Precision Farming by Cotton Producers in Eleven Southern States: Results from the 2005 Southern Precision Farming Survey

Rebecca L. Cochran, Roland K. Roberts, Burton C. English, James A. Larson, W. Robert Goodman, Sherry L. Larkin, Michele C. Marra, Steven W. Martin, Kenneth W. Paxton, W. Donald Shurley, and Jeanne M. Reeves

Research Series 01-06

Department of Agricultural Economics
The University of Tennessee
Knoxville, Tennessee

Rebecca L. Cochran is a Research Associate, Roland K. Roberts and Burton C. English are Professors, and James A. Larson is an Associate Professor at the University of Tennessee. W. Robert Goodman is an Associate Professor at Auburn University, Sherry L. Larkin is an Assistant Professor at the University of Florida, Michele C. Marra is a Professor at North Carolina State University, Steven W. Martin is an Assistant Professor at Mississippi State University, Kenneth W. Paxton is a Professor at Louisiana State University, W. Donald Shurley is a Professor at the University of Georgia, and Jeanne M. Reeves is Director of Production Economics Research at Cotton Incorporated.

Please visit the department's web site at **http://economics.ag.utk.edu**.

Additional copies of this report may be obtained from:

Department of Agricultural Economics
The University of Tennessee
2621 Morgan Circle
Knoxville, TN 37796-4518
(865) 974-7231

Acknowledgements

Support for this research was provided by Cotton Incorporated and the Land Grant Universities of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, and Tennessee.

Disclaimer

Mention of trade names or other proprietary marks does not imply approval of products to the exclusion of similar products nor does it constitute endorsement by the authors, Cotton Incorporated, or the Tennessee Agriculture Experiment Station.

R11-1216-077-001-06

TABLE OF CONTENTS

Executive Summary

Precision farming uses a set of technologies to map yield variability within a farm field and diagnose its causes, prescribe variable rates of inputs across the field according to soil and crop needs, and apply those inputs at variable rates according to the prescription. The objectives of this study were 1) to determine the status of precision farming technology adoption by cotton producers in 11 states and 2) to evaluate changes in cotton precision farming technology adoption between 2000 and 2004 in six states. A mail survey of cotton producers located in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, and Virginia was conducted in January and February of 2005 to establish the use of precision farming technologies in 2004 in these states. A total of 1,215 cotton producers responded for a response rate was 10%. This report presents the results from that survey and compares them with the 2000 results from a similar survey conducted in January and February of 2001 for Alabama, Florida, Georgia, Mississippi, North Carolina, and Tennessee. The precision farming technologies evaluated were yield monitoring with GPS, yield monitoring without GPS, grid soil sampling, zone soil sampling, aerial photos, satellite images, soil survey maps, handheld GPS/PDA units, COTMAN plant mapping, digitized mapping, and variable rate application of nitrogen, phosphorous, potassium, lime, seed, growth regulator, defoliant, fungicide, herbicide, and irrigation. Forty-eight percent of respondents had used at least one precision farming technology. The most common technologies used in cotton production were cotton yield monitors, zone soil sampling and soil survey maps. Profit and environmental benefits were the most influential factors in a producer's decision to adopt precision farming technologies, while Extension/University personnel and other farmers provided the most useful information in learning about these technologies. The majority of non-adopters were unsure if

precision farming would be profitable for them to use in the future. Eighty-nine percent of adopters and 77% of non-adopters owned computers, while 66% and 40% used them for farm management, respectively. Findings from this survey are important to cotton producers because results can help research and extension personnel focus scarce resources on those producers who are most likely to use these technologies. Results can also be used to develop decision aids to help potential adopters make more informed decisions about adoption, custom hiring, or purchasing these technologies.

Precision Farming by Cotton Producers in Eleven Southern States: Results from the 2005 Southern Precision Farming Survey

Rebecca L. Cochran, Roland K. Roberts, Burton C. English, James A. Larson, W. Robert Goodman, Sherry L. Larkin, Michele C. Marra, Steven W. Martin, Kenneth W. Paxton, W. Donald Shurley, and Jeanne M. Reeves

Introduction

Production of cotton requires a multitude of inputs and cropping activities that include preparing seed beds, planting, reducing competition from insects and weeds, applying harvest aids, and harvesting cotton. Indeed, the cost of producing cotton is considerably higher than the costs of producing corn, soybeans, or wheat (Gerloff, 2005). Reducing input levels through more efficient input use has been a goal of cotton producers and researchers alike. Precision farming may increase cotton production efficiency, reduce input use, and increase yields and profits.

For more than a decade, precision farming technologies have been available to farmers (Griffin et al., 2004). These technologies are used to identify and measure within-field variability and its causes, prescribe site-specific input applications that match varying crop and

soil needs, and apply the inputs as prescribed. Despite worldwide use, questions regarding the profitability of these technologies still exist.

Griffin et al. (2004) summarized current attitudes regarding the profitability of precision farming and current adoption trends. Their study found cotton acres had experienced a slower level of adoption compared to other crops such as corn and soybeans. In a 2001 southern precision farming survey, Roberts et al. (2002) found that 21% of cotton producers from Alabama, Florida, Georgia, Mississippi, North Carolina and Tennessee were precision farming adopters. The technologies used for cotton production by the most producers were grid and management zone soil sampling, variable rate lime, phosphorous, and potassium application, plant tissue testing, soil survey maps. Twenty-eight adopting producers practiced yield monitoring with GPS.

The use of precision technology for cotton is more limited because accurate yield monitors did not become commercially available until 2000 (Perry et al. 2001). Because cotton is an important high-value crop in the Southeast, an assessment of the trends over the last few years in the use of precision farming practices, factors that influence adoption of precision farming technologies, and likelihood that cotton producers will adopt yield monitoring systems would provide important information for cotton producers and agribusinesses alike.

Cotton is produced on a wide range of soils with varying yield potentials. Topsoil, rooting depth, water-holding capacity, texture, as well as other soil characteristics vary within a field and can cause yields to vary across a field. Though accurate cotton yield monitors have only been commercially available for a few years, other precision farming technologies have been available to cotton farmers for some time. These precision farming services can be custom hired from input suppliers and crop consultants for a fee or implemented by producers.

The future of precision farming depends on how profitable producers view this set of new technologies (Griffin et al, 2004). A need exists to reevaluate producers' experiences from 2000 to 2004 with a variety of precision farming technologies and to determine what benefits they have received or expect to receive from using these technologies. Such an assessment is needed to appraise the present status and future prospects for adoption of precision farming technologies by cotton producers.

Objectives

The objectives of this study were 1) to determine the status of precision farming technology adoption by cotton producers in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, and Virginia and 2) to evaluate changes in cotton precision farming technology adoption between 2000 and 2004 in Alabama, Florida, Georgia, Mississippi, North Carolina, and Tennessee.

Methods

Survey Methods

A mail survey of cotton producers located in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, and Virginia was conducted in January and February of 2005 to establish the use of precision farming technologies in 2004 in these states. This report provides results from that survey and compares them with results for 2000 from a similar survey conducted in January and February of 2001 for Alabama, Florida, Georgia, Mississippi, North Carolina, and Tennessee.

A questionnaire was developed to query producers about their attitudes toward and use of precision farming technologies (Appendix I). Following Dillman's (1978) general mail survey procedures, the questionnaire, a postage-paid return envelope, and a cover letter explaining the

purpose of the survey were sent to each producer. The initial mailing of the questionnaire was on January 28, 2005, and a reminder post card was sent one week later on February 4, 2005. A follow-up mailing to producers not responding to previous inquiries was conducted three weeks later on February 23, 2005. The second mailing included a letter indicating the importance of the survey, the questionnaire, and a postage-paid return envelope. Recipients were instructed to circle 'neither' in question 2 and return the questionnaire if they did not grow cotton in 2003 or 2004.

Mailing lists of potential cotton producers for the 2003-2004 season was furnished by the Cotton Board in Memphis, Tennessee (Skorupa, 2004). Of the 12,243 questionnaires mailed, 18 were returned undeliverable and 182 indicated they were not cotton farmers or had retired, leaving a total of 12,043 cotton producers. Of those cotton producers, 1,215 individuals provided data. Assuming the remaining non-respondents to the survey were active cotton producers, the usable response rate was 10%.

Definition of Precision Farming

The following statement was given to farmers at the top of the questionnaire (Appendix I): "Precision farming involves collecting site-specific information about within-field variability in yields and crop needs, linking that information to specific locations within a field, and acting on that information to determine and apply appropriate input levels. This may result in varying input levels within each field." This broad definition of precision farming encompasses technologies that may or may not use Global Positioning Systems (GPS) and Geographical Information Systems (GIS). For example, two categories of yield monitoring were listed: yield monitoring with GPS and yield monitoring without GPS.

Questions for Adopters (Questions 14-21, 27-31, and 35-39)

Precision farming technology adopters indicated the information gathering technologies used to make variable rate management decisions. Off-farm precision farming services used on their farms were identified along with the cost of hiring those services. Adopters indicated if a yield map was generated using data obtained from their yield monitor. Adopters were also queried about how they assessed the yield variability within a field prior to the use of a yield monitor, how the information obtained from their yield monitor changed their perceptions of the within-field yield variability, and the value of the additional information obtained from the yield monitor. Adopters also answered questions regarding the use of a GPS guidance system regarding whether their expectations were met, the value of the system on their farm, and the field operations performed using the GPS guidance system. Adopters indicated the inputs they applied using various variable rate technologies, if they abandoned any of those technologies, and the yield effects of those technologies. Adopters indicated whether they experienced improvements in environmental quality through the use of precision farming and the reasoning behind their decision to practice precision farming.

Questions for Non-adopters (Questions 22-24, 32-34, and 40)

Precision farming non-adopters were asked to indicate how they currently assess the yield variability within their typical cotton field. Non-adopters also answered questions regarding their perceptions of the additional value of information they could obtain from a cotton yield monitor and a GPS guidance system, and if they intended to purchase a GPS guidance system within the next three years. Non-adopters also listed their most important reason for not practicing precision farming.

Questions for Adopters and Non-Adopters (Questions 1-13, 25-26, 41-52)

Precision farming adopters and non-adopters were asked about the future of precision farming; if they would prefer to own or lease equipment; and to give their best estimate of the typical purchase price of a cotton yield monitoring system with GPS. They were asked to provide demographic and farm business information. All respondents were also questioned regarding their local Extension Service and their level of knowledge regarding precision farming.

Results

Results are presented in five sections. The first section compares several characteristics of the respondents and their farming operations with data from the 2002 Census of Agriculture (US Department of Agriculture, 2004). The second section presents information about the use of precision farming technologies by cotton producers who have adopted these technologies. Non-adopters' perceptions regarding the value of information gained from the use of their reasons for not practicing precision farming are discussed in section three. In the fourth section, perceptions about the future of precision farming are presented for all respondents (adopters and non-adopters). Demographic and farm characteristics are compared for precision farming adopters and non-adopters in the fifth section.

Comparison of Survey Data with Census Data

The distribution of respondents across the 11 states in the survey (Appendix II, Table 1) corresponded closely with the 2002 distribution of cotton

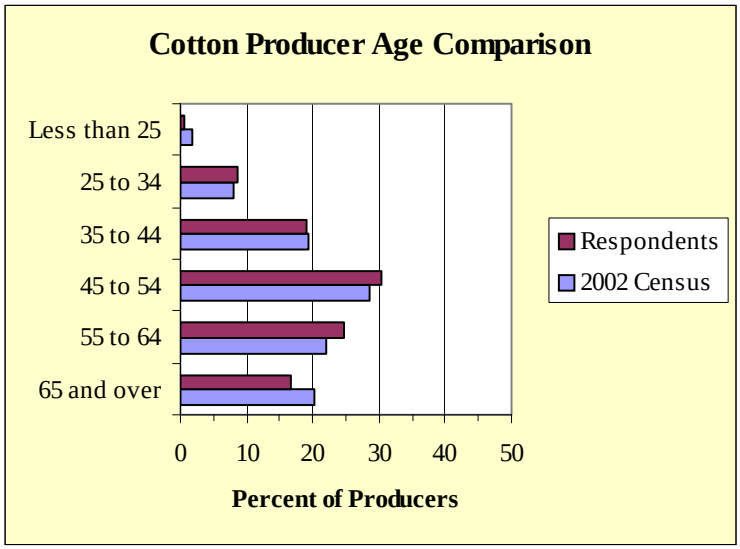


Figure 1. Age distribution of respondents compared with the 2002 Census of Agriculture.

farmers (US Department of Agriculture, 2004).

Figure 1 shows the age distributions for cotton producers as reported in the 2002 Census compared with the ages of the producers who responded to the survey. The majority of respondents (55%) ranged in age from 45 to 64 years, compared with 50% in this category reported in the Census. Respondents who were 25 to 34 years of age were a slightly larger percentage of total producers (9%) than were represented in the 2002 Census (8%) for this age category. Respondents who were 65 years of age or older were a smaller percentage of all respondents (17%) than reported in the Census for this age category (20%). The largest difference between survey and Census data was for the 65 years of age or older group for which the percentages of producers in this category were 17% and 20% for the survey and the Census, respectively. Results indicate that survey respondents were concentrated more in the middle age groups than was found in the 2002 Census.

Figure 2 compares cotton acres planted per farm in 2003 and 2004 from the survey and from the 2002 Census (US Department of Agriculture, 2004). A smaller percentage of cotton producers who grew less than 249 acres of cotton responded to the survey (27% and 26% for 2003 and 2004, respectively) compared with the percentage of producers reported in the 2002 Census (46%) in this category (Figure 2). In addition, larger percentages of survey respondents reported planting 250 or more acres in 2003 (73% of respondents) and 2004 (74%)

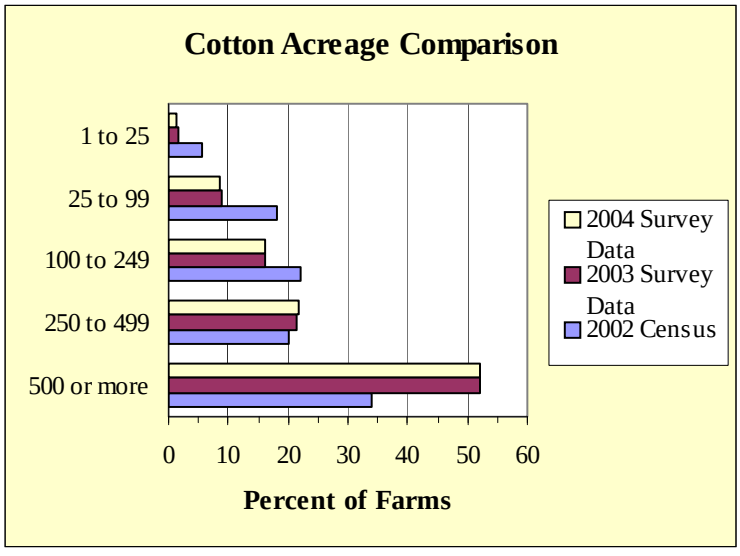


Figure 2. Cotton acres planted per farm for survey respondents compared with the 2002 Census of Agriculture.

than was recorded in the Census (54% of producers). Farmers with larger acreage appear to have responded more readily to the survey.

Adopter Responses Regarding Precision Farming

Precision Farming Technology Use

A response to any part of questions 14 and 15 or map or sensor-based technologies in question 35 indicated that a cotton producer was an adopter of at least one of the precision farming technologies listed. Responses indicated that 580 of the 1,215 respondents, or 48%, had adopted some form of precision farming technology (Appendix II, Table 1). Results from the 2005 survey showed an increase in adopters from the previous 2001 survey that identified only 23% of respondents as adopters (Appendix II, Table 2).

Survey question 14 asked adopters to indicate if they had used yield monitoring with GPS, aerial or satellite infrared imagery, handheld GPS units, or COTMAN plant mapping to make a variable rate management decision. Seventy-four percent of adopters used yield monitoring with GPS to make fertility or lime decisions. Another 62% of adopters identified zones and 39% made drainage decisions using information collected from a yield monitor with GPS (Appendix II, Table 3).

Fifty-two percent of adopters used aerial or satellite infrared imagery to identify zones. Aerial or satellite infrared imagery was used by 50% of adopters to make a variable rate decision regarding growth regulators and 48% used the imagery for drainage decisions. Handheld GPS units were mostly used to make variable rate fertility and lime decisions (67%) and identify zones (53% of adopters) and (Appendix II, Table 3). Seventy-four percent of adopters who

adopted COTMAN plant mapping technology, used it for variable rate growth regulator decisions and 68% used it for variable rate harvest aids decisions.

Adopters were asked to provide the number of years used and number of acres in 2004 for ten different uses of information gathering technology for cotton production in question 15. Two hundred, seventeen adopters used zone soil sampling for an average of 14 years on 1,153 acres in contrast to 205 adopters who used grid soil sampling on 876 acres for an average of five years (Appendix II, Table 4). One hundred, fifteen adopters used soil survey maps and 109 adopters used aerial photos for 13 and 14 years, respectively. Least used by adopters were digitized mapping, yield monitoring without a GPS, and satellite images (Appendix II, Table 4).

In question 16 of the survey, adopters were asked to identify the information gathering technologies they had adopted and subsequently abandoned. Adopters abandoned grid soil sampling (51%) more than any other previously adopted technology. Fourteen percent of producers adopting COTMAN plant mapping later abandoned the technology (Appendix II, Table 5).

Precision Farming Services

Precision farming adopters who had used off-farm precision farming services were asked to identify the services they had used or employed and the cost of those services (question 15). One hundred, eight adopters reported receiving management and technical advice for an average of $6.20/acre concerning grid soil sampling and 89% of adopters would purchase that service again (Appendix II, Table 6). Comparison of the 2005 survey results to the six states previously surveyed in 2001 showed a dramatic increase in the number of adopters purchasing technical advice in the past four years. Results for the 2001 survey show only four adopters purchasing advice for grid soil sampling compared to 79 adopters in 2005 (Appendix II, Table 6). Based on

the 2005 survey, technical advice was purchased for grid and zone soil sampling by adopters more than other information gathering technologies. The average cost of advice on grid soil sampling was $6.08/ac in 2005 for the previously surveyed states and $3.88/ac in 2001. When comparing costs for the six states in 2005 and 2001, prices showed an upward trend. Technical advice for zone soil sampling was the most expensive advice averaging $8.85/ac (Appendix II, Table 6).

The most popular custom services hired by adopters are presented in Table 7 of Appendix II. The most popular custom services purchased in both 2005 and 2001 were grid and zone soil sampling. Nearly all adopters who purchased the custom service agreed they would purchase the service again. In 2005, the average costs of custom hiring the services were $9.82/ac and $5.10/ac for grid and zone soil sampling, respectively (Appendix II, Table 7). Custom services cost per acre for grid and zone soil sampling was substantially lower in 2001.

Cotton Yield Monitoring Systems

Adopters were asked to answer several questions (17-21) regarding cotton yield monitors. Only 24% of adopters generated a yield map using data from their cotton yield monitor (question 17). An overwhelming majority of adopters (76%) did not convert their yield monitor data into a yield map (Appendix II, Table 8). Sixty-four percent of adopters used year-to-year field records to assess yield variability prior to adopting a cotton yield monitor (question 18). Twenty-eight percent used soil maps to assess variability prior to the yield monitor (Appendix II, Table 9). Only 1% of adopters reported using satellite imagery or 4% used COTMAN and aerial photography.

Table 10 in Appendix II reports adopters' changes in yield perception related to cotton yield monitor usage (question 19). Twenty-seven adopters (33%) admitted use of yield monitor

changed their yield perception by an increase of 25-50% in the yield variability. Twenty-two adopters (27%) reported a slight increase in their perception of yield variability while two other adopters reported a slight decrease in their perceptions of yield variability (Appendix II, Table 10). Seventy-six percent of adopters believe the additional information obtained from their cotton yield monitor to be valuable (question 20) and would place an additional value of $21.25/ac on average on that information (question 21; Appendix II, Table 11).

GPS Guidance Systems

Only 21% of respondents reported using a lightbar and 7% had used autosteer (question 26; Appendix II, Table 12). The majority of adopters (80%) of a GPS guidance system reported it had met their expectations (question 27; Appendix II, Table 12). Sixty-one percent of adopters reported they used a GPS guidance system to improve spraying capacity and overall efficiency (question 28). Forty percent used it to eliminate the need for row markers (Appendix II, Table 13).

Survey question 29 asked adopters if their GPS guidance system was of value to them and 89% reported yes it was valuable. The average value placed on the GPS guidance system (question 30) was $11.85/ac and ranged from $1 to $600/ac (Appendix II, Table 14). In question 31, adopters reported the field operations they performed using a GPS guidance system. Eighty-one percent of adopters used a GPS guidance system for spraying. Thirty-one percent used GPS guidance systems for planting and 26% used it for primary tillage (Appendix II, Table 15).

Variable Rate Input Application Technologies

Cotton producers who had adopted some form of precision farming technology were asked in question 35 about their use of variable rate application technologies on cotton (Appendix II, Table 16). Results from the 2005 survey indicated sensor-based technology has

been used to apply inputs for fewer years, on average, compared with map-based and row marker technologies. Map-based technology along with row markers has been used for irrigation for an average of 15 years. Map-based technology has also been used to variably apply seed and herbicide for an average of 14 and 12 years, respectively (Appendix II, Table 16). Adopters had never made irrigation decisions using sensor-based technology. Other inputs applied using sensor-based technology had been used for 4-6 years on average. Row markers had been used to variably apply most inputs for the last 14-18 years on 601 to 881 acres, on average (Appendix II, Table 16).

In 2001, 48% of responding adopters used variable rate lime application compared to 23% for the same six states in 2005. Variable rate phosphorous and potassium application was used by 39% of adopters in 2001 and then dropped to 21% for the same geographical area in 2005 (Appendix II, Table 16).

Adopters were queried in question 36 as to which variable rate technologies they had previously used then abandoned. Forty-one percent of respondents who had adopted variable rate application of herbicide later abandoned the practice. Twenty-five adopters (33%) had abandoned variable rate application of nitrogen while 32% and 31%, respectively, of adopters had abandoned variable rate application of phosphorous and potassium (Appendix II, Table 17).

Adopters were asked to indicate how their perception of the yield effects on their farm from variable rate input application cotton yields changed (question 37). Fifty-two percent of adopters perceived an increase in their lint yields for an average of 115 lb/ac. Forty-six percent reported no change in lint yields and only 1% reported a decrease in yields of 233 lb/ac (Appendix II, Table 18). In 2001, 37% adopters experienced an increase in yields, 54% reported a decrease, and 9% indicated no change in cotton yields (Appendix II, Table 18). In the four

years since the 2001 survey, adopters' perceptions regarding the yield effects from variable rate input application have changed. In 2001, 54% adopters believed their yields decreased. In 2005, only 2% of previously surveyed adopters believed their yields decreased due to variable rate input technology (Appendix II, Table 18).

Changes in Environmental Quality

Question 38 of the survey dealt with adopter perceptions about the environmental consequences of precision farming. Forty-two percent of adopters in 2005 thought they had experienced an improvement in environmental quality as a result of precision farming (Appendix II, Table 19). Interestingly, responses to this question from the six states surveyed in 2005 and 2001 were exactly the same. The majority of adopters who responded to both surveys did not perceive an environmental benefit from adopting precision farming.

Factors Influencing Use of Precision Farming Technologies

Precision farming adopters were asked to rate on a scale of 1 (not important) to 5 (very important) several factors that went into their decision to adopt precision farming technologies (question 39). Adopters reported that profit was the most important factor prompting their adoption of precision farming (4.6 average score), with 74% of respondents considering it very important and only 2% indicating it was not important to their decision (Appendix II, Table 20). Profit was also the primary influence in precision farming adoption in the 2001 Southern Precision Farming Survey with an average score of 4.5. In both 2005 and 2001, environmental benefits received the second highest average score, which was somewhat lower than the average score received for profit, but still more than moderately important. The fear of being left behind was least likely to persuade producers to practice precision farming. In comparison, average

scores or factors influencing adoption from the 2005 and 2001 surveys were very similar (Appendix II, Table 20).

Non-adopter Responses about Precision Farming

Perceived Benefits of a Cotton Yield Monitoring System

Survey question 22 asked cotton yield monitor non-adopters to identify how they assess the yield variability within a typical cotton field. The overwhelming majority (66%) indicated year-to-year field records as the most popular way to asses yield variability. Other methods and soil maps followed at 23% and 21%, respectively, as how non-adopters determined yield variability (Appendix II, Table 21). Seventy-four percent of non-adopters believe the additional information they could obtain from a cotton yield monitor would be valuable to them (question 23) and would place an additional value of $20.40/ac on average that could be obtained from that information (question 24) (Appendix II, Table 22).

Perceived Benefits of a GPS Guidance System

Table 23 in Appendix II reports non-adopters opinions regarding a GPS guidance system. Seventy percent of non-adopters believed using a GPS guidance system would be of value to them (question 32). Non-adopters place an average value of $16.04/ac on the additional information from the GPS guidance system with a standard deviation of $34.56/ac (question 33). Forty-three percent of non-adopters indicated in question 34 they did not intend to purchase a GPS guidance system in the next three years while 42% of non-adopters were undecided.

Reasoning for Not Adopting Precision Farming

In survey question 40, non-adopters were given an opportunity to list the most important reason for not adopting precision farming. Cost was the most frequently listed reason, followed by small fields, lack of knowledge, and contentment with current production practices.

Adopter and Non-adopter Responses about Precision Farming

Future of Precision Farming

Questions 4 through 6 asked all producers about the future of precision farming. They were asked in questions 4 and 5 if they thought precision farming would be profitable for them to use in the future, and if so, would they prefer to own or rent their equipment. Sixty-six percent of adopters believed use of precision farming technologies would be profitable in the future compared to only 36% of non-adopters. However, 29% and 53% of adopters and non-adopters, respectively, did not know if precision farming would be profitable. Results of the 2001 survey showed 85% of adopting producers and 63% of non-adopting producers thought precision farming would be profitable for them to use in the future (Appendix II, Table 24).

When asked if they would prefer to own or rent precision farming equipment, the majority of adopters (50%) and non-adopters (63%) indicated their decision depended on various factors. In the 2001 survey, the majority of adopters and non-adopters (62 and 52%, respectively) reported they would prefer to own the equipment (Appendix II, Table 24).

Question 6 gave respondents an opportunity to rate the importance of precision farming for cotton and other crops five years in the future. The level of importance ranged from 1 (not important) to 5 (very important). Adopters consistently rated the importance of precision farming five years in the future higher than did non-adopters (Appendix II, Table 25). For cotton

production, the average scores for adopters and non-adopters were 3.7 and 3.3, respectively, as compared to 3.9 and 3.5 for adopters and non-adopters, respectively, reported in the 2001 survey (Appendix II, Table 25).

Perceived Price of a Cotton Yield Monitoring System

In question 7, producers were asked to report their best estimate of the typical purchase price for a cotton yield monitoring system with GPS. Adopters who responded to the 2005 survey reported an average purchase price of $8,537 while non-adopters reported a purchase price of $8,562. In the 2001 survey, the average purchase price given by adopters was $8,776 while the average price given by non-adopters was $1,215 less at $7,561 (Appendix II, Table 26). Average prices reported in both 2004 and 2001 were less than the list price of $9,175 in 2004 and $9,500 in 2001 for a cotton yield monitoring system that included a monitor, a GPS receiver, and sensors on two chutes of a 4-5-row picker (Ag Leader Technology, 2001 and 2004).

Information Sources

Table 27 (Appendix II) reports the usefulness of various sources of precision farming technology information. Respondents to the 2005 survey indicated Extension/Universities (3.32) and other farmers (3.33) provided the most useful information. Precision farming information from the internet (2.54) and the news media (2.55) was least useful. Respondents to the 2001 survey indicated Extension/universities (3.86) and crop consultants (3.37) were the most helpful, while the internet (1.75) and news media (1.68) were the least helpful in learning

about precision farming technologies. The same six state from the 2001 survey reported higher scores for the internet (2.57) and news media (2.58).

Soil Sampling

Questions 9 and 10 of the survey questioned adopting producers about their soil sampling practices. Ninety-four percent of respondents had soil samples analyzed in the last three years for their cotton fields (Appendix II, Table 28). Forty-two percent of respondents collected their own soil samples while 22% used a fertilizer/chemical dealer or consultant (Appendix II, Table 28). The majority (53%) of responding adopters from the original six states collected their own soil samples while 44% in 2001 collected samples themselves (Appendix II, Table 28).

Implementing Site-Specific Information

All survey respondents were queried on methods used to implement site-specific information for variable rate application of inputs (question 25). Only 20% of respondents had used a map-based method to apply inputs. Of the 210 respondents who had used a map-based method, 44% used a fertilizer or chemical dealer to generate the maps and information required to apply the inputs. A very small percentage (4%) of respondents reported they had used a sensor-based method to apply inputs (Appendix II, Table 29). Respondents were also questioned about the use of a GPS guidance system (question 26

Respondent and Farm Characteristics for Adopters and Non-adopters

Farm Characteristics

Respondents were asked to describe their farm in 2004 (question 12). The average precision farming adopter owned 617 acres and rented 1,328 acres. Compared to adopters, the average non-adopter owned substantially less acreage (390 acres) and rented 771 acres (Appendix II, Table 30). Adopters reported ownership of 1,063 acres and non-adopters 523

acres in the 2001 survey. In 2001, adopters rented 399 acres and non-adopters rented 239 acres (Appendix II, Table 30).

Producers were asked to provide the location where the majority of their farm was located (question 1). Georgia provided the most usable surveys at 19% while North Carolina reported the most (17%) precision farming adopters (Appendix II, Table 1). Results for the 2005 survey show an increase in precision farming adopters in the original six states in the four years since the 2001 survey (Appendix II, Table 2). Of the 1,215 survey respondents, 1,193 respondents grew cotton in 2003 and 1,173 respondents grew cotton in 2004 (Appendix II, Table 31).

Producers reported acres planted and estimated yields for the crops they produced in 2003 and 2004 (question 11). On average, in 2003 adopters planted 691 acres of dryland cotton with yield averaging 862 lb/ac and 827 acres of irrigated cotton with an average yield of 1,038 lb/ac (Appendix II, Table 32). Non-adopters planted 663 dryland acres per farm in 1999, almost one-half the planted acres of adopters. In 2003, average acres of irrigated cotton for non-adopters were 256 acres less than adopters. Dryland cotton yields averaged 790 lb/ac and irrigated cotton yielded an average of 965 lb/ac for non-adopters. Average irrigated cotton yields were larger than yields for dryland cotton. On average, planted acreage and yields were similar in 2004 for both responding groups (Appendix II, Table 33).

Results from the 2001 survey show adopters planted 1,133 acres yielding 790 lb/ac, while non-adopters received yields of 685 lb/ac on 663 acres per farm in 1999 (Appendix II, Table 32). When compared to the 2005 survey responses for cotton grown in 2003, fewer acres were planted with lower yields for both adopters and non-adopters than those received in 1999. Again in 2000, adopters planted more acres of cotton than non-adopters as reported in the 2001 survey.

However, 2005 survey responses for the 2004 crop year show an increase in acres planted and lint yields compared to the 2000 year reported in the 2001 survey for both adopters and non-adopters (Appendix II, Table 33).

Responses to the 2005 survey indicated adopters planted 1,020 acres in crops other than cotton and non-adopters planted 596 acres in other crops for the 2003 crop year. In the 2001 survey, adopters and non-adopters reported planting more acres to other crops in 1999 than in 2003 (Appendix II, Table 32). For the 2004 crop year, adopters planted 1,017 acres and non-adopters planted 599 acres in other crops. The 2001 survey results show both adopters and non-adopters planting more acres in 2000 than reported in the 2005 survey for the 2004 crop year (Appendix II, Table 33).

Producers were asked to provide annual average yields for the most productive one-third, the average, and the least productive one-third of typical cotton field they farmed (question 13). Adopters reported similar or higher yields with lower standard deviations than non-adopters in all three yield categories (Appendix II, Table 34). For the 2001 survey, adopters also reported similar or higher yields than non-adopters. For a typical field, non-adopters reported less yield variability than adopters in both the 2005 and 2001 surveys. For example, the difference between the yield reported by adopters for the most productive one-third and the least productive one-third of a typical cotton field was 557 lb/ac, while this difference was slightly lower at 514 lb/ac for non-adopters as reported in the 2005 survey (Appendix II, Table 34).

Table 35 (Appendix II) presents producers' responses to question 3 concerning livestock. In the 2005 survey, 26% of adopters and 29% of non-adopters reportedly owned livestock. In 2001, a higher percentage of adopters (37%) and non-adopters (33%) reported that they owned

livestock. In 2005, 18% of all responding cotton producers and 24% of all responding producers in 2001, applied manure to their fields.

Respondent Characteristics

Producers were queried about their age, years of farming experience, education, and computer usage (survey questions 41 through 47). The average age (question 41) of a precision farming adopter was 48 years and varied from 20 to 79 years. Non-adopters averaged 54 years of age, ranging from 21 to 85 years (Appendix II, Table 36). The average age for adopters and non-adopters in 2001 was similar to 2005 results. Precision farming adopters had farmed an average of 25 years, while non-adopters had farmed an average of 29 years (question 36). Years of farming ranged from two to 70 years for both adopters and non-adopters (Appendix II, Table 36). In 2001, the average years of farming was the same as in 2005.

Ninety-six percent of adopters reported they had completed high school while 90% of non-adopters completed high school (question 44) and both groups averaged two to three years of college (question 43; Appendix II, Tables 37-38). In 2001, the overwhelming majority of adopters (97%) and non-adopters (95%) completed high school. Adopters completed an average of three years of college while non-adopters completed two years of college. Comparisons of the 2005 and 2001 data show a slight decline in the percentage of non-adopters who completed high school.

Eighty-nine percent of adopters own a computer (question 45) compared to a lesser majority (77%) of non-adopters who own a computer (Appendix II, Table 39). In 2001, the majority of adopters (86%) and non-adopters (74%) owned a computer. In 2005, 66% of adopters reportedly used a computer for farm management compared with only 40% of non-adopters (question 46). Seventy-four percent of adopters and 55% of non-adopters used the

computer for farm management based on 2001 survey results (Appendix II, Table 39). Respondents to the 2005 survey were queried on their use of a laptop or handheld computer in the field (question 47). The greatest majority of adopters and non-adopters did not use computers in the field. Twenty-one percent of adopters admitted using a computer in the field while on a very small percentage (6%) of non-adopters use a computer in the field (Appendix II, Table 39).

Producers indicated the one statement that best described their farm-planning goal in question 48. Acquiring enough farm assets to generate sufficient income for family living was the most popular farm planning goal for adopters and non-adopters in both the 2005 and 2001 surveys. Fifty-four percent of adopters and 49% of non-adopters in 2005 and 53% of adopters and 52% of non-adopters in 2001 indicated the previous statement represented their farm-planning goal (Appendix II, Table 40). The least popular planning goal was to sell the farm and move to a different career for both survey years (Appendix II, Table 40).

Questions 49 and 50 referred to respondents' household income from both farm and non-farm sources for 2004. Fifty-six percent of adopters earned a pre-tax household income of $50,000 to $149,999 while 50% of non-adopters had an income of $99,999 or less (question 49). Results from the 2001 survey indicated 59% of adopters and 63% of non-adopters earned a household income of $99,999 or less in 2000 (Appendix II, Table 41). In the four years between the two surveys, pre-tax household income has increased slightly for both adopters and non-adopters. Adopters and non-adopters indicated that income from farming (question 50) was responsible for the majority of their total household income in 2004 and 2000 (Appendix II, Table 41).

Attitudes Regarding the Extension Service

The 2005 survey questioned respondents about their local Extension Service's level of knowledge regarding precision farming. When asked if the Extension Service needed to provide more educational outreach about precision farming in their area (question 51), the majority of adopters (73%) and non-adopters (67%) responded yes. The majority of adopters and non-adopters agreed that their county agent did have the necessary skills in precision farming to meet their needs (question 52, Appendix II, Table 42).

Closing Remarks

The objectives of this study were 1) to determine the status of precision farming technology adoption by Southeast cotton producers and 2) to evaluate changes in cotton precision farming technology adoption between the 1999-2000 and 2003-2004 crop seasons in the Southeast. Cotton producers are confronted everyday with information concerning the rapidly growing precision farming industry. The most important comparison between the 2005 and 2001 survey shows the increasing number of adopters. Twenty-three percent of survey respondents in 2001 were precision farming adopters. In the 2005 survey, the percentage of adopters increased to 48%. Most responding cotton producers use computers for farm management decisions, believe precision farming will be profitable in the future, and those producers who adopt these technologies do so to increase profit. Cotton producers are listening to Extension and university research personnel along with other farmers in making decisions about precision farming. As more information becomes available, cotton producers will have greater opportunities to make more informed decisions about the use of these technologies on their farms. Findings from this and other studies that investigate the current use and future prospects for precision farming technologies are important to cotton producers because they

provide the needed information for making better decisions about the adoption of these technologies.

References

Ag Leader Technology. 2001. 2001 List Prices. 2202 South Riverside Drive, Ames, IA 50010.

Ag Leader Technology. 2004. 2004 List Prices. 2202 South Riverside Drive, Ames, IA 50010.

Dillman, D.A. 1978. Mail and telephone surveys, the total design method. John Wiley & Sons, New York.

Gerloff, D.C. 2005. Field Crop Budgets for 2005. Department of Agricultural Economics, Agricultural Extension Service, University of Tennessee, AE 01-43.

Griffin, T.W., J. Lowenberg-DeBoer, D.M. Lambert, J. Peone, T. Payne, and S.G. Daberkow. 2004. Adoption, Profitability, and Making Better Use of Precision Farming Data. Staff Paper #04-06. Department of Agricultural Economics, Purdue University.

Perry, C.D., G. Vellidis, N. Wells, and C. Kvien. 2001. "Simultaneous Evaluation of Multiple Commercial Yield Monitors in Georgia," pp. 328-339. In *Proceedings of the Beltwide Cotton Conferences*, Anaheim, CA. January 9-13, 2001. National Cotton Council of America, Memphis, TN.

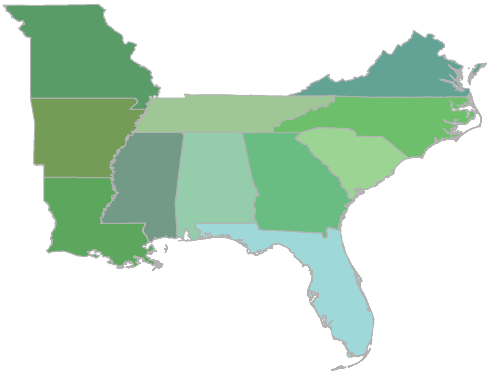
Roberts, R.K., B.C. English, J.A. Larson, R.L. Cochran, W.R. Goodman, S.L. Larkin, M.C. Marra, S.W. Martin, W.D. Shurley, and J.M. Reeves. 2002. Department of Agricultural Economics, Research Series 03-02, Agricultural Experiment Station, University of Tennessee.

Skorupa, B. 2004. Cotton Board, 871 Ridgeway Loop, Ste. 100, Memphis, TN 38120-4019.

US Department of Agriculture. 2004. 2002 Census of Agriculture: Tennessee State and County Data. Vol. 1, Geographic Area Series, Part 42. National Agricultural Statistics Service, Washington, D.C.

Appendix I: The Questionnaire

2005 Southern Precision Farming Survey



Researchers at several Southern Land Grant Universities and Cotton Incorporated request your help in evaluating the use of new and emerging methods or technologies in precision farming. As agricultural economists, we want to use the results of this survey to help each cotton farmer determine whether precision farming is right for him or her. Even if you do not use precision farming technologies, your response to this survey will provide useful information about whether precision farming will improve the bottom line for you and other cotton farmers. Regardless of whether or not you use precision farming technologies, please take a few minutes to fill out this survey.

Jeanne Reeves, a production economist in the Agricultural Research Division of Cotton Incorporated states, "*I encourage you to participate in this survey. Cotton Incorporated is sponsoring this important effort to obtain information about cotton practices. Our goal is to share this information with producers through Extension programs, and ultimately increase profitability as you evaluate new technologies and production practices.*"

The survey may appear long at first glance, but should take only about 20 minutes or less to complete. Several questions that seem long really require only a minute or two to answer. We realize that some of the questions may be difficult but we ask that you answer each question that applies to your farming situation by providing your best estimate. Please return the completed survey in the enclosed self-addressed envelope.

We want to assure you that your responses will be anonymous. Answering this survey is voluntary and your response serves as an informed consent to participate in the study. Your responses will not be published or communicated in any way that could possibly identify you with them. Also, we assure you that after the survey is completed we will not be able to associate your name with your response.

Thanks in advance for your participation in this important survey. If you have questions about this survey, please call (865) 974-7231 and speak with Roland Roberts, Burt English, or Jim Larson at The University of Tennessee.

Roland K. Roberts
Professor of Agricultural Economics

2005 Southern Precision Farming Survey

"Precision farming" involves collecting site-specific information about within-field variability in yields and crop needs, linking that information to specific locations within a field, and acting on that information to determine and apply appropriate input levels. This may result in varying input levels within a field.

1. Where is most of your farm located? County _____ State _____

2. Please circle the years during which you grew cotton: 2003 2004 Neither
   If you circled "Neither", please return this blank survey now.

3. Do you own livestock? Yes ____ No ____ Do you apply manure on your fields? Yes ____ No ____

4. Do you think it would be profitable for you to use precision farming technologies in the future?
   Yes _____ No _____ Don't Know _____

5. Would you prefer to own or rent precision farming equipment? Own _____ Rent _____ Depends _____

6. Please circle in the table below how *important* you believe precision farming will be five years from now for cotton and other crops in your state.

	Not Important		Somewhat Important		Very Important
Cotton	1	2	3	4	5
Other Crops	1	2	3	4	5

7. What is your best guess for the typical purchase price of a GPS cotton yield monitoring system that can be used to generate a yield map? $_____

8. Where do you get your precision farming information?

Circle each source you have used to get information. ----------→	Farm Dealers	Crop Consultants	Extension/ Universities	Other Farmers	Trade Shows	Internet	News Media
Rank the *usefulness* of each source you have used in assisting you to make decisions about precision farming, where: (circle number→) 1 is not useful 3 is somewhat useful 5 is very useful.	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5

9. In the last three years, have you had soil samples analyzed for your cotton fields? Yes ____ No ____

10. Who typically collects your soil samples? (Please check the best item)
    Self ____ Consultant ____ Fertilizer or Chemical Dealer ____ Family Member ____ Other ____

11. Please give the acres planted and estimated *average* yields for 2003 and 2004.

	2003		2004	
Crop	Acres Planted	Yield/acre	Acres Planted	Yield/acre
Dryland Cotton		lb		lb
Irrigated Cotton		lb		lb
Other Crops				

12. How many of your 2004 total cropped acres were owned or rented?
Owned? _____acres Rented? _____acres

13. Since yields are likely to vary within a field, please estimate your *cotton lint yields* (lb/acre) for the following portions of your typical cotton field:
Least productive 1/3 _____ Average productive 1/3 _____ Most productive 1/3 _____

14. For each variable rate management decision, indicate with an X which of the 4 information gathering technologies you use to make the decision. Leave blanks for technologies you do not use.

Variable Rate Decision	1. Yield Monitoring with GPS	2. Aerial or Satellite Infrared Imagery	3. Handheld GPS Units	4. COTMAN Plant Mapping
Identify Zones				
Drainage				
Fertility or Lime				
Seeding				
Growth Regulator				
Harvest Aids				
Fungicide				
Herbicide				
Insecticide				
Irrigation				

15. For each technology listed below, please complete the table. Leave blanks for technologies you do not use.

	Use of Information Gathering Technology for *Cotton* Production	Number of years used	Number of acres used in 2004	If you received technical advice in 2003 or 2004		If you hired custom services in 2003 or 2004	
				What was the per-acre cost?	Will you purchase this advice again?	What was the per-acre cost?	Will you purchase this service again?
a	Yield monitor – with GPS				**Y N**		**Y N**
b	Yield monitor – no GPS				**Y N**		**Y N**
c	Soil sampling – grid				**Y N**		**Y N**
d	Soil sampling – zone				**Y N**		**Y N**
e	Aerial photos				**Y N**		**Y N**
f	Satellite images				**Y N**		**Y N**
g	Soil survey maps				**Y N**		**Y N**
h	Handheld GPS/PDA				**Y N**		**Y N**
i	COTMAN plant mapping				**Y N**		
j	Digitized mapping				**Y N**		**Y N**

16. List the letters of the technologies in Question 15 that you used in the past and then abandoned: _____

If you currently use a cotton yield monitor, please answer the next 5 questions, otherwise skip to Question 22.

17. Did you or a consultant generate a yield map using data from your cotton yield monitor? Yes ____ No ____

18. How did you assess the yield variability *within* a typical cotton field on your farm before you began using a cotton yield monitor? (Check all that apply)
Grid sampling _____ Year-to-year field records _____ Soil maps_____ Consultants' estimates_____
Satellite imagery _____ COTMAN _____ Aerial photography _____ Other (specify) _____

19. How did the yield information you obtained from yield monitoring change your perception of the yield variability within your typical cotton field? Circle the statement that *best* matches your findings.

A. Substantially increased my perception; my yields appear to be at least 50% more variable than I thought.
B. Somewhat increased my perception; my yields appear to be from 25-50% more variable than I thought.
C. Slightly increased my perception; my yields appear to be from 1-25% more variable than I thought.
D. Did not change my perception; my yields appear to be the same as I originally thought.
E. Slightly decreased my perception; my yields appear to be from 1-25% less variable than I thought.
F. Somewhat decreased my perception; my yields appear to be from 25-50% less variable than I thought.
G. Substantially decreased my perception; my yields appear to be at least 50% less variable than I thought.

20. Do you think the additional information about within-field yield variability you obtain from your cotton yield monitor is valuable to you? Yes _____ No _____

21. If yes, what value do you place on the additional information you obtain from your cotton yield monitor?
$_____ acre/year

If you currently use a cotton yield monitor, skip to Question 25, otherwise continue with Question 22.

22. How do you assess the yield variability *within* a typical cotton field on your farm? (Check all that apply)
Grid sampling _____ Year-to-year field records _____ Soil maps _____
Consultants' estimates (without a yield monitor) _____ Satellite imagery _____
Aerial photography _____ COTMAN _____ Other (specify) _____

23. Do you think the additional information about within-field yield variability that you could obtain from a cotton yield monitor would have some value to you? Yes _____No _____

24. If yes, what value would you place on the additional information you could obtain from a cotton yield monitor? $_____ acre/year

25. Two basic methods of implementing site-specific information for variable rate application of inputs include map-based and sensor-based methods. The map-based method uses a computer to generate a site-specific input application map. The map is entered into a data card, which is then placed in a variable rate controller on the implement or tractor. The sensor-based method uses sensors to measure desired properties and the information is used immediately to control a variable rate input applicator on-the-go.

A. Have you used a map-based method to apply inputs? Yes ___ No ___ **(If "No", skip to Question 25.C.)**

B. If yes, who typically generates the maps and information required to apply the inputs? (Check one)
Yourself ____ Consultant ____ Fertilizer or Chemical Dealer ____ Family member ____ Other ____

C. Have you used a sensor-based method to apply inputs? Yes _____ No _____

26. Have you used any of the following GPS guidance systems? (Check all that apply)
Lightbar _____ Autosteer _____ Other (specify) _____ None _____
If you checked "None", skip to Question 32, otherwise continue with Question 27.

27. Has your GPS guidance system met your expectations? Yes _____ No _____

28. For what reasons did you use your GPS guidance system? (Circle all that apply)

    a. Improved planting b. Improved spraying capacity c. Improved overall efficiency
    d. Eliminate need for row markers e. Other (list) _____

29. Do you think your GPS guidance system is of value to you? Yes _____ No _____

30. If yes, what value do you place on using a GPS guidance system on your farm? $_____ acre/year

31. For which field operations do you use a GPS guidance system? (Circle all that apply)
    a. Primary tillage b. Planting c. Spraying d. Cultivating e. Harvesting

If you currently use a GPS guidance system, skip to Question 35, otherwise continue with Question 32.

32. Do you think the use of a GPS guidance system would have some value to you? Yes _____ No_____

33. If yes, what value would you place on using a GPS guidance system on your farm?
    $_____ acre/year

34. Do you plan to purchase a GPS guidance system in the next 3 years? Yes _____ No____ Don't know ____

35. Please fill in this table for each cotton *input* you have *applied* using each of the 4 *variable rate technologies*. Leave blanks for technologies you have not used.

Input	Enter number of years used and 2004 **cotton acres** for each input							4. Did you use a GPS guidance system?
	1. Map-based		2. Sensor-based		3. Row Markers			
	Years Used	2004 Acres	Years Used	2004 Acres	Years Used	2004 Acres		
a. Nitrogen								Y N
b. Phosphorous								Y N
c. Potassium								Y N
d. Lime								Y N
e. Seed								Y N
f. Growth regulator								Y N
g. Defoliant								Y N
h. Fungicide								Y N
i. Herbicide								Y N
j. Insecticide								Y N
k. Irrigation								Y N

36. Please indicate which cotton inputs in Question 35 you have applied using variable rate technologies, but no longer apply using variable rate technologies. List the letters _____

37. If you use variable rate input technologies, circle the letter of the sentence that *best* reflects your perception of the yield effects on your farm from variable rate input application. Fill in the blank with your *best guess*.
A. My average cotton lint yields increased approximately _____ lb. lint/acre.
B. My average cotton lint yields did not change.
C. My average cotton lint yields decreased approximately _____ lb. lint/acre.

38. If you use precision farming technologies, have you experienced any *improvements* in environmental quality from using precision farming technologies? Yes _____ No _____

39. If you use precision farming methods, how *important* were each of the following reasons in your decision to practice precision farming? Circle the appropriate number.

Reason	Not Important		Somewhat Important		Very Important
Profit	1	2	3	4	5
Environmental benefits	1	2	3	4	5
Be at the forefront of agricultural technology	1	2	3	4	5
Not wanting to be left behind	1	2	3	4	5

40. If you do not use precision farming methods, please list your most important reason for not practicing precision farming. _____

Please answer the following questions about the primary decision maker on the farm. Answers to all questions will remain strictly confidential.

41. In what year were you born? _____ 42. Number of years farming? _____

43. Number of years of formal education excluding kindergarten? ____ (Example, 13 is one year of college)

44. Check all degrees received.
High school _____ Associate _____ BS or BA _____ Graduate degree _____

45. Do you own a computer? Yes ___No ___ 46. Do you use a computer for farm management? Yes ___ No ___

47. Do you use a laptop or handheld computer in the field? Yes _____ No _____

48. Please check the one statement that *best* describes your farm planning goal.
___ I want to acquire enough farm assets to generate sufficient income for family living.
___ I want to expand the size of operation through acquiring additional resources.
___ I am thinking about retirement and transfer of farm to the next generation.
___ I am considering selling the farm and moving on to a different career.

49. Please check the category that best reflects your total estimated pre-tax household income from both farm and non-farm sources in 2004.
Less than $50,000 _____ $50,000 to $99,999 _____ $100,000 to $149,999 _____
$150,000 to $199,999 _____ $200,000 to $499,999 _____ $500,000 or greater _____

50. About what percentage of your 2004 household income was from farming? _____%

51. Does the Extension Service need to provide more educational outreach about precision farming in your area? Yes _____ No _____
52. Does your county agent have the necessary skills in precision farming to meet your needs? Yes ___ No ___

Appendix II: Tables of Results

Table 1. Location of cotton farm businesses, response rates, and precision farming adopters and non-adopters reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

State	2002 Census of Agriculture[b]	Cotton Farmers Surveyed[c]	Number of Useable Surveys	Precision Farming Adopters	Precision Farming Non-adopters
Alabama	1,320	1,200	141 (12%)[d]	57 (10%)	84 (13%)
Arkansas	1,192	1,221	95 (8%)	48 (8%)	47 (7%)
Florida	268	265	23 (2%)	6 (1%)	17 (3%)
Georgia	3,216	3,185	225 (19%)	83 (14%)	142 (22%)
Louisiana	1,072	1,032	96 (8%)	57 (10%)	39 (6%)
Mississippi	1,596	1,308	169 (14%)	94 (16%)	75 (12%)
Missouri	596	587	48 (4%)	28 (5%)	20 (3%)
North Carolina	2,091	1,652	200 (16%)	100 (17%)	100 (16%)
South Carolina	497	538	73 (6%)	32 (6%)	41 (6%)
Tennessee	920	822	116 (10%)	60 (10%)	56 (9%)
Virginia	318	233	29 (2%)	15 (3%)	14 (2%)
11-State Total	13,086	12,043	1,215 (100%)	580 (100%)	635 (100%)

[a] Survey question 1. [b] Reported in the 2002 Census of Agriculture, USDA. [c] Individuals surveyed minus incorrect addresses and surveys indicating that the respondent was not a cotton farmer. [d] Numbers in parenthesis indicated the percentage of respondents who gave the associated answer.

Table 2. Comparison of location of cotton farm businesses, response rates, and precision farming adopters for cotton farmers surveyed in the 2005 and 2001 Southern Precision Farming Surveys.[a]

State	2005 Survey Results			2001 Survey Results		
	Cotton Farmers Surveyed[b]	Number of Useable Surveys	Precision Farming Adopters	Cotton Farmers Surveyed	Number of Useable Surveys	Precision Farming Adopters
Alabama	1,200	141	57 (14%)[c]	991	238	46 (15%)
Florida	265	23	6 (2%)	192	50	7 (2%)
Georgia	3,185	225	83 (21%)	2,883	301	75 (24%)
Mississippi	587	169	94 (24%)	1,282	262	65 (21%)
North Carolina	1,652	200	100 925%)	1,698	370	94 (30%)
Tennessee	822	116	60 (15%)	839	152	29 (9%)
6-State Total	7,711	874	400 (100%)	7,885	1,373	316 (100%)

[a] Survey question 1. [b] Individuals surveyed minus incorrect addresses and surveys indicating that the respondent was not a cotton farmer. [c] Numbers in parenthesis indicated the percentage of respondents who gave the associated answer.

Table 3. Information gathering technologies used by cotton farmers to make a variable rate management decision – 2005 Southern Precision Farming Survey.[a]

Variable Rate Decision	Yield Monitoring with GPS[b]	Aerial or Satellite Infrared Imagery	Handheld GPS Units	COTMAN Plant Mapping
Identify Zones	72 (62%)[c]	54 (52%)	62 (53%)	18 (36%)
Drainage	45 (39%)	49 (48%)	27 (23%)	6 (12%)
Fertility or Lime	86 (74%)	40 (39%)	78 (67%)	16 (32%)
Seeding	26 (22%)	15 (15%)	10 (9%)	13 (26%)
Growth Regulator	24 (21%)	52 (50%)	22 (19%)	37 (74%)
Harvest Aids	18 (16%)	46 (45%)	16 (14%)	34 (68%)
Fungicide	15 (13%)	16 (16%)	5 (4%)	12 (24%)
Herbicide	16 (14%)	14 (14%)	13 (11%)	12 (24%)
Insecticide	21 (18%)	31 (30%)	15 (13%)	25 (50%)
Irrigation	15 (13%)	19 (18%)	11 (9%)	15 (30%)
Number of Responses	116 (100%)	103 (100%)	116 (100%)	50 (100%)

[a] Survey question 14. [b] Global positioning system. [c] Number in parenthesis indicate the percentage of respondents who gave the associated answer.

Table 4. Use of information gathering technology for cotton production - 2005 Southern Precision Farming Survey.[a]

Use of information gathering technology for cotton production	Average number of years used	Number of respondents		Average number of acres used in 2004	Number of respondents
Yield monitor – with GPS	3	73		1,719	71
Yield monitor – no GPS	3	22		1,698	20
Soil sampling – grid	5	205		876	196
Soil sampling – zone	14	217		1,153	209
Aerial photos	14	109		1,550	97
Satellite images	2	26		1,233	24
Soil survey maps	13	115		1,183	94
Handheld GPS/PDA	3	48		1,955	44
COTMAN plant mapping	5	30		1,560	27
Digitized mapping	5	10		2,297	9

[a] Survey question 15.

Table 5. Producers who abandoned information gathering technology – 2005 Southern Precision Farming Survey.

Use of information gathering technology for cotton production	Number of respondents who adopted the technology at least one year [a]	Number of respondents that abandoned the technology [b]
Yield monitor – with GPS	73(6%) [c]	14 (19%) [d]
Yield monitor – no GPS	22 (2%)	12 (55%)
Soil sampling – grid	205 (17%)	58 (28%)
Soil sampling – zone	217 (18%)	15 (7%)
Aerial photos	109 (9%)	13 (12%)
Satellite images	26 (2%)	10 (38%)
Soil survey maps	115 (9%)	12 (10%)
Handheld GPS/PDA	48 (4%)	4 (8%)
COTMAN plant mapping	30 (2%)	16 (53%)
Digitized mapping	10 (1%)	2 (2%)
Number of respondents	473 (39%) [c]	113 (24%) [d]

[a] Survey question 15. [b] Survey question 16. [c] Numbers in parentheses indicate the percentage of survey respondents who adopted the specific information gathering technology. [d] Numbers in parentheses indicate the percentage of adopters of each information gathering technology who later abandoned the technology.

Table 6. Technical advice usage reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]												
Use of information gathering technology for cotton production	2005 Survey Results – 11-States				2005 Survey Results – 6-States[b]				2001 Survey Results			
	Average per-acre cost	Number of Responses	Will you purchase this advice again?		Average per-acre cost	Number of Responses	Will you purchase this advice again?		Average per-acre cost	Number of Responses	Will you purchase this advice again?	
			Yes	No			Yes	No			Yes	No
Yield monitor – with GPS	$3.94	18	28 (93%)[c]	2 (7%)	$4.55	10	17 (94%)	1 (6%)	$5.44	2	2 (100%)	0 (0%)
Yield monitor – no GPS	$3.12	1	5 (71%)	2 (29%)	$3.12	1	3 (100%)	0	$3.50	6	6 (100%)	0 (0%)
Soil sampling – grid	$6.20	108	110 (89%)	13 (11%)	$6.08	79	76 (88%)	10 (12%)	$3.88	4	4 (100%)	0 (0%)
Soil sampling – zone	$8.85	87	91 (92%)	8 (8%)	$10.25	67	70 (96%)	3 (4%)	$2.00	4	4 (100%)	0 (0%)
Aerial photos	$2.91	19	26 (84%)	5 (16%)	$3.39	11	15 (88%)	2 (12%)	$4.00	6	2 (34%)	4 (66%)
Satellite images	$6.72	11	13 (81%)	3 (19%)	$9.33	6	8 (80%)	2 (20%)	Nn[d]	12	11 (92%)	1 (8%)
Soil survey maps	$3.21	17	31 (84%)	6 (16%)	$4.05	11	22 (85%)	4 (15%)	$2.50	11	11 (100%)	0 (0%)
Handheld GPS/PDA	$1.60	6	15 (100%)	0 (0%)								
COTMAN plant mapping	$4.33	6	11 (92%)	1 (8%)								
Digitized mapping	$2.38	4	5 (100%)	0 (0%)								

[a] Survey question 15. [b] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey. [c] Numbers in parenthesis indicate the percentage of respondents who gave the associated answer. [d] No observations.

Table 7. Custom services usage reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]												
Use of information gathering technology for cotton production	2005 Survey Results – 11-States				2005 Survey Results – 6-States[b]				2001 Survey Results			
	Average per-acre cost	Number of Responses	Will you purchase this advice again?		Average per-acre cost	Number of Responses	Will you purchase this advice again?		Average per-acre cost	Number of Responses	Will you purchase this advice again?	
			Yes	No			Yes	No			Yes	No
Yield monitor – with GPS	$4.14	9	11 (100%)[c]	0 (0%)	$4.42	3	4 (100%)	0	$4.88	14	11 (78%)	3 (22%)
Yield monitor – no GPS	$5.00	1	3 (75%)	1 (25%)	Nn[d]	Nn	1 (100%)	0	Nn	--[e]	--	--
Soil sampling – grid	$9.82	94	105 (94%)	7 (6%)	$6.23	70	75 (93%)	6 (7%)	$5.90	87	72 (82%)	15 (18%)
Soil sampling – zone	$5.10	55	56 (95%)	3 (5%)	$5.42	43	42 (95%)	2 (5%)	$2.21	27	22 (82%)	5 (18%)
Aerial photos	$4.08	12	15 (75%)	5 (25%)	$5.10	5	7 (70%)	3 (30%)	$8.00	6	3 (50%)	3 (50%)
Satellite images	$3.92	6	7 (78%)	2 (22%)	$4.50	2	3 (75%)	1 (25%)	Nn	4	2 (50%)	2 (50%)
Soil survey maps	$5.21	7	16 (89%)	2 (11%)	$5.21	7	13 (87%)	2 (13%)	$5.00	10	7 (69%)	3 (31%)
Handheld GPS/PDA	Nn	Nn	3 (100%)	0 (0%)								
Digitized mapping	$4.00	1	2 (100%)	0 (0%)								

[a] Survey question 15. [b] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey. [c] Numbers in parenthesis indicate the percentage of respondents who gave the associated answer. [d] No observations. [e] Not reported to avoid disclosure.

Table 8. Yield monitor data usage as reported by cotton farmers who use yield monitors – 2005 Southern Precision Farming Survey.[a]			
Did you or a consultant generate a yield map using data from your cotton yield monitor?	Yes	No	Number of Responses
	54 (24%)[b]	173 (76%)	227

[a] Survey question 17. [b] Numbers in parenthesis indicate the percentage of respondents who gave the associated answer.

Table 9. Yield variability assessment methods used prior to cotton yield monitor adoption reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]		
How did you assess the yield variability within a typical cotton field on your farm before you began using a cotton yield monitor?	Yes	No
Grid sampling	13 (10%)[b]	121 (90%)
Year-to-year field records	86 (64%)	48 (36%)
Soil maps	37 (28%)	97 (72%)
Consultants' estimates	23 (17%)	111 (83%)
Satellite imagery	1 (1%)	133 (99%)
COTMAN	5 (4%)	129 (96%)
Aerial photography	5 (4%)	129 (96%)
Other	32 (24%)	102 (76%)
Number of Responses	134 Total	

[a] Survey question 18. [b] Numbers in parenthesis indicate the percentage of respondents who gave the associated answer.

Table 10. Changes in perception of yield variability related to cotton yield monitor usage reported by cotton farmers – 2005 Southern Precision Farming Survey.	
How did the yield information you obtained from yield monitoring change your perception of the yield variability within your typical cotton field? [a]	Yes
Substantially increased my perception: my yields appear to be at least 50% more variable than I thought.	12 (15%)[b]
Somewhat increased my perception; my yields appear to be from 25-50% more variable than I thought.	27 (33%)
Slightly increased my perception; my yields appear to be from 1-25% more variable than I thought.	22 (27%)
Did no change my perception; my yields appear to be the same as I originally thought.	18 (22%)
Slightly decreased my perception; my yields appear to be from 1-25% more variable than I thought.	2 (2%)
Somewhat decreased my perception; my yields appear to be from 25-50% more variable than I thought.	1 (1%)
Substantially decreased my perception: my yields appear to be at least 50% more variable than I thought.	Nn[c]
Number of Responses	82 (100%)

[a] Survey question 19. [b] Numbers in parenthesis indicate the percentage of respondents who gave the associated answer. [c] No observations.

Table 11. Adopters' opinions regarding value of information obtained from a cotton yield monitor reported by cotton farmers – 2005 Southern Precision Farming Survey.					
Item			Yes	No	Number of Responses
Do you think the additional information about within-field yield variability you obtain from your cotton yield monitor is valuable to you?[a]			80 (76%) [b]	25 (24%)	105 (100%)
	Average	Standard Deviation	Minimum	Maximum	Number of Responses
If yes, what value do you place on the additional information you obtain from your cotton yield monitor? ($ acre/year)[c]	$21.25	$29.93	$0.00	$150.00	51

[a] Survey question 20. [b] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [c] Survey question 21.

Table 12. Use of GPS[a] guidance systems reported by cotton farmers – 2005 Southern Precision Farming Survey.			
Item	Yes	No	Number of Responses
Have you used any of the following GPS guidance systems? [b]			
Lightbar	231 (21%)[c]	853 (79%)	1,084
Autosteer	80 (7%)	1,004 (93%)	
Other	15 (1%)	1,061 (99%)	
None	465 (71%)	319 (29%)	
	Yes	No	Number of Responses
Has your GPS guidance system met your expectations?[d]	232 (80%)	58 (20%)	290

[a] Global positioning system. [b] Survey question 26. [c] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [d] Survey question 27.

Table 13. Reasons for GPS [a] guidance system use reported by cotton farmers – 2005 Southern Precision Farming Survey.[b]	
Item	Yes
Improved planting	85 (27%)[c]
Improved spraying capacity	195 (61%)
Improved overall efficiency	195 (61%)
Eliminate need for row markers	126 (40%)
Other	41 (13%)
Number of Respondents	318 Total

[a] Global positioning system. [b] Survey question 28. [c] Numbers in parentheses indicate the percentage of respondents who gave the associated answer.

Table 14. Adopters opinions regarding the value of their GPS[a] guidance system reported by cotton farmers – 2005 Southern Precision Farming Survey.

Item	Yes	No	Responses
Do you think your GPS guidance system is of value to you?[b]	279 (89%) [c]	36 (11%)	315 (100%)

	Average	Standard Deviation	Minimum	Maximum	Responses
If yes, what value do you place on using a GPS guidance system on your farm? ($ acre/year)[d]	$11.85	$43.06	$1.00	$600.00	212

[a] Global positioning system. [b] Survey question 29. [c] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [d] Survey question 30.

Table 15. Field operations performed using a GPS [a] guidance system reported by cotton farmers – 2005 Southern Precision Farming Survey.[b]

Item	Yes
Primary tillage	82 (26%)[c]
Planting	98 (31%)
Spraying	252 (81%)
Cultivating	32 (10%)
Harvesting	33 (11%)
Number of Respondents	312 Total

[a] Global positioning system. [b] Survey question 31. [c] Numbers in parentheses indicate the percentage of respondents who gave the associated answer.

Table 16. Inputs applied using variable rate technologies reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Input	Map-based		Sensor-based		Row Markers		Did you use a GPS[b] guidance system?	
	Average years used	Average 2004 acres	Average years used	Average 2004 acres	Average years used	Average 2004 acres	Yes	No
Nitrogen	7	1,016	6	706	15	754	45 (23%)[c]	154 (77%)
Phosphorous	6	1,090	5	677	15	821	72 (34%)	141 (66%)
Potassium	6	1,094	4	719	16	821	74 (35%)	135 (65%)
Lime	6	790	5	792	15	601	104 (45%)	127 (55%)
Seed	14	1,460	8	675	18	858	9 (6%)	145 (94%)
Growth regulator	7	1,134	4	918	14	852	27 (19%)	118 (81%)
Defoliant	8	1,207	5	560	15	765	30 (21%)	113 (79%)
Fungicide	12	909	2	780	15	729	11 (11%)	85 (89%)
Herbicide	12	1,093	4	648	21	881	30 (22%)	108 (78%)
Insecticide	10	1,155	6	502	19	802	28 (20%)	109 (80%)
Irrigation	15	762	0	0	16	848	1 (3%)	36 (97%)
Responses	238	Na[d]	28	Na	168	Na	384	

Did you use variable rate technology to apply inputs?	2005 Survey 6-State Results[e]			2001 Survey Results		
	Yes	No	Responses	Yes	No	Responses
Nitrogen	149 (17%)	725 (83%)	874	74 (23%)	250 (77%)	324
Phosphorous and Potassium	181 (21%)	693 (79%)	874	126 (39%)	196 (61%)	322
Lime	199 (23%)	675 (77%)	874	161 (48%)	176 (52%)	337
Seed	120 (14%)	754 (86%)	874	32 (11%)	271 (89%)	303
Herbicide	94 (11%)	780 (89%)	874	47 (15%)	259 (85%)	306
Insecticide	98 (11%)	776 (89%)	874	43 (14%)	260 (86%)	303
Irrigation	19 (2%)	855 (98%)	874	10 (3%)	275 (97%)	285
Fungicide	71 (8%)	803 (92%)	874	18 (6%)	276 (94%)	294
Growth regulator	106 (12%)	768 (88%)	874	73 (24%)	230 (76%)	303
Defoliant	106 (12%)	768 (88%)	874	46 (15%)	256 (85%)	302

[a] Survey question 35. [b] Global positioning system. [c] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [d] Non-applicable. [e] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 17. Respondents that used map and sensor-based variable rate technologies to apply inputs and then abandoned the technology as reported by cotton farmers – 2005 Southern Precision Farming Survey.

Input	Adopted Technology[a]	Abandoned Technology[b]
Nitrogen	75 (6%)[c]	25 (33%)[d]
Phosphorous	114 (9%)	36 (32%)
Potassium	117 (10%)	36 (31%)
Lime	154 (13%)	40 (26%)
Seed	22 (2%)	5 (23%)
Growth regulator	43 (4%)	10 (23%)
Defoliant	44 (4%)	11 (25%)
Fungicide	18 (1%)	4 (22%)
Herbicide	27 (2%)	8 (30%)
Insecticide	26 (3%)	9 (35%)
Irrigation	8 (1%)	0 (0%)
Responses	188 (15%) [c]	71 (38%) [d]

[a] Survey question 35. [b] Survey question 36. [c] Numbers in parentheses indicate the percentage of survey respondents that adopted variable rate technology to apply inputs. [d] Numbers in parentheses indicate the percentage of adopters who abandoned variable rate technology to apply the respective input.

Table 18. Adopters' perception of yield changes related to variable rate technology use reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

What is your perception of the yield effects on your farm from variable rate input application?	Responses	Increase	Same	Decrease
2005 Survey 11-State Results	231	121 (52%) [c]	107 (46%)	3 (1%)
2005 Survey 6-State Results [b]	159	80 (50%)	76 (48%)	3 (2%)
2001 Survey Results	210	78 (37%)	18 (9%)	114 (54%)
Estimate the increase/decrease in yield. (lb/acre)	Responses	Average Increase	Responses	Average Decrease
2005 Survey 11-State Results	119	115	3	233
2005 Survey 6-State Results	78	102	3	233
2001 Survey Results	61	97	12	166

[a] Survey question 37. [b] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey. [c] Numbers in parentheses indicate the percentage of respondents who gave the associated answer.

Table 19. Perceived environmental benefit experienced by adopting cotton farmers – 2005 Southern Precision Farming Survey.

Item	Responses	Yes	No
Have you experienced any improvements in environmental quality from using precision farming technologies? [a]			
2005 Survey 11-State Results	327	136 (42%) [b]	191 (58%)
2005 Survey 6-State Results [c]	250	95 (38%)	155 (62%)
2001 Survey Results	246	94 (38%)	152 (62%)

[a] Survey question 38. [b] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [c] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 20. Factors that influenced the adoption of precision farming practices reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Crop	Number of Responses	Level of Importance[b] Not Important----------Very Important					Average Score
		1	2	3	4	5	
2005 Survey 11-State Results							
Profit	361	8 (2%)[c]	4 (1%)	24 (7%)	58 (16%)	267 (74%)	4.6
Environmental benefits	346	20 (6%)	31 (9%)	100 (29%)	98 (28%)	97 (28%)	3.6
Be at the forefront of agricultural technology	342	72 (21%)	51 (15%)	108 (32%)	67 (20%)	44 (13%)	2.9
Fear of being left behind	341	110 (32%)	66 (195)	77 (23%)	49 (14%)	39 (11%)	2.5
2005 Survey 6-State Results[d]							
Profit	266	5 (2%)	3 (1%)	17 (6%)	46 (17%)	195 (73%)	4.6
Environmental benefits	257	12 (5%)	28 (11%)	73 (28%)	71 (28%)	73 (28%)	3.6
Be at the forefront of agricultural technology	255	55 (22%)	42 (17%)	75 (29%)	50 (20%)	33 (13%)	2.9
Fear of being left behind	252	82 (33%)	51 (20%)	59 (23%)	33 (13%)	27 (11%)	2.5
2001 Survey Results							
Profit	324	6 (2%)	5 (2%)	15 (4%)	80 (25%)	218 (67%)	4.5
Environmental benefits	303	12 (4%)	20 (7%)	75 (25%)	112 (37%)	84 (28%)	3.8
Be at the forefront of agricultural technology	296	45 (15%)	41 (14%)	88 (30%)	76 (26%)	47 (16%)	3.1
Fear of being left behind	296	109 (37%)	51 (17%)	69 (23%)	41 (14%)	26 (9%)	2.4

[a] Survey question 39. [b] Level of importance ranges from not important (1) to very important (5). [c] Number in parenthesis indicate the percentage of respondents who gave the associated answer. [d] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 21. Yield variability assessment methods currently used by cotton yield monitor non-adopters reported by cotton farmers – 2005 Southern Precision Farming Survey.

How did you assess the yield variability within a typical cotton field on your farm before you began using a cotton yield monitor? [a]	Yes	No
Grid sampling	74 (8%) [b]	813 (92%)
Year-to-year field records	587 (66%)	300 (34%)
Soil maps	182 (21%)	705 (79%)
Consultants' estimates (without a yield monitor)	161 (18%)	726 (82%)
Satellite imagery	12 (1%)	875 (99%)
Aerial photography	22 (2%)	865 (98%)
COTMAN	10 (1%)	877 (99%)
Other	205 (23%)	682 (77%)
Number of Responses	887 Total	

[a] Survey question 22. [b] Numbers in parentheses indicate the percentage of respondents who gave the associated answer.

Table 22. Non-adopters' opinions regarding the value of information that could be obtained from a cotton yield monitor reported by cotton farmers – 2005 Southern Precision Farming Survey.

Item	Yes	No	Number of Responses
Do you think the additional information about within-field yield variability that you could obtain from a cotton yield monitor would have some value to you?[a]	643 (74%) [b]	224 (26%)	867 (100%)

	Average	Standard Deviation	Minimum	Maximum	Number of Responses
If yes, what value would you place on the additional information you could obtain from a cotton yield monitor? ($ acre/year)[c]	$20.40	$28.72	$0.00	$200.00	433

[a] Survey question 23. [b] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [c] Survey question 24.

Table 23. Non-adopters opinions regarding a GPS[a] guidance system reported by cotton farmers – 2005 Southern Precision Farming Survey.

Item	Yes	No	Responses
Do you think the use of a GPS guidance system would have some value to you?[b]	572 (70%) [c]	243 (30%)	815 (100%)

	Average	Standard Deviation	Minimum	Maximum	Responses
If yes, what value would you place on using a GPS guidance system on your farm? ($ acre/year)[d]	$16.04	$34.56	$0.00	$500.00	355

	Yes	No	Don't know	Responses
Do you plan to purchase a GPS guidance system in the next three years?[e]	125 (15%)	367 (43%)	357 (42%)	849 (100%)

[a] Global positioning system. [b] Survey question 32. [c] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [d] Survey question 33. [e] Survey question 34.

Table 24. Opinions regarding the future profitability of precision farming reported by cotton farmers – 2005 Precision Farming Survey.

Item	2005 Survey Results						2001 Survey Results	
	11-State			6-State[a]				
Do you think it would be profitable for you to use precision farming technologies in the future? [b]								
	Yes	No	Don't Know	Yes	No	Don't Know	Yes	No
All	603 (50%) [c]	100 (8%)	497 (41%)	417 (48%)	75 (9%)	370 (43%)	800 (68%)	368 (32%)
Adopters	382 (66%)	29 (5%)	168 (29%)	253 (63%)	22 (6%)	124 (31%)	240 (85%)	42 (15%)
Non-adopters	221 (36%)	71 (11%)	329 (53%)	164 (35%)	53 (11%)	246 (53%)	560 (63%)	326 (37%)
Would you prefer to own or rent precision farming equipment? [d]								
	Own	Rent	Depends	Own	Rent	Depends	Own	Rent
All	420 (36%)	76 (7%)	657 (57%)	301 (37%)	48 (6%)	473 (58%)	486 (55%)	401 (45%)
Adopters	244 (43%)	36 (6%)	284 (50%)	170 (44%)	21 (5%)	199 (51%)	150 (62%)	91 (37%)
Non-adopters	176 (30%)	40 (7%)	373 (63%)	131 (30%)	27 (6%)	274 (63%)	366 (52%)	311 (48%)

[a] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey. [b] Survey question 4. [c] Numbers in parenthesis indicated the percentage of respondents who gave the associated answer. [d] Survey question 5.

Table 25. Importance of precision farming five years from now reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Crop	Number of Responses	Level of Importance[b]					Average Score
		Not Important----------Very Important					
		1	2	3	4	5	
Cotton							
2005 Survey 11-State Results							
All	1,168	50 (4%)[c]	105 (9%)	459 (39%)	317 (27%)	237 (20%)	3.5
Adopters	572	11 (2%)	44 (8%)	187 (33%)	180 (31%)	150 (26%)	3.7
Non-adopters	596	39 (7%)	61 (10%)	272 (46%)	137 (23%)	87 (15%)	3.3
2005 Survey 6-States Results [d]							
All	838	36 (4%)	78 (9%)	341 (41%)	225 (27%)	158 (19%)	3.5
Adopters	395	7 (2%)	26 (7%)	134 (34%)	129 (33%)	99 (25%)	3.7
Non-adopters	443	29 (7%)	52 (12%)	207 (47%)	96 (22%)	59 (13%)	3.2
2001 Survey Results							
All	1,166	89 (8%)	115 (10%)	292 (25%)	366 (31%)	303 (26%)	3.6
Adopters	301	7 (2%)	27 (9%)	63 (21%)	96 (32%)	108 (36%)	3.9
Non-adopters	865	82 (10%)	88 (10%)	229 (26%)	270 (31%)	195 (23%)	3.5
Other Crops							
2005 Survey Results							
All	1,040	43 (4%)	126 (12%)	409 (39%)	270 (26%)	192 (18%)	3.4
Adopters	528	11 (2%)	58 (11%)	177 (34%)	158 (30%)	124 (23%)	3.6
Non-adopters	512	32 (6%)	68 (13%)	232 (45%)	112 (22%)	68 (13%)	3.2

[a] Survey question 6. [b] Level of importance ranges from not important (1) to very important (5). [c] Number in parenthesis indicate the percentage of respondents who gave the associated answer. [d] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 26. Estimates of the typical purchase price for a cotton yield monitoring system with GPS[a] that can be used to generate a yield map reported by cotton farmers – 2005 Southern Precision Farming Survey.[b]

Group	Number of Responses	Average	Standard Deviation	Minimum	Maximum
2005 Survey 11-State Results					
All	882	$8,548	$8,048	$1.00	$50,000
Adopters	497	$8,537	$7,458	$3.00	$50,000
Non-adopters	385	$8,562	$8,760	$1.00	$50,000
2005 Survey 6-State Results[c]					
All	622	$8,214	$7,836	$1.00	$50,000
Adopters	339	$8,125	$7,409	$3.00	$50,000
Non-adopters	283	$8,320	$8,331	$1.00	$50,000
2001 Survey Results					
All	338	$7,904	$6,220	$400	$56,000
Adopters	124	$8,776	$5,580	$1,000	$40,000
Non-adopters	314	$7,561	$6,471	$400	$56,000

[a] Global positioning system. [b] Survey question 7. [c] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 27. Usefulness of information sources about precision farming reported by Tennessee cotton farmers – 2005 Southern Precision Farming Survey.[a]

Source	Number of Responses	Level of Usefulness[b] Not Useful---------- ----------Very Useful					Average Score
		1	2	3	4	5	
2005 Survey 11-State Results							
Farm Dealers	775	118 (15%)[c]	112 (14%)	271 (35%)	164 (21%)	110 (14%)	3.05
Crop Consultants	682	127 (19%)	100 (15%)	196 (29%)	152 (22%)	107 (16%)	3.02
Extension/ Universities	799	90 (11%)	89 (11%)	258 (32%)	197 (25%)	165 (21%)	3.32
Other Farmers	77	83 (11%)	104 (13%)	230 (30%)	197 (25%)	163 (21%)	3.33
Trade Shows	710	113 (16%)	125 (18%)	227 (32%0	173 (24%)	72 (10%)	2.95
Internet	605	173 (29%)	114 (19%)	183 (30%)	91 (15%)	44 (7%)	2.54
News Media	743	213 (29%)	127 (17%)	234 (31%)	117 (16%)	52 (7%)	2.55
2005 Survey 6-State Results[d]							
Farm Dealers	542						3.06
Crop Consultants	476						3.00
Extension/ Universities	567						3.41
Other Farmers	545						3.36
Trade Shows	509						3.02
Internet	421						2.57
News Media	524						2.58
2001 Survey							
Farm Dealers	153						3.10
Crop Consultants	137						3.37
Extension/ Universities	145						3.86
Other Farmers	110						2.38
Trade Shows	91						1.79
Internet	80						1.75
News Media	84						1.68

[a] Survey question 8. [b] Level of usefulness ranges from not useful (1) to very useful (5). [c] Number in parenthesis indicate the percentage of respondents who gave the associated answer. [d] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 28. Soil sampling practices reported by cotton farmers – 2005 Southern Precision Farming Survey.

Item	Responses	Percentage
In the last three years, have you had soil samples analyzed for your cotton fields? [a]		
Yes	1,121	94%
No	73	6%

	2005 Survey Results				2001 Survey Results	
	11-State		6-State [c]			
	Responses	Percentage	Responses	Percentage	Responses	Percentage
Who typically collects your soil samples? [b]						
Self	500	42%	390	53%	118	44%
Consultant	264	22%	169	23%	68	25%
Fertilizer/Chemical Dealer	260	22%	181	24%	84	31%
Family Member	26	2%				
Other	31	3%				
Respondents who used more than one collection method	101	9%				

[a] Survey question 9. [b] Survey question 10. [c] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 29. Methods used by cotton yield monitor adopters to implement site-specific information for variable rate application of inputs reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Item	Yes	No	Responses
Have you used a map-based method to apply inputs?	210 (20%)[b]	854 (80%)	1,064

	Yourself	Consultant	Fertilizer/ Chemical Dealer	Family Member	Other	Chose more than one person	Responses
If yes, who typically generates the maps and information required to apply the inputs?	29 (14%)	62 (30%)	92 (44%)	1 (<1%)	14 (7%)	12 (6%)	210

	Yes	No	Responses
Have you used a sensor-based method to apply inputs?	41 (4%)	963 (96%)	1,004

[a] Survey question 25. [b] Numbers in parentheses indicate the percentage of respondents who gave the associated answer.

Table 30. Farm size characteristics reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Item	Responses	Average	Standard Deviation	Minimum	Maximum
2005 Survey 11-State Results					
Acres owned					
All	892	500	767	0	10,200
Adopters	433	617	936	0	10,200
Non-adopters	459	390	540	0	4,450
Acres rented					
All	1,010	1,047	1,285	0	13,500
Adopters	500	1,328	1,555	0	13,500
Non-adopters	510	771	867	3	7,800
2005 Survey 6-State Results[b]					
Acres owned					
All	722	971	1,207	0	13,100
Adopters	296	626	998	0	10,200
Non-adopters	355	360	493	0	3,771
Acres rented					
All	651	481	776	0	10,200
Adopters	341	1,264	1,452	0	13,100
Non-adopters	381	709	855	3	7,800
2001 Survey Results					
Acres owned					
All	1,240	632	1,894	0	40,000
Adopters	251	1,063	2,950	0	40,000
Non-adopters	990	523	1,549	0	20,500
Acres rented					
All	1,240	253	643	0	6,000
Adopters	251	399	630	0	6,000
Non-adopters	990	239	647	0	5,500

[a] Survey question 12. [b] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 31. Years respondents grew cotton and crop acreage and yields – 2005 Southern Precision Farming Survey.[a]

Item	2003		2004		Neither
	Yes	No	Yes	No	
Respondents who grew cotton	1,193 (99%)[b]	13 (1%)	1,173 (97%)	34 (3%)	8

[a] Survey question 2. [b] Numbers in parenthesis indicated the percentage of respondents who gave the associated answer.

Table 32. Plant acres and estimated average crop yields for 1999 and 2003 reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Crop	All		Adopters		Non-adopters	
	Planted acres	Yield	Planted acres	Yield	Planted acres	Yield
2005 Survey 11-State Results – 2003 Crop Year						
Dryland Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	585	825	691	862	487	790
Standard Deviation	699	243	791	266	587	215
Minimum	5	150	5	150	8	200
Maximum	6,464	5,100	6,464	5,100	6,000	1,500
Number of Responses	1,064	1,048	509	504	555	544
Irrigated Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	724	1,009	827	1,038	571	965
Standard Deviation	1,288	218	1,019	179	1,598	260
Minimum	9	40	25	400	9	40
Maximum	20,000	1,750	8,800	1,600	20,000	1,750
Number of Responses	407	401	243	241	164	160
Other Crops						
Average	828		1,020		596	
Standard Deviation	1,053		1,250		684	
Minimum	8		8		10	
Maximum	10,000		10,000		6,000	
Number of Responses	533		292		241	
2005 Survey 6-State Results[b]						
Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	1,230	948	1,441	952	941	941
Standard Deviation	1,340	210	1,579	172	844	254
Minimum	38	400	38	400	80	470
Maximum	12,000	1,717	12,000	1,390	5,000	1,717
Number of Responses	204	199	118	115	86	84
Other Crops						
Average	726		909		521	
2001 Survey Results – 1999 Crop Year						
Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	776	711	1,133	790	663	685
Standard Deviation	933	224	1,271	214	826	226
Minimum	8	50	25	50	8	50
Maximum	8,248	1,400	9,248	1,285	7,000	1,400
Number of Responses	1,182	1,155	284	277	898	878
Other Crops						
Average	1,932		2,503		1,745	

[a] Survey question 11. [b] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 33. Plant acres and estimated average crop yields for 2000 and 2004 reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Crop	All		Adopters		Non-adopters	
	Planted acres	Yield	Planted acres	Yield	Planted acres	Yield
2005 Survey 11-State Results – 2004 Crop Year						
Dryland Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	597	869	693	896	507	844
Standard Deviation	732	315	747	230	706	375
Minimum	5	75	5	75	8	75
Maximum	11,000	7,500	4,300	1,500	11,000	7,500
Number of Responses	1,047	1,033	502	497	545	536
Irrigated Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	710	1,059	859	1,085	488	1,021
Standard Deviation	903	250	1,068	241	499	259
Minimum	18	50	25	50	18	70
Maximum	8,800	2,200	8,800	2,200	3,000	1,750
Number of Responses	402	396	241	237	161	159
Other Crops						
Average	831		1,017		599	
Standard Deviation	1,003		1,164		691	
Minimum	8		8		9	
Maximum	9,700		9,700		6,000	
Number of Responses	498		276		222	
2005 Survey 6-State Results[b]						
Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	1,292	953	1,554	946	931	964
Standard Deviation	1,426	318	1,692	242	829	399
Minimum	50	313	61	313	50	340
Maximum	12,000	3,660	12,000	1,457	5,000	3,660
Number of Responses	202	196	117	112	85	84
Other Crops						
Average	731		911		532	
2001 Survey Results – 2000 Crop Year						
Cotton		(lb/acre)		(lb/acre)		(lb/acre)
Average	815	777	1,175	865	699	749
Standard Deviation	935	223	1,266	218	828	225
Minimum	8	18	15	18	8	100
Maximum	10,100	1,800	10,100	1,170	7,300	1,800
Number of Responses	1,1556	1,120	282	276	874	843
Other Crops						
Average	1,885		2,375		1,731	

[a] Survey question 11. [b] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 34. Average spatial yield variability of a typical cotton field reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Cotton (lb/acre)	Least productive third			Average yield			Most productive third		
	All	Adopters	Non-adopters	All	Adopters	Non-adopters	All	Adopters	Non-adopters
2005 Survey 11-State Results									
Average Yield	599	619	576	847	873	816	1,136	1,176	1,090
Standard Deviation	202	199	203	195	191	195	256	247	259
Minimum	100	100	100	200	200	200	300	325	300
Maximum	1,300	1,300	1,200	1,650	1,530	1,650	2,060	2,060	2,000
Responses	945	501	444	943	501	442	935	498	437
2005 Survey 6-State Results[b]									
Average Yield	578	594	560	827	849	804	1,118	1,152	1,081
Standard Deviation	203	198	208	196	186	204	260	241	274
Minimum	100	100	100	200	200	200	300	325	300
Maximum	1,300	1,300	1,200	1,650	1,500	1,650	2,060	2,060	2,000
Responses	679	349	330	678	349	329	672	347	325
2001 Survey Results									
Average Yield	548	589	533	821	870	804	1,078	1,148	1,053
Standard Deviation	194	176	200	173	153	180	246	210	259
Minimum	50	50	50	125	200	125	100	100	100
Maximum	1,200	950	1,200	1,500	1,168	1,500	2,000	1,500	2,000
Responses	833	217	616	847	224	650	829	216	613

[a] Survey question 13. [b] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 35. Number of cotton farmers that own livestock or apply manure to their fields – 2005 Precision Farming Survey.[a]

	Do you own livestock?			Do you apply manure on your fields?		
	All	Adopters	Non-adopters	All	Adopters	Non-adopters
2005 Survey 11-State Results						
11-States						
Responses	1,204	578	626	1,021	477	544
Yes	332 (28%)[b]	148 (26%)	184 (29%)	179 (18%)	88 (18%)	91 (17%)
No	872 (72%)	430 (74%)	442 (71%)	842 (82%)	389 (82%)	453 (83%)
2005 Survey 6-State Results[c]						
Responses	865	398	467	742	336	406
Yes	269 (31%)	120 (30%)	149 (32%)	138 (19%)	65 (19%)	73 (18%)
No	596 (69%)	278 (70%)	318 (68%)	604 (81%)	271 (81%)	333 (82%)
2001 Survey Results						
Responses	1,255	305	950	704	170	534
Yes	421 (34%)	112 (37%)	309 (33%)	212 (24%)	67 (31%)	145 (22%)
No	834 (66%)	193 (63%)	641 (66%)	674 (76%)	151 (69%)	524 (78%)

[a] Survey question 3. [b] Numbers in parenthesis indicated the percentage of respondents who gave the associated answer. [c] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 36. Average age and number of years farming reported by the primary decision-maker for cotton farms – 2005 Southern Precision Farming Survey.

Item	Age[a]			Years of Farming[b]		
	All	Adopters	Non-adopters	All	Adopters	Non-adopters
2005 Survey 11-State Results						
Average	51	48	54	27	25	29
Minimum	20	20	21	2	2	2
Maximum	85	79	85	70	70	70
Responses	1,174	569	605	1,140	562	578
2005 Survey 6-State Results[c]						
Average	51	48	54	28	25	30
Minimum	22	22	23	2	2	2
Maximum	82	81	82	70	70	70
Responses	844	394	450	822	390	432
2001 Survey Results						
Average	50	48	51	27	25	28
Minimum	21	25	21	2	3	2
Maximum	92	78	92	78	63	78
Responses	1,262	312	950	1,209	302	907

[a] Survey question 41. [b] Survey question 42. [c] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 37. Number of years of formal education reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

Years of formal education	Responses	Average	Minimum	Maximum
All	1,134	14	6	23
Adopters	554	15	6	23
Non-adopters	580	14	7	20

[a] Survey question 43.

Table 38. Education level as reported by cotton farmers – 2005 Southern Precision Farming Survey.						
Item	All		Adopters		Non-adopters	
	Yes	No	Yes	No	Yes	No
2005 Survey 11-State Results						
Degrees received:[a]						
High school	1,122 (93%)[b]	86 (7%)	558 (96%)	21 (4%)	564 (90%)	65 (10%)
Associate	191 (16%)	1,017 (84%)	96 (17%)	483 (83%)	95 (15%)	534 (85%)
BS or BA	416 (34%)	792 (66%)	242 (42%)	337 (58%)	174 (28%)	455 (72%)
Graduate degree	92 (8%)	1,116 (92%)	56 (10%)	523 (90%)	36 (6%)	593 (94%)
2005 Survey 6-State Results [c]						
Completed High school	804 (93%)	65 (7%)	386 (97%)	13 (3%)	418 (89%)	52 (11%)
Average years of college	2		3		2	
2001 Survey Results						
completed High school	1,198 (95%)	59 (5%)	302 (97%)	10 (3%)	896 (95%)	49 (5%)
Average years of college	2		3		2	

[a] Survey question 44. [b] Numbers in parentheses indicate the percentage of survey respondents who gave the associated answer. [c] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 39. Computer ownership and usage as reported by the primary decision maker for cotton farms – 2005 Southern Precision Farming Survey.						
	Do you own a computer? [a]		Do you use a computer for farm management? [b]		Do you use a laptop/handheld computer in the field? [c]	
	Yes	No	Yes	No	Yes	No
2005 Survey 11-State Results						
All	973 (83%)[d]	202 (17%)	591 (53%)	532 (47%)	159 (14%)	1,009 (86%)
Adopters	511 (89%)	61 (11%)	362 (66%)	185 (34%)	122 (21%)	448 (79%)
Non-adopters	462 (77%)	141 (23%)	229 (40%)	347 (60%)	37 (6%)	561 (94%)
2005 Survey 6-State Results [e]						
All	695 (82%)	152 (18%)	412 (51%)	394 (49%)		
Adopters	351 (89%)	45 (11%)	247 (66%)	130 (34%)		
Non-adopters	344 (76%)	107 (24%)	165 (38%)	264 (62%)		
2001 Survey Results						
All	967 (775)	284 (23%)	625 (60%)	412 (40%)		
Adopters	269 (86%)	44 (14%)	207 (74%)	73 (26%)		
Non-adopters	98 (74%)	240 (26%)	419 (55%)	339 (45%)		

[a] Survey question 45. [b] Survey question 46. [c] Survey question 47. [d] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [e] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 40. Farm planning goals reported by cotton farmers – 2005 Southern Precision Farming Survey.[a]

	I want to acquire enough farm assets to generate sufficient income for family living.	I want to expand the size of operation through acquiring additional resources.	I am thinking about retirement and transfer of farm to the next generation.	I am considering selling the farm and moving on to a different career.	Chose more than one planning goal.
2005 Survey 11-State Results					
All	585 (51%)[b]	211 (19%)	236 (21%)	29 (3%)	77 (7%)
Adopters	300 (54 %)	112 (20%)	85 (15%)	11 (2%)	49 (9%)
Non-adopters	285 (49%)	99 (17%)	151 (26%)	18 (3%)	28 (5%)
2005 Survey 6-State Results[c]					
All	414 (54%)	157 (21%)	167 (22%)	24 (3%)	
Adopters	209 (59%)	82 (23%)	56 (16%)	9 (3%)	
Non-adopters	205 (50%)	75 (18%)	111 (27%)	15 (4%)	
2001 Survey Results					
All	612 (52%)	196 (17%)	288 (25%)	73 (6%)	
Adopters	152 (53%)	70 (25%)	47 (16%)	17 (5%)	
Non-adopters	460 (52%)	127 (14%)	240 (28%)	56 (7%)	

[a] Survey question 48. [b] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [c] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey.

Table 41. Estimated total household income from farm and non-farm sources reported by cotton farmers – 2005 Southern Precision Farming Survey.

	2005 Survey 11-State Results			2005 Survey 6-State Results [a]			2001 Survey Results		
Household Income	Total Household Income[b]	Percentage of Household Income from Farming[c]		Total Household Income	Percentage of Household Income from Farming		Total Household Income	Percentage of Household Income from Farming	
		Resp. [d]	Percent		Resp.	Percent		Resp.	Percent
All									
Less than $50,000	144 (13%)[e]	187	71%	112 (145)	139	71%	340 (29%)	310	69%
$50,000 to $99,999	371 (34%)	411	71%	272 (34%)	296	70%	417 (35%)	409	63%
$100,000 to $149,999	207 (19%)	252	72%	144 (18%0	172	73%	170 (14%)	172	66%
$150,000 to $199,999	93 (8%)	140	74%	64 (8%)	93	74%	59 (5%)	58	71%
$200,000 to $500,000	158 (14%)	204	80%	116 (15%)	146	80%	115 (10%)	113	74%
$500,000 or greater	123 (11%)	170	84%	85 (11%)	114	85%	91 (8%)	90	89%
Adopters									
Less than $50,000	51 (10%)	80	77%	39 (11%)	59	77%	69 (23%)	65	72%
$50,000 to $99,999	179 (34%)	209	77%	129 (35%)	148	78%	110 (36%)	99	73%
$100,000 to $149,999	114 (22%)	145	74%	81 (22%)	101	74%	50 (15%)	48	62%
$150,000 to $199,999	43 (8%)	75	76%	29 (8%)	50	74%	12 (4%)	10	67%
$200,000 to $500,000	69 (13%)	99	80%	45 (12%)	66	80%	35 (11%)	34	78%
$500,000 or greater	70 (13%)	102	83%	43 (12%)	64	84%	30 (10%)	29	84%
Non-adopters									
Less than $50,000	93 (16%)	107	66%	73 (17%)	80	66%	242 (28%)	203	69%
$50,000 to $99,999	192 (34%)	202	64%	143 (33%)	148	63%	305 (35%)	247	56%
$100,000 to $149,999	93 (16%)	107	69%	63 (15%)	71	70%	122 (14%)	103	64%
$150,000 to $199,999	50 (9%)	65	72%	35 (8%)	43	74%	48 (6%)	37	73%
$200,000 to $500,000	89 (16%)	105	79%	71 (17%)	80	79%	82 (9%)	58	75%
$500,000 or greater	53 (9%)	68	86%	42 (10%)	50	87%	61 (7%)	51	90%

[a] 2005 responses for the original six states included in the 2001 Southern Precision Farming Survey. [b] Survey question 49.
[c] Survey question 50. [d] Number of Respondents. [e] Numbers in parentheses indicate the percentage of respondents who gave the associated answer.

Table 42. Cotton farmers' opinions regarding the Extension Service – 2005 Southern Precision Farming Survey.			
Item	Responses	Yes	No
Does the Extension Service need to provide more educational outreach about precision farming in your area? [a]			
All	1,096	766 (70%)[b]	330 (30%)
Adopters	551	403 (73%)	148 (27%)
Non-adopters	545	363 (67%)	182 (33%)
Does your county agent have the necessary skills in precision farming to meet your needs?[c]			
All	926	550 (59%)	376 (41%)
Adopters	469	275 (59%)	194 (41%)
Non-adopters	457	275 (60%)	182 (40%)

[a] Survey question 51. [b] Numbers in parentheses indicate the percentage of respondents who gave the associated answer. [c] Survey question 52.