2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

FACTORS AFFECTING USE OF PRECISION SOIL SAMPLING AND VARIABLE RATE LIME APPLICATION

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Abstract

Probit analysis of responses from a 2001 survey of cotton farmers in six southeastern states was used to determine the factors that influence cotton farmers to use precision soil sampling and variable rate lime application. Farm size, college attendance, farmer age, land quality, and the farmer's perceptions about the importance and profitability of cotton precision farming were significant in determining the use of precision soil sampling. Variable rate lime application, given that a farmer used precision soil sampling, was significantly explained by land quality and the farmer's age and knowledge about the cost of precision farming.

Introduction

Cotton is a high-value, high-input crop with potential for profitable precision farming and reductions in input losses to the environment (Roberts et al., 2002b). The objective of this research was to determine the factors that influence cotton farmers to use precision soil sampling (grid and/or management zone soil sampling) and variable rate lime application. Identifying these factors could help policymakers increase input efficiency through policies that stimulate the use of precision farming technologies. Extension programs and agribusiness firms might also benefit from targeting their efforts toward farmers who are most likely to use these technologies.

Materials and Methods

The farmer who maximizes expected benefits will choose to: 1) use precision soil sampling and variable rate lime application (VRT) technologies; 2) use precision soil sampling and uniform rate lime application (URT) technologies, or 3) use traditional whole-field information gathering technology and URT. Gathering whole-field information and using VRT is not possible because the site-specific information necessary for VRT use was not gathered. By choosing to precision soil sample, the farmer is self-selected into the group of farmers who can choose between VRT and URT. This property implies the use of probit regression methods that account for sample selection (Greene, 1997; Khanna, 2001).

A bivariate probit model was specified with two dependent variables: 1) $I_s = 1$ if the farmer used precision soil sampling and $I_s = 0$ otherwise, and 2) $I_v = 1$ if the farmer used precision soil sampling and VRT for lime application and $I_v = 0$ otherwise. The model was first estimated with the correlation (ρ) across the two equations unconstrained and then again with ρ constrained to zero. A likelihood ratio test was performed to test the null hypothesis that ρ equals zero. Individual binomial probit models can be estimated for the two equations if the null hypothesis is not rejected (Greene, 1997, 1998).

Data were collected from a mail survey of cotton producers in Alabama, Florida, Georgia, Mississippi, North Carolina, and Tennessee conducted in 2001 (Roberts et al., 2002a). Of the 5,976 cotton producers surveyed, 1,031 (17%) responded. The number of usable responses was reduced to 773 because of missing data. Of these 773 respondents, 136 (18%) said they used precision soil sampling and 56 of those respondents (40%) said they used VRT.

Results

The estimate of ρ was 0.33 with a standard error of 12.17 and a t-ratio of 0.027. The likelihood ratio test also indicated failure to reject the null hypothesis that ρ equals zero. The likelihood ratio test statistic (Chi-squared, 1 df) was –2(–402.37 – (–402.36)) = 0.022. The individual binomial probit models significantly explained the use of precision soil sampling and VRT as indicated by highly significant Chi-squared statistics for each probit model. The VRT probit model correctly predicted 31 of 56 farmers (55%) who used both precision soil sampling and VRT and it correctly predicted 64 of 80 farmers (80%) who used precision soil sampling but not VRT. The probit model for precision soil sampling correctly predicted 633 of 637 farmers (99%) who used neither of these precision farming technologies.

Farm size, land quality, college attendance, farmer age, and perceptions about the profitability and importance of precision farming in the future significantly influenced the probability that a farmer would use precision soil sampling. Use of variable rate lime technology, given precision soil sampling, was significantly explained by land quality and the farmer's age and knowledge about the cost of using precision farming technologies. Using a computer for farm management and owning more land relative to the amount of land rented were not significant factors in explaining the use of precision soil sampling or variable rate lime application.

Conclusions

The results of this research could be used to develop policies that stimulate the use of precision farming technologies. For example, results suggest that educational programs designed to increase cotton farmers' knowledge about the costs of precision farming technologies may increase the use of variable rate lime application among those farmers who already use precision soil sampling. Also, targeting cotton farmers who are under 50 years of age by extension programs and agribusiness firms may be more fruitful than targeting older farmers.

Acknowledgements

Cotton Incorporated and the Agricultural Experiment Stations or Extension Services of the participating institutions funded this project.

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