# TRENDS IN COTTON PRECISION FARMING: 2000-2008

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## Abstract

The Southern Cotton Precision Farming Survey funded in part by Cotton, Incorporated, has been an ongoing activity since 2001 and has expanded to 12 southern states – Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, Texas, and Virginia. Three surveys, one every four years, have been taken to evaluate farmer's use of precision farming technologies. Both adoption and abandonment issues have been evaluated of various precision technologies based on the findings of these surveys. This article summarizes initial findings from 2009 Southern Cotton Precision Farming Survey and compares them with results from the surveys conducted in 2001 on cotton farmers located in 6 states and in 2005 on cotton farmers located in 11 states. A mail survey of 13,579 cotton producers across the southern United States was conducted from February to March of 2009. In total, 56% of respondents from an 11-state survey region (excludes Texas) were classified as having adopted information gathering technology or variable rate management in 2008. This represents an eight percentage point increase in precision farming adoption since 2004 for this region. Similarly, adoption figures for 2008 show a 30 percentage point increase in the use of information gathering technologies and variable rate management since 2000 in a smaller 6-state region. From 2004 to 2008, use of yield monitoring with GPS and grid and zone soil sampling showed the largest increases among information gathering technology adopters. Among those making variable rate management decisions, the variable rate application of fertility and lime inputs had the largest increase in adoption between 2004 and 2008. GPS autosteer systems and the use of GPS guidance systems in general for planting and tillage field operations also showed large increases in adoption between 2004 and 2008.

## Introduction

Cotton is produced in a wide range of production environments with varying yield potential. Differences in soil type, depth, moisture content, and other related properties often occur within a field and may result in within-field yield variability. While cotton yield monitors have become commercially available only in the past decade, other

precision farming technologies have been available to cotton farmers for some time. These precision farming services can be implemented by producers or custom hired for a fee. Yet questions remain about their profitability and potential for widespread use among cotton farmers (Roberts et al., 2006).

The future of precision farming depends on how profitable producers view this set of new technologies (Griffin et al, 2004). In light of new data collected through the 2009 Southern Cotton Precision Farming Survey, a need exists to reevaluate producers' experiences with precision farming technologies over the past decade and to outline emerging trends that may indicate what benefits cotton farmers have received or expect to receive in the future. Such an assessment is needed to appraise the present status and future prospects for adoption of precision farming technologies by cotton producers. The objective of this study was to conduct an initial exploration of emerging trends in cotton precision farming adoption by cotton producers in the southern United States from 2000 to 2008 based cotton precision farming survey data gathered in 2001, 2005, and 2009. Results may change slightly with further evaluation of the survey data.

## Materials and Methods

This report compares results from the 2009 Southern Cotton Precision Farming Survey with results from similar surveys conducted in 2001 and 2005. Each year that the survey has been taken, the region covered has expanded. Originally, in 2001, six states were surveyed – Alabama, Florida, Georgia, Mississippi, North Carolina, and Tennessee. In 2005, the area increased to eleven states adding Arkansas, Louisiana, Missouri, South Carolina, and Virginia. By 2009, farmers in those eleven states were surveyed plus Texas. When comparisons are made, data from the same geographical areas are used.

### Description of the 2009 Survey

A mail survey of cotton producers located in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, Texas, and Virginia was conducted in 2009, to establish the current use of cotton precision farming technologies in these states. The mailing list of potential cotton producers was furnished by the Cotton Board. A questionnaire was developed to elicit cotton farmer attitudes toward and use of precision farming technologies. 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. A reminder post card was sent two weeks after the initial mailing. A second mailing of the questionnaire to producers not responding to previous inquiries was then conducted three weeks later. The second mailing included a letter indicating the importance of the survey, the questionnaire, and a postage-paid return envelope.

The following statement was printed on the survey questionnaire: "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 and Geographical Information Systems.

### Overview of the 2001 and 2005 Surveys

The 2009 Southern Cotton Precision Farming Survey represents the third in a series of cotton precision farming surveys. The 2001 and 2005 surveys employed similar survey methodologies as described for the 2009 survey and used an identical definition of precision farming.

In the 2001 Southern Cotton Precision Farming Survey, Roberts et al. (2002) found that 23% of cotton producers from Alabama, Florida, Georgia, Mississippi, North Carolina and Tennessee were precision farming adopters. Precision farming technology adopters were defined as any respondent who had used an information gathering technology or made a variable rate management decision. The most widely used cotton precision farming technologies were grid and zone soil sampling, variable rate lime, phosphorous, and potassium application, and soil survey maps. Only 28 of 1,373 responding producers practiced yield monitoring with GPS.

In a 2005 follow-up survey, Roberts et al. (2006) reported that 48% of cotton producers had used at least one precision farming technology. Grid and zone soil sampling and variable rate application of lime, phosphorous, and

potassium remained the most common precision farming technologies used in cotton production; however the use of a cotton yield monitoring system equipped with GPS grew considerably with 116 of 1,215 respondents having reported using this technology.

## Results and Discussion

Results are presented in four sections. The first section outlines the changes in overall precision farming adoption from 2000 to 2008. The remaining three sections detail changes in the mix of information gathering technologies, variable rate management decisions, and GPS guidance used by cotton producers, respectively.

### Overall Precision Farming Adoption

In the 2009 survey, respondents were identified as precision farming adopters if they reported using information gathering technology, variable rate management, or GPS guidance (Mooney et al., 2010). Overall, 1,061 of the 1,692 respondents from the 12-state region, or 63%, were classified as precision farming adopters. This definition of an adopter varies slightly from previous surveys conducted in 2001 and 2005 (Roberts et al., 2002; Roberts et al., 2006). In these earlier surveys, respondents were defined as precision farming adopters if they reported using information gathering technology or variable rate management. That is, respondents who reported using GPS guidance but not information gathering technology or variable rate management were not counted among adopters.

Tables 1 and 2 compare results from the 2009 survey with the 2001 and 2005 surveys, respectively, using the previous definition of a precision farming adopter (i.e., respondents who reported having used GPS guidance were not counted among adopters). The adjusted precision farming adoption rate in 2009 for the 11-state region surveyed in 2005 was 56%, which is an 8 percentage point increase over the precision farming adoption rate found in 2005 (Table 1). Similarly, for the 6-state region surveyed in 2001, the adjusted precision farming adoption rate in 2009 was 54%. This figure represents an 8 and 30 percentage point increase over the adoption rates found in the 2005 and 2001 surveys, respectively (Table 2).

**Table 1. Comparison of cotton farm location, response rate, and precision farming adoption in eleven southern states – 2005 and 2009 southern cotton precision farming surveys**

| State | 2009 Survey Results | | | 2005 Survey Results | | |
|---|---|---|---|---|---|---|
| | Cotton Farmers Surveyed | Usable Surveys Returned | Precision Farming Adopters[a] | Cotton Farmers Surveyed | Usable Surveys Returned | Precision Farming Adopters |
| | Number | % | % | Number | % | % |
| Alabama | 782 | 13.6 | 47.2 | 1,200 | 11.8 | 40.4 |
| Arkansas | 812 | 7.8 | 58.7 | 1,221 | 7.8 | 50.5 |
| Florida | 184 | 14.7 | 33.3 | 265 | 8.7 | 26.1 |
| Georgia | 2,046 | 8.3 | 50.3 | 3,185 | 7.1 | 36.9 |
| Louisiana | 581 | 12.2 | 63.4 | 1,032 | 9.3 | 59.4 |
| Mississippi | 714 | 17.9 | 60.2 | 1,308 | 12.9 | 55.6 |
| Missouri | 464 | 7.3 | 67.6 | 587 | 8.2 | 58.3 |
| North Carolina | 1,036 | 16.3 | 54.4 | 1,652 | 12.1 | 50.0 |
| South Carolina | 355 | 13.5 | 66.7 | 538 | 13.6 | 43.8 |
| Tennessee | 631 | 16.6 | 61.0 | 822 | 14.1 | 51.7 |
| Virginia | 162 | 14.2 | 60.9 | 233 | 12.4 | 51.7 |
| 11-State Total | 7,767 | 12.1 | 56.0 | 12,043 | 10.1 | 47.7 |

[a] Definition does not include GPS guidance in order to maintain consistency with the definition of precision farming adopters used in 2005 and 2001.

**Table 2. Comparison of cotton farm location, response rate, and precision farming adoption in six southern states – 2001, 2005, and 2009 southern cotton precision farming surveys**

| State | 2009 Survey Results | | | 2005 Survey Results | | | 2001 Survey Results | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cotton Farmers Surveyed | Usable Surveys Returned | Precision Farming Adopters[a] | Cotton Farmers Surveyed | Usable Surveys Returned | Precision Farming Adopters[a] | Cotton Farmers Surveyed | Usable Surveys Returned | Precision Farming Adopters[a] |
| | Number | % | % | Number | % | % | Number | % | % |
| Alabama | 782 | 13.6 | 47.2 | 1,200 | 11.8 | 40.4 | 991 | 24.0 | 19.3 |
| Florida | 184 | 14.7 | 33.3 | 265 | 8.7 | 26.1 | 192 | 26.0 | 14.0 |
| Georgia | 2,046 | 8.3 | 50.3 | 3,185 | 7.1 | 36.9 | 2,883 | 10.4 | 24.9 |
| Mississippi | 714 | 17.9 | 60.2 | 587 | 28.8 | 55.6 | 1,282 | 20.4 | 24.8 |
| North Carolina | 1,036 | 16.3 | 54.4 | 1,652 | 12.1 | 50.0 | 1,698 | 21.8 | 25.4 |
| Tennessee | 631 | 16.6 | 61.0 | 822 | 14.1 | 51.7 | 839 | 18.1 | 19.1 |
| 6-State Total | 5,393 | 13.1 | 53.6 | 7,711 | 11.3 | 45.8 | 7,885 | 17.4 | 23.0 |

[a] Definition does not include GPS guidance in order to maintain consistency with the definition of precision farming adopters used in 2005 and 2001.

**Information Gathering Technology**

Changes in the mix of information gathering technology used as reported by information gathering technology adopters are shown in Figure 1. The horizontal bars indicate the percentage of these information gathering technology adopters who reported having used each of the seven technologies listed. Use of yield monitoring with GPS and zone and grid soil sampling increased over 5% among information gathering technology adopters between 2004 and 2008. By contrast, use of aerial photography, handheld GPS/PDA, and COTMAN decreased slightly.

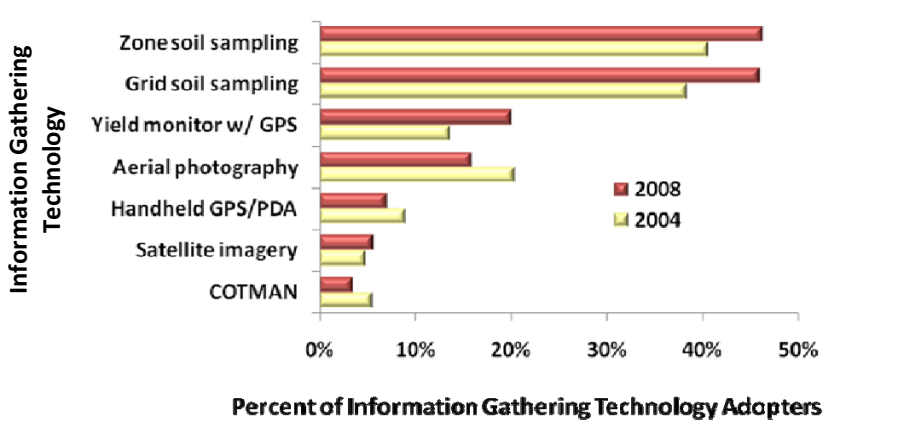


**Figure 1. Change in Mix of Information Gathering Technologies Used, 2004-2008**

**Variable Rate Management**

Changes in the mix of variable rate management decisions made as reported by variable rate management adopters are illustrated in Figure 2. Results shown are for those adopters who reported basing their variable rate decision on information gathered using a yield monitor with GPS or aerial/satellite imagery. The horizontal bars indicate the percentage of yield monitor and aerial/satellite imagery users who reported having made each of the nine variable rate decisions listed. Variable rate decisions for fertility and lime increased among both yield monitor and aerial/satellite imagery users between 2004 and 2008. Variable rate decisions involving insecticide, harvest aid, herbicide, irrigation, and fungicide decreased among aerial/satellite imagery users decreased from 2004 to 2008, but remained relatively constant among yield monitor users. By contrast, use of yield monitor and aerial/satellite imagery information for making variable rate drainage decisions decreased from 2004 to 2008.

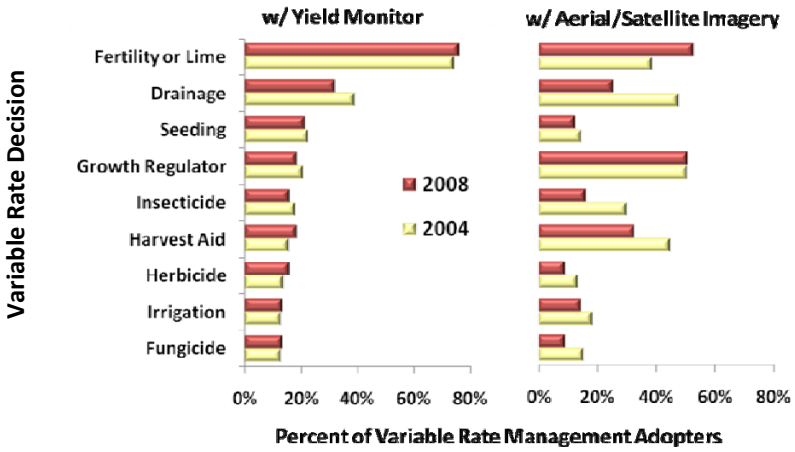


**Figure 2. Change in Mix of Variable Rage Management Decisions for Yield Monitor and Aerial/Satellite Imagery Adopters, 2004-2008**

## GPS Guidance

Changes in the mix of GPS guidance systems used by guidance adopters are depicted in Figure 3. In 2004, over three-quarters of GPS guidance system adopters reported using a GPS lightbar system. By 2008, however, over half of GPS guidance adopters reported using GPS autosteer or both GPS autosteer and GPS lightbar systems.

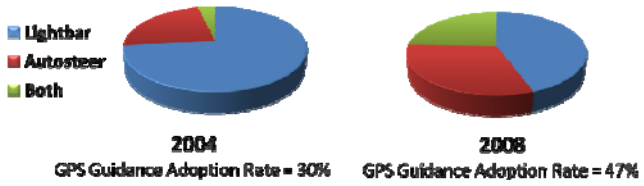


**Figure 3. Use of GPS Guidance Systems, 2004 and 2008**

Changes in the use of GPS guidance systems by field operation are shown in Figure 4. The use of such systems in 2004 was mostly for planting, with less than one-third of adopters having reported using their GPS guidance systems for each of the four other operations listed. However, by 2008 over one-half of adopters reported having used GPS guidance for their planting and tillage operations.

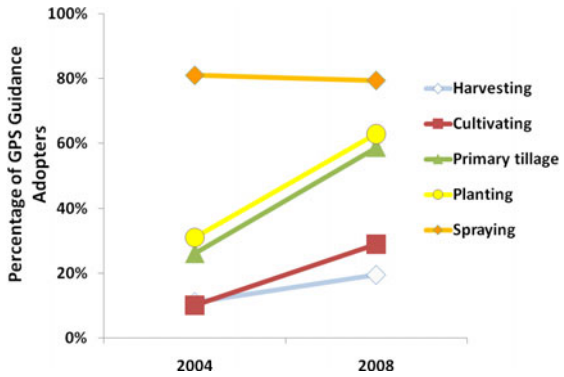


**Figure 4. Use of GPS Guidance by Field Operations GPS Guidance Systems, 2004-2008**

## Summary

This article presents preliminary results from the 2009 Southern Cotton Precision Farming Survey and compares them with similar surveys conducted in 2001 and 2005. A mail survey of 13,579 cotton producers across southern U.S. states was conducted from February to March of 2009. In total, 56% of respondents from an 11-state survey region were classified as having adopted information gathering technology or variable rate management in 2008. This represents an eight percentage point increase in precision farming adoption since 2004 for this region. Similarly, adoption figures for 2008 show a 30 percentage point increase in the use of information gathering technologies and variable rate management since 2000 in a smaller 6-state region. From 2004 to 2008, use of yield monitoring with GPS and grid and zone soil sampling showed the largest increases among information gathering technology adopters. Among those making variable rate management decisions, the variable rate application of fertility and lime inputs had the largest increase in adoption between 2004 and 2008. Autosteer GPS guidance systems and use of GPS guidance systems in general for planting and tillage field operations also showed large increases in adoption between 2004 and 2008.



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## Disclaimer

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