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REPRESENTATIVE FARM ADOPTION OF ULTRA NARROW ROW COTTON UNDER ALTERNATIVE CROP AND FARM LEGISLATION CONDITIONS

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Abstract

Within the last 10 years the production of upland cotton in the southeastern region of the United States has undergone a period of rapid technological adjustment. Recent advances in production technology include the eradication of the Boll Weevil, adoption of conservation tillage, development of a new generation of crop protection chemicals, and release of insect and herbicide resistant transgenic cotton varieties. This research describes the farm resource allocation decision for a representative Alabama cotton farm under alternative assumptions regarding production technology, crop enterprises, commodity prices, and government support programs.

Introduction

Within the last 10 years the production of upland cotton in the Southeast has undergone a period of rapid technological adjustment. Recent advances in production technology include the eradication of the Boll Weevil, adoption of conservation tillage, development of a new generation of crop protection chemicals, and release of insect and herbicide resistant transgenic cotton varieties. As farmers struggle to survive financially, they must become more efficient. Thus, while modern farms using new production technologies have an advantage in terms of flexibility in their choices of how they choose to produce cotton, this flexibility comes with a "price" in terms of increased managerial requirements. Farm managers must successfully choose production systems that best fit their resource set. This managerial requirement is the most serious challenge facing cotton producers today. This research is an attempt to provide information relating to some of these choices.

One cropping system that has emerged through application of new technology is ultra-narrow-row-cotton (UNRC). UNRC is defined as a very high population of cotton planted in 15-inch wide or narrower rows, and harvested with a "stripper" picker rather than the more traditional (for the Southeast) “spindle” picker. Use of herbicide-tolerant cotton varieties allows herbicides, usually glyphosate or "Round-Up" ®, to be sprayed "over the top" of the cotton. These early herbicide applications, along with the soil shading foliar canopy provided by a plant population roughly three or four times the customary number, provides effective control of most grasses and broadleaf weeds. No mechanical weeding cultivation is necessary, nor is it possible. UNRC has been developed into a viable alternative to conventional and no-till, wide row, spindle picked cotton production.

Another significant factor in the farm organization decision is the structure of the farm program umbrella under which all cotton farms must operate. In recent years, a large proportion of net farm income has resulted from government payments, due to historically low cotton prices. Thus, farmers must comply with government regulations to remain eligible for farm program benefits and payments, and they must consider program payment limitations in any farm organization decision.

Purpose and Methods

The purpose of this study was to examine the changes in optimal organization of a representative Alabama cotton farm when alternative enterprises included no-till cotton grown on conventional wide rows and no-till cotton grown on rows of 15 inches or less, called ultra-narrow-row cotton (UNRC), as well as soybeans, corn, and peanuts. A computer simulation utilized maximization of net returns above variable and fixed costs. Two parameters of the farm organization decision were examined. First, UNRC is commonly at more risk of price deductions or "dockage" for quality considerations. For this reason a parametric program was constructed to discover the price discounts - above those for conventional cotton - at which UNRC would remain in the solution set. Second, with the passage of the Farm Security and Rural Investment Act of 2002, an evaluation of the impact of crop subsidies and payment limitations on the optimal farm was warranted. Additional crop enterprises, reflecting the planting flexibility provisions of the new farm bill, were also considered. The model examined the farm organization decision regarding cotton production under short-run and long-term planning horizons, as well as how those farm program benefits paid to commodity producers on the basis of actual farm production affected acreage.

The limiting resources of the representative farm developed for this study consisted of owned and rented cropland in two productive classes, investment and operating capital, labor, and harvesting equipment capacity. Typically, the most important constraint to farm managers is the availability of land suitable for farming. In this application, 1000 acres was chosen as representative of many crop farms in Alabama. Of this 000 acres, 600 acres was be considered class 1 land and the remaining 400 acres was considered class 2 land. It was assumed that the productivity of the class 2 land was 80 to 90% of the productivity of class 1 land. Additional rented land was made available at a rate of $35 and $25 per acre for class 1 and class 2, respectively. While in some areas of the state cropland commands a considerably higher rent, these rates were considered realistic in the majority of locations.

Labor was the limiting resource considered second in the model. Labor was divided into six periods of two months beginning in January, with labor requirement for each crop alternative broken down by hours per acre required in each period. The model assumed two laborers available with a 60-hour week maximum.

The third limiting resource was availability of harvesting equipment. Harvesting expenses, both fixed and variable are two of the largest costs of crop production. Because harvesting expenses are high, and because outright ownership of harvesting equipment is necessary in many parts of Alabama, farmers often limit crop acreage by harvesting capacity. This model was designed to mimic this limitation of many real farms, but a "machine hire" activity was also available. Thus, a planting decision could be modelled both with and without additional harvesting capacity being available.

The last constraining resources were operating and investment capital. While selection of capital limits was somewhat arbitrary, their inclusion in the model was necessary. Farmers often base planning decisions on capital requirements. Cotton and peanuts, for example require considerably more operating and investment capital than corn or soybeans. However, cotton and peanuts usually - but not always - have the potential of larger net returns. Thus, inclusion of the capital constraints allowed the model some flexibility in examining the risk-return tradeoff.

Results

An initial baseline solution maximizing returns over variable costs resulted in a solution containing a relatively large acreage of UNRC on owned and rented class 1 land and a smaller acreage of corn for grain on owned class 2 cropland. Marketing gain (program payment) limit was set at $50,000 and UNRC price discount per pound of cotton lint was $.02. Limiting factors were program payments ($50,000) paid on cotton sold at $.40 per pound and owned cropland. Although labor and capital were available for corn or soybean production, neither generated sufficient revenue to offset the cost of renting additional land. Sensitivity analysis indicated that returns for these crops would have to increase between $4.05 and $14.51 per acre before they would enter the solution basis. Significant in the results were that the addition of each acre of conventional wide-row cotton would reduce optimal returns by only $2.14 per acre and that diversion of resources (program payment limits) to produce either UNRC or wide-row cotton on less productive class 2 land would result in reduced returns of about the same amount ($11.68 and $11.39 for conventional and UNRC, respectively). Also noteworthy was that the dual price for an additional unit of payment limitation (one pound of cotton lint) was $0.18 while the value of the payment was $0.12 at the base price level chosen. In other words, approximately 2/3 of net returns from cotton production resulted from government payments. Right-hand side range sensitivity analysis indicated that substantial increases and decreases in constraints of land, labor and capital would not result in basis changes.

When the objective function reflected returns over total costs some differences were noted. First, wide-row cotton did not enter the solution until UNRC discounts were at least $0.056 per pound. Further, while solutions were generally similar to those generated when variable costs alone were considered, basis changes occurred at higher UNRC discounts. In these "long-term" decisions, UNRC persisted in the solutions at higher discounts, and was not replaced by wide-row cotton as readily.

The results of the parametric programming were that as the discount of UNRC initially increased, the solution remained stable, with only UNRC and no conventional cotton in the enterprise mix. This relationship held until UNRC price decreased to $0.56 per pound, relative to a constant $0.68 per pound for conventional cotton. At this point 1000 acres were still in UNRC and 60 acres were diverted to conventional cotton. This result was also stable until the UNRC price reached $0.54, at which point the solution was 300 acres of conventional cotton and 700 acres of UNRC - with leased UNRC harvesting capacity for 200 acres. The crop mix changed again when the UNRC prices declined to $0.51, with 300 acres of cotton in conventional wide row, 500 acres in UNRC and 200 acres in soybeans. The solution was stable for further UNRC price declines until price fell to $.0.48. This solution contained 300 acres of conventional cotton, 100 acres of UNRC and 600 acres of soybeans. UNRC was not in the basis at $0.47 and below, the model returning a solution, which contained 400 acres of conventional cotton and 600 acres of soybeans.

Conclusions and Implications

The decision factors used in the linear programming model, i.e. UNRC price discount, UNRC relative yield advantage, and government commodity program payment limits were very important determinants of technology adoption. Of these factors, only relative yield advantage is not dependent on market forces. Payment limitations would only be a limiting factor in periods of low cotton price. In the linear programming trials where no yield advantage was programmed, wide-row cotton dominated UNRC under all scenarios whether maximizing returns over variable or total costs.

Corn and soybeans were planted only to use idle cropland when crop prices were set near loan rates. These crops were unable to generate returns sufficient to provide revenue over even variable expenses on rented land.

Results of this modeling effort can be summarized as follows: In describing the UNRC/ wide-row cotton decision, if a 15-20% yield advantage for UNRC was not expected or if more than a five-cent UNRC discount was expected, wide-row cotton dominated UNRC. Government program payments formed a large part of farm returns, and no crop was planted at prices below loan rate when payment limitations were exceeded.

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