ECONOMIC IMPACT OF DOUBLE PLANTING AND THE BENEFITS OF AUTOMATIC SECTION CONTROL TECHNOLOGY FOR PLANTERS

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Abstract

In the context of Precision Agricultural (PA) technologies, Automatic Section Control (ASC) Technology for planters provides control over planting operations such that sections or rows on the planter are turned off in areas of the field that had been previously planted or areas that have been marked not to plant. Potential benefits of this technology are lower seed costs due to reduction in double-planted acres, and improved yield potential in these double-planted areas at harvest time (Fulton et al. 2010). Reduced cost (i.e. seed savings) and additional revenue (i.e. improved yield) will vary based on field shape and size. A study was conducted in West Tennessee to identify proportion variation of double-planted areas based on field geometry (i.e. field shape and size). Information on twenty-seven cotton fields, totaling 1,117 acres, was collected between April and June of 2010. Additional cost and reduced revenue due to double planting was compared to a base case scenario where the use of an ASC technology for planter is assumed. An economic evaluation of potential economic losses that could be avoided by using an ASC technology for planters was conducted using a partial budgeting analysis.

Fields in this study were classified based on their percentage of double planted area. Preliminary results showed that losses from double planting increased with the irregularity of the field shape. Very irregular-shaped fields resulted in higher net losses due to double planting when compare to more regular-shaped fields. Therefore, potential economic benefits (i.e. lower seed costs due to reduction in double-planted acres, and improved yield potential in these double-planted areas at harvest time) from adopting ASC technology increased as the proportion of fields with irregular shapes on a farm operation increases.

Introduction

In the context of Precision Agricultural (PA) technologies, Automatic Section Control (ASC) Technology for planters provides control over planting operations such that sections or rows on the planter are turned off in areas of the field that had been previously planted or areas that have been marked not to plant. Potential benefits of this technology are lower seed costs due to reduction in double-planted acres, and improved yield potential in these double-planted areas at harvest time. Reduced cost (i.e. seed savings) and additional revenue (i.e. improved yield) will vary based on field shape and size.

Methods

A study was conducted in West Tennessee to identify proportion variation of double-planted areas based on field geometry (i.e. field shape and size). Information on twenty-seven cotton fields, totaling 1,117 acres, was collected during the 2010 planting season. Additional cost and reduced revenue due to double planting were evaluated.

Fields were classified based on field geometry (i.e. shape) and percentage of double planted area: 1) Low cost fields (i.e., percentage of double planted area less than 1%), 2) Moderate cost fields (i.e., percentage of double planted area between 1% and 3%), and 3) High costs fields (i.e., percentage of double planted area greater than 3%). Figure 1 shows examples of the different types of fields.

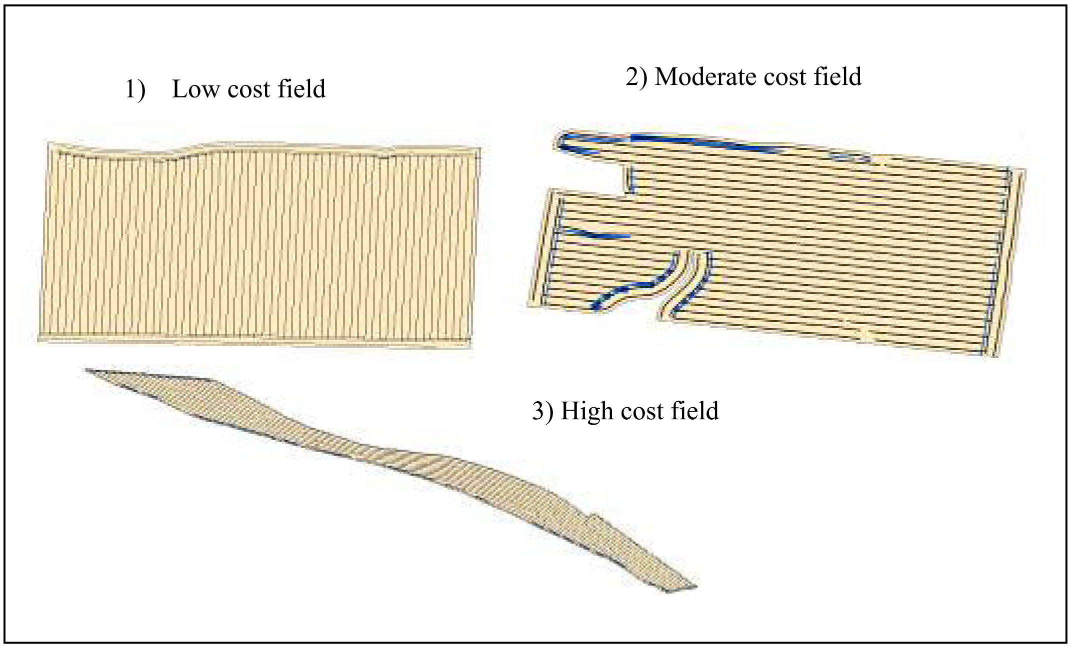

Figure 1. Classification of fields based on geometry

To understand the economic benefits of the Automatic Section Control (ASC) technology for planters one has to first evaluate the economic losses associated with double planting. To estimate the economic impact of double planting, we economically quantify the losses associated with seed and yield attributed to double planting. A marginal approach that utilizes partial budgeting techniques (Kay and Edwards, 1999) was used to ascertain the marginal change in costs and revenues associated with double planting. This approach enabled us to determine the potential profit reduction (per acre) due to double planting and therefore the potential saving associated with the adoption of ASC technology for planters.

Assuming a seed cost of $104/acre, cotton lint yield of 867 lb/acre, and cotton lint price of $0.70/lb (University of Tennessee Field Crops Budgets 2010), losses associated to double planting were calculated. Information on yield losses due to double planting was estimated based on data collected from a study conducted at the Research and Education Center at Milan during the 2010 growing season. In this study, yield was reduced by about 25% in double planted areas with one pass harvesting. When the double-planted areas were cross-picked, the yield reduction due to double planting decreased to 5%. For this study we assumed a 5% yield reduction due to double planting to estimate reduced revenue associated to yield reduction.

Results and Discussion

Using partial budgeting techniques, we estimated total losses due to double planting for the twenty-seven fields used in this study to illustrate the economic losses associated with double planting. From the total 1,117 acres evaluated, about 13.4 were double planted. The additional cost associated with the double-planted area for the twenty-seven fields is estimated as $1,394 (i.e., $104/acre x 13.4 acres). The reduced revenue associated with double planting is estimated as $407 for all the fields (i.e., $0.70/lb x 5% reduced yield x 867lb/acre x 13.4 acres). The sum of additional cost and reduced revenue due to double planting results in an estimated profit reduction of $1,801.

Table 1 presents information about average net losses per acre associated with double planting based on field geometry. According to the results, losses increased with the irregularity of the field shape, given that the percenatge of double-planted area also increases with the irregularity of field shapes.

Table 1. Average Losses due to Double Planting Based on Field Type

Field Type	Average Net Losses/acre ($/acre)
Low Cost	0.5
Moderate Cost	2.7
High Cost	5.1

Losses due to double planting may also vary based on the percentage of fields under each field classification in a farm. Table 2 presents information about total losses for a 1,000 and 2,000 acre farm scenario for two cases: 1) thirty percent low cost fields, forty percent moderate cost fields, and thirty percent high cost fields, and 2) sixty percent low cost fields, twenty five percent moderate cost fields, and fifteen percent high costs fields. Based on these field type distributions, net losses from double planting varied from $1.7/acre to $2.8/acre.

Table 2. Net Losses due to Double Planting Based on Farm Size and Distribution of Field Types

	1,000 acres	2,000 acres
Distribution of Field Types	Net losses ($)	
30% - 40% - 30%	$2,760	$5,520
60% - 25% - 15%	$1,740	$3,480

The Operator Effect

The figures presented in Table 2 are based on the minimum double-planted area that would have occurred in the 27 fields without ASC technology. Equipment operators can have an impact on the percentage of double planting in a farm operation. If the operator drops the planter too early at the start of a planter pass or pulls up the planter too late at the end of the pass, the percentage of double planted area can increase. Net average losses from double planting may increase by $1.1 /acre due to the operator effect.

Investment analysis

For a farmer to make decisions of whether or not to incorporate an ASC technology for planters in his production system he/she might be interested in evaluating the initial cost of the investment, the net cash revenues realized, and the number of years necessary to pay back the investment. For a twelve-row planter we assumed an initial investment cost of $6,000 to incorporate row cut offs in a planter that already has a GPS/GNNS receiver, a controller and software capable of automatic section control. Assuming the investment is financed through a loan at a six percent interest rate, we evaluate the number of years it will take the operator to pay back the investment, making sure that he/she guarantees a positive net cash flow on a yearly basis. For a 1,000 acres operation, with a distribution of fields of thirty percent low cost fields, forty percent moderate cost fields, and thirty percent high cost fields (i.e., 30% - 40% - 30%) it will take three years to pay back an initial investment of $6,000. For a 1,000 acres operation with a distribution of fields of sixty percent low cost fields, twenty five percent of fields moderate cost, and fifteen percent high cots fields (i.e., 60% - 25% - 15%) it will take five years to pay back the technology. If we increase the size of the operation to 2,000 acres for both the 30% - 40% - 30% and the 60% - 25% - 15% field distribution cases the number of years to pay back the technology will be reduced to two years (see Table 3).

Table 3. Number of Years to Payback Investment in ASC Technology for Planters Based on Fram Size and Distribution of Field Types

	1,000 acres	2,000 acres
Distribution of Field Types	Payback period (years)	
30% - 40% - 30%	3	2
60% - 25% - 15%	5	2

Summary

Preliminary results suggest that losses from double planting increase with the irregularity of the field shape. Very irregular-shaped fields or fields with a lot of point rows or inclusion of terraces or waterways will result in higher net losses due to double planting when compared to more regular-shaped fields with little or no point rows. Therefore, potential economic benefits (i.e. lower seed costs due to reduction in double-planted acres, and improved yield potential in these double-planted areas at harvest time) from adopting an ASC technology increased as the proportion of high cost fields (i.e., irregular-shaped) on a farm operation increases. The more acres planted with planters equipped with ASC technology, the more acres an operator has to distribute initial investment cost over, and therefore the shortest the time necessary to pay back the initial investment.

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References

Kay, R. D. and W.M. Edwards. 1999. Farm Management, Fourth Edition, McGraw-Hill, Boston, MA.

University of Tennessee Field Crops Budgets 2010. Online. http://economics.ag.utk.edu/budgets/2010

Fulton, J., D. Mullenix, S. Basinger, A. Winstead, S. Norwood, B. Ortiz. 2010. "Automatic Section Control (ASC) for Planters." Precision Agriculture Series. Timely Information, Agriculture, Natural Resources & Forestry. Alabama Cooperative Extension Service.