibility that you will cease farming in the next few years due to retirement or other reasons (<i>CEASE</i>)	2.44 ^f
q) Concern about planting a perennial crop such as switchgrass on land that is leased (<i>LEASE</i>)	2.15
¹ The scale is 1=not at all, 2=not very, 3=somewhat, 4=very, 5=extremely. ² Like letters beside the means indicate no significant difference at the 95% confidence level.	

Effects of Information Sources on Attitudes

We examined how differing information sources may influence producer attitudes toward switchgrass production by evaluating the mean importance ratings of factors influencing the decision to produce switchgrass across whether the producer used a particular type of information source or not, using t-tests at the 95% confidence level. The results are shown in Table 3. Opinions about six of the factors (*SWIPROF*, *EROSION*, *CRPQUAL*, *SECURE*, *ENVIRON*, and *CONCAP*) are excluded from the table as they do not change across any of the information sources. Also, none of the opinions about the factors are significantly different across the state agricultural agency or private firm sources, so these two sources are omitted from the table. Some interesting patterns can be seen in the results presented in Table 3. First, farmers' opinions about the effects of potential planting and harvest conflicts of switchgrass with other crops appear to be shaped by farmer/commodity organizations and farmer/commodity magazines. Similarly, opinions about broader benefits from switchgrass, including the importance of switchgrass potential to add jobs or provide wildlife habitat, may be influenced by federal agricultural agencies. Opinion about the importance of the potential for switchgrass to lower input use appears to be influenced by use of Extension service and university sources, as well as other farmers. It would also appear that the use of multiple sources of information may lower producers' concerns about their knowledge of switchgrass relative to other crops.

Table 3.
Effect of Information Source on Mean Importance of Factors Influencing Decision to Grow Switchgrass^{a,b}

Factors Influencing Decision to Grow Switchgrass	Sources of Information About Switchgrass								
	Farmer/Commodity Magazines	Other Mass Media	Extension Service	University	Federal Ag. Agency	Farmer Commodity Organiz.	Other Farmers/Friends/Neighbors	Other	Multiple Sources ^b
<i>PLANCON</i>	Increased					Increased			Increased
<i>MKTCON</i>	Increased							Increased	
<i>FCEASE</i>						Decreased			
<i>KNOW</i>									Decreased
<i>CONLEASE</i>		Decreased							
<i>DIVERSE</i>				Increased	Increased				Increased

JOBS					Increased				
HABITAT					Increased			Increased	
LFEED							Increased		
LAGPOT			Increased						
LINPUT			Increased	Increased			Increased	Increased	

^a The shaded boxes indicate the differences in the mean importance rating of a factor across whether the information source is used at the 95% confidence level. The text reflects the direction of the change in the mean when the information source is used.

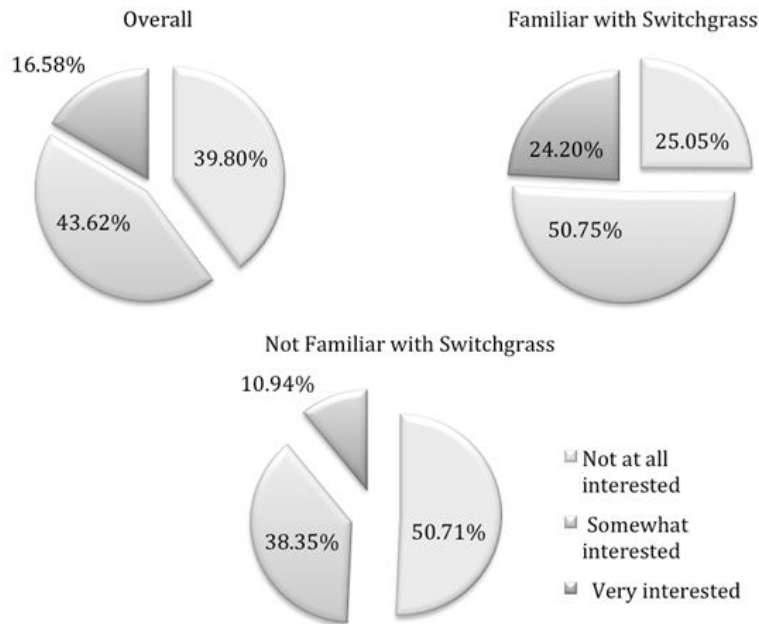
^b If three or fewer information sources were used, Multiple Sources is assigned a value of zero. If greater than three sources are used, Multiple Sources is assigned a value of one

Interest in Growing Switchgrass and Familiarity with Switchgrass

Over 60% of the responding farmers are somewhat or very interested in growing switchgrass if profitable. This level of interest is higher than prior studies (Jensen et al., 2007; Wen et al., 2009). The pie charts displayed in Figure 2 show the percentages of farmers interested in growing switchgrass across familiarity with switchgrass. Among producers who are unfamiliar with switchgrass, 49.29% are somewhat or very interested in growing switchgrass. For producers who are familiar with switchgrass, this percentage jumps to 74.95%. The chi-square test of association shows a significant level of association between familiarity with switchgrass and interest in growing it if profitable (calculated $\chi^2 = 82.33$ with 2 df, significant at the 99% confidence level). This result suggests that information and education have a positive influence on interest in growing switchgrass.

Figure 2.

Producer Interest in Growing Switchgrass if Profitable Overall and Across Familiarity with Switchgrass

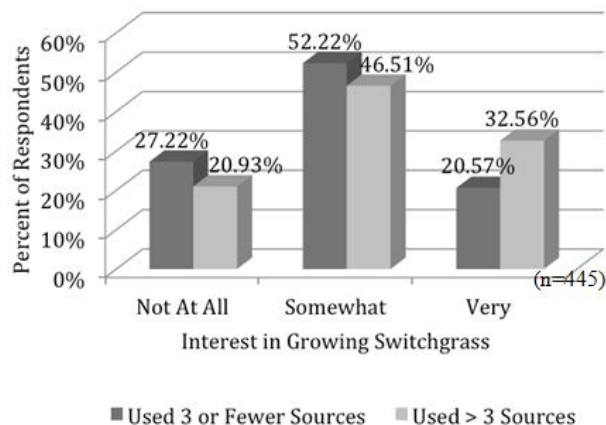


Interest in growing switchgrass is also compared across the number of different types of information sources used. In Figure 3, the percentages of farmers with various interest levels in growing switchgrass are shown for both farmers who used three or fewer types of information sources and for those who used more than three. Notably, among those who used three or fewer sources, 27.72% are not at all interested; however among those using more than three sources, only 20.93% are not at all interested. Conversely, only 20.57% of those using three or fewer sources are very interested in growing switchgrass, while 32.56% of those using more than three sources are. The chi-square test of association shows a significant level of association between use of more information sources and interest in growing switchgrass if profitable

(calculated $\chi^2 = 7.4898$ with 2 df, significant at 95% confidence level). Hence, interest in growing switchgrass is positively correlated with use of multiple information sources. This finding suggests that farmers are likely to respond to educational materials they receive from a variety of sources and formats, and/or that farmers who are interested in an unfamiliar endeavor such as switchgrass production will seek information from a variety of sources.

Figure 3.

Interest in Growing Switchgrass Across Number of Information Sources



Conclusions

Many farmers are still unfamiliar with the production of switchgrass as a biofuel feedstock, particularly older, less educated farmers with lower farm incomes. This finding highlights the need to provide education about switchgrass to farmers that Extension is uniquely poised to reach. Farmers who are familiar with switchgrass tend to use multiple information sources and tend to use differing sources to formulate various opinions about switchgrass. The results from the study reported here suggest that familiarity with switchgrass and using multiple sources of information may build farmer interest in growing switchgrass. Hence, farmer education will likely be a key to development of switchgrass as a feedstock on a commercial scale.

Not surprisingly, the study also finds that profitability is important to farmers when it comes to interest in growing switchgrass. A majority of farmers are at least somewhat interested in growing switchgrass if production is profitable. In terms of factors influencing growing decisions, almost all of the informational sources were found to have a significant impact on at least one decision-making factor. This suggests that farmers are seeking information to support decision-making and that the various information sources affect these decision processes differently.

As the third most often used source of information, Extension is uniquely positioned to have significant impacts on farmer decision-making regarding growing switchgrass as a bioenergy feedstock. A key factor influencing interest in growing switchgrass for which Extension information contributed to shaping farmers views is the ability of switchgrass to lower input use. The fact that various facets of farmers' views on switchgrass are shaped by different information sources suggests that partnering approaches among Extension, university researchers, commodity organizations, farmers, and state and federal agencies can provide a full complement of information for farmers to use in decision making regarding switchgrass.

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