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# BREAKEVEN ANALYSIS FOR A COTTON YIELD MONITOR INFORMATION SYSTEM

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## Abstract

Cotton yield monitors are a relatively new technology and their cost of ownership has not been thoroughly evaluated. This research evaluated the breakeven yield gains and input savings required to cover the cost of a yield monitoring information system. Results suggest that for a farm with 528 cotton acres, a yield gain of 19 lb/acre was required to pay for the yield monitoring information system if it was used for making variable rate nitrogen input decisions.

## Introduction

Precision farming has the potential to improve profitability by increasing yields and lowering input costs for farmers while providing environmental benefits to society. These benefits are potentially very important in input intensive cotton production. One of the impediments to the adoption of precision technology by cotton farmers has been the lack of a reliable yield monitoring system. Cotton yield monitors, first introduced in 1997, had poor accuracy and were not reliable (Searcy and Roades, 1998; Valco et al., 1998; Durrence et al., 1999; Sassenarath-Cole et al., 1998). Subsequent cotton yield monitor technology introduced in 2000 appears to be more reliable and may be more readily adopted by farmers (Perry et al., 2001). Because cotton yield monitors are a relatively new technology, information about the yield gains and input savings required to pay for a cotton yield monitoring information system would be useful for farmers considering an investment in the technology. The objectives of this research were: 1) to determine the per acre investment cost for a cotton yield monitoring information system, and 2) to analyze the breakeven lint yield gains and input savings needed to pay back the investment cost for a farmer using the information system to make variable rate technology (VRT) input application decisions.

## Data and Methods

The following breakeven analysis equation was used to evaluate the economic effects of changes in revenues and costs associated with the decision to invest in a cotton yield monitoring information system:

$$\Delta y = \frac{r\Delta x + vrc + oic + \dfrac{fc_c}{a_c} + \dfrac{fc_{c+o}}{a_c + a_o}}{p} \qquad [1]$$

where $\Delta y$ is the gain in lint yield (lb/acre) from applying a crop input using the information system to make the VRT input decision, r is price per unit of crop input x, $\Delta x$ is the difference in the input application rate for VRT versus uniform rate technology (URT) (units/acre), vrc is the difference in input application costs ($/acre) for VRT versus URT, oic is the cost ($/acre) of other information used to make the VRT decision (e.g., grid soil sampling information), $fc_c$ ($) is the fixed cost for yield monitoring system equipment components that are specific to the cotton enterprise, $fc_{c+o}$ ($) is the fixed cost for system components that can be used for other crop enterprises, $a_c$ is cotton enterprise acreage, $a_o$ is other crop enterprise acreage, and p is cotton lint price ($/lb). Fixed costs include charges for depreciation, interest, taxes, insurance, and housing. For this analysis, the information system was assumed to include a general-purpose monitor/controller console, cotton flow sensors, GPS receiver, memory card, desktop computer/printer with a card reader, GIS field mapping software, and training in data management and analysis. Ownership costs were calculated for an Ag Leader Technology PF 3000 cotton yield monitor (Ag Leader Technology, 2001). Computer hardware and GIS field mapping software costs were an average for several software vendors. The desktop computer, printer, and card reader were assumed to have a purchase cost of $1,376. The GIS software was assumed to have an initial investment cost of $2,186 with an annual update cost of $825. A $500 charge for installation of yield monitor on the picker and a $500 annual charge for training were included in the calculation of fixed costs. Depreciation and interest were calculated using the capital recovery method, a zero salvage value, and a real rate of interest of 7% (U. S. Department of Agriculture, Economic Research Service, 2001; Congress of the U.S., Council of Economic Advisors, 2001). Taxes, insurance, and housing were calculated as 2% of purchase cost (ASAE Standards, 2000). Fixed costs per acre were calculated for different farm sizes derived from a six state survey of cotton farmers (Roberts et al, 2002) and the assumption that one four-row picker can harvest 712 acres in one season (Cooke, Parvin, and Spurlock, 1991). Yield gains and input savings to pay for the investment for different farm sizes were calculated assuming the information system was used to make variable rate nitrogen fertilization decisions. The average 1991 through 2000 nitrogen price of $0.32/lb, expressed in year 2000 dollars, was used to calculate breakeven values (U.S. Department of Agriculture, National Agricultural Statistics Service, Various Issues). The average nitrogen application rate of 83 lb/acre for Upland cotton in the United States (U.S.

Department of Agriculture, National Agricultural Statistics Service, Various Issues) was used to calculate yield gains for assumed nitrogen input savings with VRT that range from 25% below to 25% above the base URT nitrogen rate of 83 lb/acre. A VRT versus URT input application cost difference (vrc) of $2.00/acre and an other information cost (oic) value of $1.00/acre were used to calculate lint yield and input cost differences (Roberts, English, and Sleigh, 2000).

## Results

Total annual ownership cost of the yield monitoring information system for a farm with one four-row picker was estimated to be $3,959. Ownership cost results indicate that most of the farm size cost advantage for the information system was achieved for farms with over 1,000 acres of cotton (Figure 1). When all fixed costs for the information system were allocated to the cotton enterprise, the per acre expense was $4.66/acre for a 1,230 acre cotton enterprise compared with a much larger $35.35/acre for a farm with only 112 acres of cotton. Fixed costs per acre were less when expenses for the desktop computer and GIS software, which can be used for other crops, were allocated across all crop acres. For example, information system ownership costs for the 528 acre farm dropped to $4.12/acre when computer and software costs were allocated across all crop acres. The yield monitor console could also be used for other crops, which can further reduce the per acre ownership costs of the information system when its cost is allocated over all crop acres.

Required lint yield gains to pay for the information system for different VRT input saving scenarios and for three farm sizes are presented in Figure 2. This graph shows the required yield gain based on the percentage change from the base URT input cost. The required lint yield gain (lb/acre) to pay for the information system is given on the vertical axis of the graph for different input saving scenarios (on the horizontal axis). For example, assume that a farmer expects to reduce nitrogen cost by 10% from the base URT nitrogen application rate of 83 lb/acre by using the information system and VRT. For a farm with 112 cotton acres, the required yield gain was 64 lb/acre to pay for the information system. The required yield gains were much smaller for farms with larger cotton acreages—14 lb/acre for a farm with 528 cotton acres and 9 lb/acre for a farm with 1,230 cotton acres. Allocating computer and software costs across all crop acres reduces the required annual average yield gains to pay for the investment in the information system (Figure 2). In Figure 2, if the expected yield gain is less than the required yield gain on the sloped line, then the expected cost savings and yield gains are not enough to pay for the investment in the information system. On the other hand, if the expected yield gain is above the sloped line, then the expected input savings and expected yield gain will more than pay for investment in the information system.

## Conclusion

Farmers who purchase a cotton yield monitoring information system for making variable rate input application decisions need particular levels of lint yield gains and input savings to pay for their investment. Results suggest that for a farm with 528 cotton acres, a yield gain of 19 lb/acre was required to pay for the yield monitoring information system when it is used for making variable rate nitrogen input decisions. The required yield gains to pay for the information system were less for farms with larger cotton acreages.

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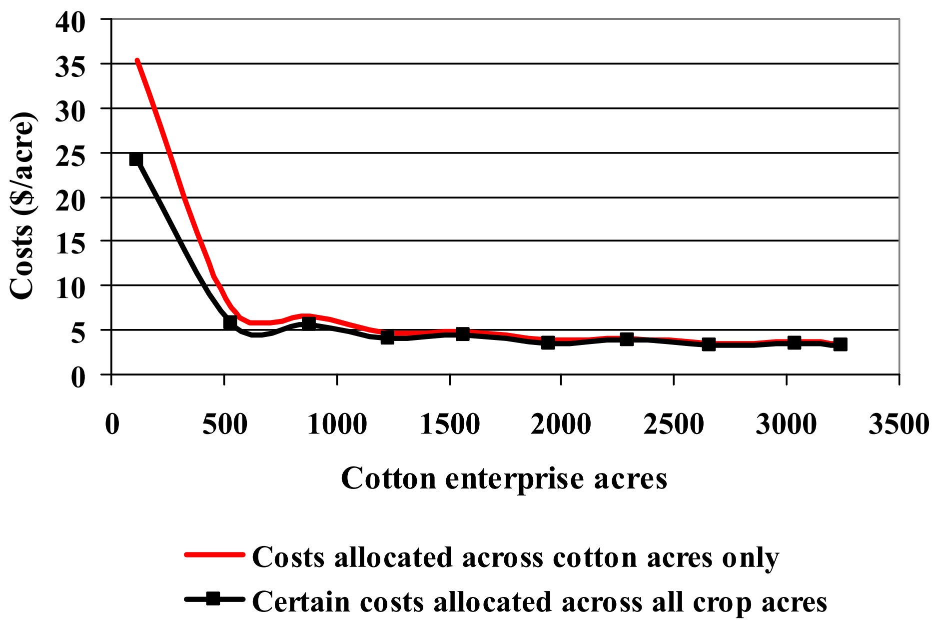


Figure 1. Cotton yield monitoring information system annual ownership costs for alternative cotton farm sizes

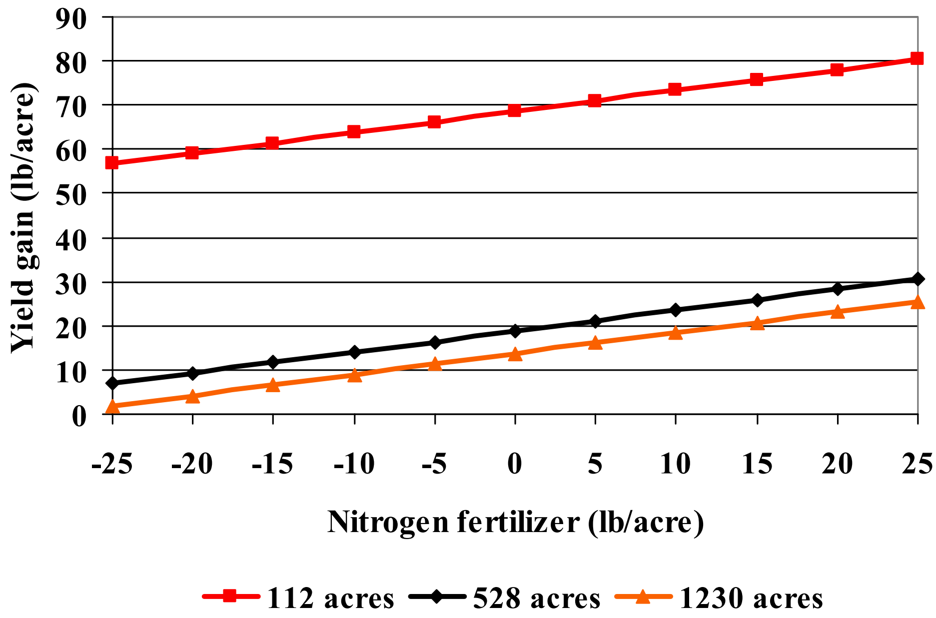


Figure 2. Breakeven lint yield gains for alternative nitrogen savings scenarios to pay for a cotton yield monitoring information system for three farm sizes