ADOPTION OF AUTOMATIC SECTION CONTROL IN COTTON PRODUCTION

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Abstract

Automatic Section Control is a precision farming technology that has been rapidly adopted by producers in that past few years. Automatic Section Control (ASC) technologies provide control over planting or spraying operations such that sections or rows on the planters/sprayers are turned off in areas of the field that had been previously covered or on and off at point and end rows, during headland turns, and when avoiding obstacles within a field boundary. Potential benefits of this technology are input savings, improved application efficiency, and environmental stewardship. Little is known about adoption rates among cotton farmers and the factors affecting adoption of this technology. Using descriptive statistics and a probit regression, we identified adoption rates of ASC technology among cotton producers in the southeast region and potential factors influencing the adoption of ASC for planters and sprayers. Such information may be useful for industry in terms of product marketing and for Extension with respect to informational programming and dissemination.

Introduction

Increasing seed, fertilizer, and chemical costs motivate farmers to use precision agriculture (PA) technologies that may improve the efficiency of input application. An example of input application inefficiency is input over-application. Over-application of fertilizer and/or chemicals increases production costs, may reduce yields, and could increase the risk of fertilizer and chemicals runoff into surface and ground water sources (Shockley et al. 2012). In the context of Precision Agricultural (PA) technologies, Automatic Section Control technologies controls input over application by turning planter/sprayer sections or rows off in areas were inputs have been previously applied or on and off at headland turns, point rows, terraces, and/or waterways (Shockley et al. 2012). Although rapidly adopted since first available in the market when compared to other PA technologies, little is known about adoption rates of Automatic Section Control technologies among cotton producers as well as the factors influencing the adoption of this technology among these producers. The objective of this study is to evaluate the factors influencing the adoption of ASC technologies in cotton production.

Materials and Methods

A mail survey of cotton producers located in Alabama, Arkansas, Florida, Georgia, Kansas, Louisiana, Mississippi, Missouri, New Mexico, North Carolina, South Carolina, Tennessee, Texas, and Virginia was conducted in February of 2013 to establish the current use of cotton precision farming technologies in these states. A mailing list of 13,556 cotton producers was furnished by the Cotton Board. A total of 1,810 of these farmers provided a valid response for a response rate of 13.76% (Boyer et al., 2013).

A weighted probit regression was used to identify factors influencing adoption of ASC among cotton farmers. Post-stratification survey weights based on the number of cotton farms representing six farm size classes were estimated to adjust the central tendency measures of the survey data to more closely match the distribution of the cotton producer

population data from the 2012 Agricultural Census. Additionally, multicollinearity and endogentiy were tested for the regression model used in this analysis.

Results and Discussion

Results are presented in two sections. The first section summarizes ASC technology adoption percentages for all the fourteen states included in the survey. The factors influencing overall adoption rates for ASC technologies are discussed in the second section.

ASC Adoption Rates by State

Initial findings suggested that Tennessee has the highest ASC adoption rate (48%) while Florida has the lowest ASC adoption rate with 13% of the 16 Florida cotton producers included in our sample adopting ASC technologies (Table 1).

Table 1. ASC Adoption by State (n=1,157)

State		Unweighted Means	Weighted Means
Alabama	(n=97)	0.31	0.25
Arkansas	(n=30)	0.40	0.36
Florida	(n=16)	0.19	0.13
Georgia	(n=146)	0.21	0.17
Kansas	(n=12)	0.33	0.32
Louisiana	(n=44)	0.18	0.15
Mississippi	(n=69)	0.30	0.25
Missouri	(n=37)	0.32	0.28
North Carolina	(n=170)	0.30	0.26
Oklahoma	(n=15)	0.53	0.46
South Carolina	(n=63)	0.27	0.24
Tennessee	(n=80)	0.56	0.48
Texas	(n=356)	0.23	0.20
Virginia	(n=22)	0.41	0.37

Factors Influencing Adoption of Automatic Section Control Technologies

The dependent and independent variables used in the probit regressions are identified in Table 2. Weighted means suggest that 23% of the producers in our sample had adopted ASC for planting and/or spraying. The average age of producers included in the sample is 58; 50% use computers for farm management; 32% of the producers have their operations in states with irregularly shaped fields; and 59% have an associate's degree or higher. The weighted average of cotton acres planted in 2011 and 2012 was 499 acres compared to the unweighted average of about 689 acres. The weighted average of farm and garden machinery and equipment wholesalers was 4 per county.

Table 2. Descriptions and Summary Statistics of Dependent and Independent Variables (n=1,157)

Variables	Description	Unweighted Mean	Weighted Mean
Dependent Variable			
ASC	=1 if the producer uses ASC for sprayers or planters	0.29	0.23
Independent Variables			
AGE	Age of the primary decision maker.	57.41	57.80
COMP	=1 if the producer uses computers for farm management.	0.53	0.50
IRRFIELD	=1 if the producer farm is located in a state with non-rectangular fields (no PLSS system to determine boundaries).	0.42	0.32
ASBAGD	=1 if the producer has an associates, bachelors, or graduate degree.	0.59	0.59
AVACRES	Average cotton acres (2011 and 2012).	689.27	498.72
TOTALEST	Total number of farm and garden machinery and equipment merchant wholesalers.	3.91	4.15

Factors positively influencing the decision to adopt ASC according to both the weighted and unweighted probit regressions were computer use and planted cotton acres (Table 3). A producer using a computer for farm management is 19% more likely to adopt ASC technologies while an additional acre of planted cotton will increase the probability of adopting ASC by only about 0.001%. Those factors negatively influencing the adoption of ASC were age and number of farm and garden machinery and equipment merchant wholesalers in the county where the farm operation is located. The non-weighted probit regression suggests that those farms located in states with more irregular field shapes are 7% more likely to adopt ASC technologies but this significant effect vanishes when using post-stratification survey weights in the estimation (Table 3).

Table 3. Estimated Parameters and Marginal Effects from Probit Models Evaluating Factors Influencing Adoption of ASC (n=1,157)

	Probit Model		Weighted Probit Model	
Independent Variables	Estimated Parameters	Marginal Effects	Estimated Parameters	Marginal Effects
AGE	-0.0165***	-0.0048	-0.0132***	-0.0035
	(0.0031)		(0.0032)	
COMP	0.6364***	0.1839	0.7270***	0.1914
	(0.0920)		(0.1040)	
IRRFIELD	0.2366***	0.0684	0.1072	0.0282
	(0.0895)		(0.0975)	
ASBAGD	0.1154	0.0333	0.1221	0.0321
	(0.0902)		(0.1041)	
AVACRES	0.0004***	0.0001	0.0004***	0.0001
	(0.0001)		(0.0001)	
TOTAEST	-0.0226**	-0.0065	-0.0198**	-0.0052
	(0.0094)		(0.0110)	
Likelihood value	-592.903		-7959.77	
Likelihood ratio/Wald	201***		144***	

*, **, *** denotes significance at the 10%, 5%, and 1% levels respectively.

Summary

This article presents initial findings regarding the factors influencing the adoption of ASC technologies among cotton farmers using data from the 2013 Southern Cotton Precision Farming Survey.

The preliminary results presented above suggested that younger producers, with larger cotton operations, using computers for farm management, are more likely to use ASC technologies for planters and/or sprayers in cotton production.

Additionally tests for potential endogeneity of the variable representing total number of farm and garden machinery and equipment merchant wholesalers should be explored given the nature of this variable (count). Other regression models should be considered if endogeneity problems are identified using alternative tests.

Acknowledgements

The authors acknowledge financial support from Cotton Incorporated and the agricultural research institutions of the University of Florida, Louisiana State University, Mississippi State University, North Carolina State University, University of Tennessee, and Texas Tech University.

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