



*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

**Give to AgEcon Search**

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

*No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.*

# Willingness to Plant Identity Preserved Crops: The Case of Mississippi Soybeans

Darren Hudson and Tom Jones

## ABSTRACT

The willingness to plant identity preserved (IP) crops was examined using Mississippi soybean producers as an example. A contingent valuation framework was used to assess the impacts of offered premiums on a producer's probability of planting IP soybeans. Findings suggest that offered premiums significantly affect planting decisions. In addition, desire to learn more about IP production was found to increase the probability of planting, suggesting that desire to learn leads to experimentation. Finally, prior knowledge or experience planting IP crops significantly decreased the probability of planting.

**Key Words:** *identity preservation, soybeans, contingent valuation, experimentation, logit, probit.*

**JEL Codes:** Q13, Q16

The consuming public has come to demand higher quality products and greater product variety. In turn, processors are demanding higher quality raw inputs with specific traits that are most efficient in producing products for specific end uses. Science has responded with biotechnology in an attempt to engineer crops that produce the desired traits, which has changed the way we look at both production and marketing of agricultural products (Kalaitzandonakes; Kalaitzandonakes and Bjornson; Klein, Hobbs, and Kerr; Lentz and Akridge). Biotechnology has raised both

consumer concerns (McGuirk, Preston, and Jones; Trelawny and Stonehouse; Barnett and Gibson) and marketing opportunities (Renkowski; Leask and Anderson; Brester, Biere, and Armbrister). Recognizing the interaction between price, production, and marketing is a pivotal element in understanding how the markets for biologically engineered crops and products will evolve.

Biotechnology has altered supply chains due to the need for identity preservation (Kalaitzandonakes and Bjornson; Kalaitzandonakes and Maltsbarger; Renkowski). *Identity preservation* (IP) refers to the need to maintain the identity of the commodity to insure that the desired traits have not been mixed with non-IP varieties. This necessitates separate production, harvesting, storage, and transportation strategies as compared to non-IP crops. These separate handling procedures mean added cost which accrue, at least in part, to the producer. In addition to these costs, technology fees are typically assessed so that patent holders can recover costs and profit from re-

---

The authors are associate professor and extension economist, Department of Agricultural Economics, Mississippi State University. The author acknowledges the comments of Barry Barnett, John Lee, Stan Spurlock and seminar participants at Texas Tech University on an earlier draft of this paper. All remaining errors belong to the authors. This research was supported by the Mississippi Agricultural and Forestry Experiment Station and a cooperative agreement between The Agribusiness Institute, Mississippi State University, and the U.S. Department of Agriculture/Rural Business Cooperative Service.

search and development expenditures. Little is known about the added costs of IP crop production, due in part to a lack of research as well as the fact that many of these IP products are new or still in developmental phases.

The marketing system has tended to favor the use of premiums to induce farmers to produce IP crops (Kalaitzandonakes and Maltsbarger). The premise behind this strategy is that the premium will induce the producer to contract with a processor to produce the IP crop, which follows with the general notion of quality premiums (Hudson, Ethridge and Segarra; Pannell; Hennessy and Devadoss; Ahmadi and Stanmore). If the premium is sufficient to cover the added cost of production (including any perceived risks), the rational producer is assumed to be willing to produce the crop. However, with little information on the added cost of production it is difficult to know what premium will be necessary to induce the producer to switch from non-IP crop production to IP crops.

The newness of IP technology necessarily limits the ability to perform time-series analysis of IP products and markets. This scarcity of data leads to the need to use experimental methods (this problem is not unlike that faced by researchers in the area of integration and coordination as alluded to by Boehlje). In the current context, the question becomes "what is the producer response to offered premiums?" This question can be addressed *via* experimental methods such as contingent valuation. Thus, the objective of this paper is to assess the relationship between offered premiums and willingness-to-plant, using Mississippi soybean producers as an example.

## Effects of Premiums

The observation that premiums and discounts affect production decisions is not new. Waugh began the formalization of what later became known as *hedonic analysis* (Lancaster; Rosen), which explicitly recognizes the impact that quality has on market price. Inducing production of desired quality attributes (or discouraging the production of undesired attributes) underlies the use of premiums

(discounts) in the market. Premiums and discounts have been examined in cotton (Ethridge and Davis; Brown et al.; Hudson, Ethridge, and Brown), tomatoes (Bierlen and Grunewald), wheat (Ahmadi and Stanmore; Bale and Ryan), dairy (Gao, Spreen and DeLorenzo), soybeans (Updaw, Bullock, and Nichols), corn (Hill, Brophy, and Florkowski), onions (Centner et al.), organic and specialty crops (Dobbs; Dobbs and Cole; Jolly), as well as others.

In the current context, premiums are being offered for the production of identity preserved soybeans. Assume that a producer has a fixed number of acres on which to produce soybeans and that the yields of IP and non-IP soybeans are the same, resulting in a total production,  $Q$ , which is divided between IP soybean production,  $q$ , and non-IP soybean production ( $Q - q$ ). Also assume that the price of non-IP soybeans is  $p$  and the price of IP soybeans is  $(p + k)$ , where  $k$  is the fixed premium. The profit function for the producer is defined as:

$$(1) \quad \pi = p(Q - q) + (p + k)q - C(Q - q) - K(q),$$

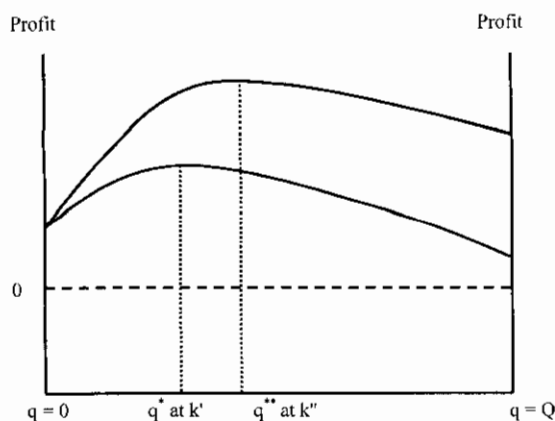
where  $C(Q - q)$  is the cost function for non-IP soybeans and  $K(q)$  is the cost function for IP soybeans. It is assumed that the derivative  $C'(Q - q)$  is positive in  $(Q - q)$  (i.e., non-IP production) and negative in  $q$  (i.e., IP production). The derivative of  $K(q)$  is assumed positive in  $q$ .

The necessary and sufficient conditions for maximum profit with respect to IP production are:

$$(2) \quad \frac{\partial \pi}{\partial q} = -p + (p + k) - C'(Q - q) - K'(q) \\ = 0 = k - C'(Q - q) - K'(q) = 0 \\ \frac{\partial^2 \pi}{\partial q^2} = [-C''(Q - q) - K''(q)] < 0$$

Solving the first order condition for  $q = q^*(k)$  and inserting the result into the first-order condition yields:

$$(3) \quad k - C'(Q - q^*(k)) - K'(q^*(k)) = 0.$$



**Figure 1.** Potential profit relationship between IP and non-IP soybean production

Differentiating equation 3 with respect to  $k$  yields:

$$(4) \quad 1 - C''(Q - q^*(k)) \frac{dq^*}{dk} - K''(q^*(k)) \frac{dq^*}{dk} = 0,$$

which can be rearranged to yield:

$$(5) \quad \frac{dq^*}{dk} = \frac{-1}{-C''(Q - q^*(k)) - K''(q^*(k))} > 0.$$

Thus, the anticipated impact of the premium is to increase the optimal production of IP soybeans.

Figure 1 depicts a hypothesized profit relationship for a soybean farm with an initial offered premium level of  $k'$ . This premium results in an optimal output of IP soybeans of  $q^*$ . Increasing the premium to  $k''$  changes the shape of the profit function and results in an increase in the optimal output of IP soybeans from  $q^*$  to  $q^{**}$ . Figure 1, however, assumes that an interior solution exists. That is, one could argue that the nature of IP production results in a corner solution of either 100 percent IP production or 100 percent non-IP production. Institutional constraints such as contractors not wishing to have too many acres coming from one producer (i.e., geographic diversification) may prevent these producers

from planting 100 percent of their acres to IP soybeans.

## Methods

### Survey

To assess willingness-to-plant identity preserved crops (and jointly test the hypothesis that premiums offered for identity preserved crops will induce a shift to IP production), a survey of Mississippi soybean producers was conducted in the vein of the contingent valuation literature. This approach has been used in several instances where payments to induce producer behavior were in question (Cooper and Keim; Cooper; Lohr and Park).

The questionnaire was designed to elicit information about the producer's operation, marketing techniques, and levels of satisfaction with various components in the market channel.<sup>2</sup> Questions were pre-tested on extension personnel and modifications made on the basis of their recommendations. The survey was mailed to a stratified random sample of 620 Mississippi soybean producers by the Mississippi (National) Agricultural Statistics Service with telephone follow-up used to mitigate non-response bias. A total of 376 responses were returned, yielding a 61-percent response rate.

A factorial design was used to elicit producer's willingness-to-plant IP soybeans based on premiums offered. One of four premium levels was offered: 0.20, 0.40, 0.60, and 0.80 dollars per bushel above the current market price for soybeans. These estimated premiums were derived from United Soybean Board estimates of the use values of different types of IP soybeans (different combinations of genetic traits enhanced within the particular strain of soybean seed). Each producer was told that a

<sup>1</sup> Generally speaking, the price of the IP soybeans is equal to the price of non-IP soybeans plus a fixed premium. Thus, the expected price of IP soybeans is simply the expected price of the non-IP soybeans plus the fixed premium.

<sup>2</sup> The survey was designed to elicit a broad array of information, but the IP question was the central element of the survey.

hypothetical premium was being offered for production.<sup>3</sup>

Producers were told that production of IP soybeans could increase their cost of production due to technology fees and added handling costs. Producers were not given a specific amount for the cost of the production increase, but were told the amount for the technology fee (\$8.50 per bag of seed). The question was posed in this fashion for two reasons. First, no reliable estimates of the increase in handling costs were available. Second, any available cost increase estimate is not particularly valid for the individual because the increased cost of handling depends, at least in part, on the opportunity cost of the producer's time in performing such functions as cleaning planters between IP and non-IP plantings as well as the opportunity cost of maintaining separate handling procedures and facilities. There may also be perceived added risks to IP production.<sup>4</sup> Thus, asking the question in this fashion forced the producers to consider their cost structure, risks, and risk preferences in deciding whether the premium offered was sufficient to cover added costs for their operation, thus "revealing" their approximate cost.

Thus, each producer was offered a premium, considering the potential added costs, and asked whether they would be willing to plant IP soybeans. A response of "Yes" indicated that the producers were willing to devote some or all of their current soybean acreage to IP soybean production. A response of "No" indicated that they were not willing to devote acreage to IP production at the stated premium

level. Some added information can be gained by asking those responding "No" if they would be willing to plant at any premium. However, it was felt that this question may potentially bias the results since this was a mail survey. That is, if the respondents saw that they had the option to answer No, but then answer Yes to the question about whether they would be willing to plant at another premium level, it was felt that they would be more likely to "hold-out" for a higher premium.

### Regression Models

A binary choice model was employed to estimate the probability of responding "Yes" to the question and the general form of that model was:

$$(6) \quad \begin{aligned} P(\text{Yes} = 1) &= F(\mathbf{X}, \beta) \\ P(\text{Yes} = 0) &= 1 - F(\mathbf{X}, \beta) \end{aligned}$$

Given the theoretical uncertainty of the proper form (Greene), both the probit and logit forms of the model were estimated. The logistic distribution is given by:

$$(7) \quad P(\text{Yes} = 1) = \frac{e^{\beta'X}}{1 + e^{\beta'X}}$$

and the probit distribution is given by:

$$(8) \quad P(\text{Yes} = 1) = \int_{-\infty}^{\beta'X} \varphi(t) dt$$

where  $\varphi$  denotes the standard normal distribution. Because the estimated coefficients arising from these regressions are not marginal effects, additional calculations are necessary. Following Greene, the marginal effects for the logit model are derived by:

$$(9) \quad \frac{d\Lambda[\beta'X]}{d(\beta'X)} = \Lambda(\beta'X)[1 - \Lambda(\beta'X)]$$

where  $\Lambda(\cdot)$  is the logistic cumulative distribution function. The marginal effects for the probit model are given by:

<sup>3</sup> The producers were not informed of the specific genetic traits of the IP soybeans. It was believed that the producers would be indifferent to the genetic properties of the crop. This was a simplifying assumption, but greatly simplified the survey and was believed to increase producer understanding of the question being asked.

<sup>4</sup> If yield and price risk are not different between IP and non-IP soybeans, added risks are not relevant. "Contract" risk (risk of not being offered an IP contract in the future) is minimal if growing IP soybeans does not require significant capital investment in storage facilities and equipment. If capital investment is required, contract risk becomes a real issue.

**Table 1.** Descriptive Statistics for Relevant Variables Used in Model Estimation

Variable	Mean	Standard Deviation
"Yes"	0.57	0.495
Learn_IP	0.72	0.452
Know_IP	0.44	0.497
Oppor	0.38	0.485
SACres	1059.68	993.317
High	0.33	0.471
College	0.60	0.490
Age	52.05	11.256

Note: "Yes" is the proportion of respondents replying that they would grow IP soybeans at the given premium level, Learn\_IP is a dummy variable indicating that the respondent desired to learn more about IP production, Know\_IP is a dummy variable indicating that the respondent had previous experience with IP production and/or considered himself or herself knowledgeable about IP production, Oppor is a dummy variable indicating whether the respondent was satisfied with current marketing opportunities, SACres is the number of acres planted in soybeans in 1999, High is a dummy variable for high school or less education, College is a dummy variable for some college or college graduate, Age is the age of respondent in years.

$$(10) \quad \frac{\partial E[y|X]}{\partial X} = \varphi(\beta'X)\beta$$

Greene points out that the marginal effects can be computed either at the means of  $X$  or computed at each observation and the mean taken of those marginal effects. Although the latter is believed to produce better estimates of marginal effects in some instances, marginal effects were computed at sample means for this analysis because the sign, and not the magnitude, was the primary result of interest. Both the probit and logit models as well as marginal effects were estimated using *LIMDEP* software.

The vector  $X$  was composed of the variables found in Table 1, with the addition of price. Price represents the premium level offered to each respondent in dollars per bushel (0.20, 0.40, 0.60, and 0.80). According to the conceptual model, the sign on the coefficient of price is expected to be positive suggesting that producers will divert more of their acreage from non-IP soybeans to IP soybeans as the premium levels are increased (more specifically, a larger percentage of producers was

expected to be willing to plant IP soybeans as the offered premium increases).

The Learn\_IP is a dummy variable indicating whether the respondent desired to learn more about identity preservation. This variable is used as a control factor for those producers who expressed an interest in learning more about IP crop production. IP technology is relatively new and some technologies have yet to be introduced. Gerber has noted farmer skepticism of the dominant research/extension delivery of new farming practices/technologies, which has led to a more widespread use of experimentation as a learning device (Spiess; Lyon). There is some prior theoretical evidence to suggest that agents (farmers) will experiment with new technologies to decrease the time in which information on the efficacy of the new technology is publicly available (Bolton and Harris; Guzman and Ventura). Thus, it is hypothesized that a desire to learn more about IP production will induce the producer to experiment, suggesting a positive sign on the estimated coefficient.

The Know\_IP is a dummy variable indicating whether the producer had prior experience with IP crop production and/or considered himself or herself knowledgeable about IP production. This variable is included to control for those producers who have already experimented with (planted) IP crops or who consider themselves knowledgeable about IP crop production. There is no *a priori* expectation on the sign of the estimated coefficient for this variable. If previous experience has been generally positive, the sign should be positive. However, if previous knowledge or experience reveals that there are difficulties in production or hidden costs not previously considered by the producer, this could deter the producer from agreeing to produce IP crops in the future.

The Oppor is a dummy variable indicating whether the producer was satisfied with current marketing opportunities. This variable is used to indicate the producer's overall satisfaction with current marketing opportunities. It is hypothesized that if the producer is satisfied with current marketing opportunities, the producer will be less likely to alter mar-

keting and production strategies to include IP production. SAcres (soybean planted acres in 1999) is used to control for the "size" effect. That is, larger producers have more acres on which to experiment or plant IP soybeans, suggesting that they could plant IP soybeans on a portion of their acres and still have sufficient acres to plant non-IP soybeans. Smaller producers may not be able to subdivide their acres as easily, leading them to an all-or-nothing approach. If smaller producers perceive IP production to be sufficiently risky, they may elect not to plant and keep their acres in non-IP soybeans where market channels and production practices are established. Finally, the effect of age (Age) is somewhat uncertain. It is hypothesized here that the willingness to try new technologies declines with age, suggesting a negative sign. High and College are dummy variables representing education (High = 1 if the respondent has a high school education or less; College = 1 if some college or college graduate).

## Results

### *Sample Statistics*

Descriptive statistics for relevant variables are presented in Table 1. First, about 57 percent of the respondents said that they would be willing to plant IP soybeans at various price levels, suggesting that a slight majority of producers have at least some willingness to grow IP soybeans. About 72 percent of the respondents desired more knowledge of IP crop production, which indicates that a large portion of Mississippi soybean producers have some interest in IP crops and may be willing to experiment with IP production, especially if it potentially increases profits.

There appears to be some level of dissatisfaction with marketing opportunities as indicated by the fact that only 38 percent of the respondents were satisfied with current marketing opportunities. This general dissatisfaction may lead producers to explore alternative market opportunities such as IP production. The average number of soybean acres farmed was 1060, about 33 percent of the producers

had a high school diploma or less, and 60 percent had some college or a bachelor's degree with the remaining 7 percent having attended graduate school. The average age of the respondent in the sample was 52 years.

### *Regression Results*

Results from both the logit and probit models are presented in Table 2. As is generally the case (Greene), the probit and logit models yielded similar results in terms of marginal effects. The coefficient on Price is positive and statistically significant, suggesting an upward sloping supply function for IP soybeans. The results validate the *a priori* expectation that increases in offered premiums should induce a greater response in the quantity supplied. One would expect that at low premium levels only the most efficient (lowest cost) producers would be willing to plant. As the premium level increases, more producers would perceive the marginal benefits equaling or exceeding the marginal cost, thus allowing higher cost producers (as well as lower cost producers) to enter production thereby increasing the percentage of producers willing to plant.

Producers who expressed a desire to learn more about IP production were significantly more likely to say they would plant IP soybeans. Many producers will experiment with new technologies or techniques in an attempt to learn more about them and gain personal experience. This hypothesis appears to be borne out by the data. Producers who desired more knowledge of IP production were much more likely to be willing to plant IP soybeans at all premium levels. The probabilities, however, begin to converge after the \$0.60 premium level, suggesting that after that level the premium begins to attract a greater proportion of those producers with no prior interest in IP production.

In contrast to those that wanted to learn more about IP production, those that had already planted IP crops or considered themselves knowledgeable in IP crop production were significantly less likely to be willing to plant IP soybeans. Those with previous

**Table 2.** Probit and Logit Regression Results for the Probability that the Respondent Would Be Willing to Plant Identity Preserved Soybeans

Variable	Logit Model		Probit Model	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect
Constant	-3.109* (.6616)*		-1.834* (.3776)	
Price	3.531* (.5793)	0.853* (.1386)	2.024* (.3255)	0.787* (.1260)
Learn_IP	2.103* (.2908)	0.508* (.0708)	1.231* (.1647)	0.479* (.0644)
Know_IP	-0.559* (.2555)	-.135* (0.0616)	-0.319* (.1501)	-0.124* (.0584)
Oppor	0.406 (.2555)	0.098 (.0617)	0.212 (.1496)	0.082 (.0582)
SAcres	0.0002 (0.0001)	0.00004 (.00003)	0.0001 (.00009)	0.00004 (.00003)
High	0.123 (.5365)	0.030 (.1296)	0.114 (.3109)	0.044 (.1290)
College	0.216 (.5106)	0.052 (.1234)	0.172 (.2957)	0.067 (.1150)
Age	-0.0004 (.0017)	-0.00009 (.0004)	-0.0002 (.0010)	-0.00008 (.0004)
Log L	-205.40		-206.08	
Log Index Ratio	0.199		0.196	
$\chi^2$	102.07		100.72	
d.f. $\chi^2$	8		8	

*Note:* Price is the stated premium level in the survey provided to the respondent, Learn\_IP is a dummy variable indicating that the respondent desired to learn more about IP production, Know\_IP is a dummy variable indicating that the respondent had previous experience with IP production and/or considered himself or herself knowledgeable about IP production, Oppor is a dummy variable indicating whether the respondent was satisfied with current marketing opportunities, SAcres is the number of acres planted to soybeans in 1999, High is a dummy variable for high school or less education, College is a dummy variable for some college or college graduate, Age is the age of the respondent in years, d.f. is degrees of freedom.

\* Numbers in parentheses are standard errors.

\* Statistically significant at the 0.05 level.

knowledge were less likely to be willing to plant, although the difference was not as striking as with the desire to learn more about IP production. Again, the probabilities begin to converge after the \$0.60 premium level.

If previous experiences with IP crops had been negative (such as low yields or difficulty with contracts and/or handling), this would almost certainly decrease the respondents' willingness to plant IP soybeans. However, this result may also indicate a broader interpretation that after gaining experience or information about IP crop production, many producers may have concluded that the costs associated with IP production exceed potential or per-

ceived benefits. This result is somewhat interesting and suggests a potential need to examine more closely some of the reasons why those producers with prior IP experience appear to be at least somewhat dissatisfied. The remainder of the variables were not statistically significant, suggesting that producer satisfaction with marketing opportunities, farm size, education, and age have little impact on whether a farmer chooses to plant IP crops.<sup>5</sup>

<sup>5</sup> Alternative models with different combinations of these variables were attempted. In all cases, the variables found to be statistically significant here remained significant with similar parameter estimates, suggesting that these estimates are stable.

**Table 3.** Estimated Probability of Willingness-to-Plant and Turner Lower Bounds Estimate of Mean Willingness-to-Accept

Estimated Probabilities Derived From Sample		
Premium Level (\$/bushel)	N	P(Yes = 1)
0.20	100	0.3500
0.40	93	0.5591
0.60	89	0.6629
0.80	94	0.7447
Turner Lower Bound = \$0.46 per bushel		
Predicted Probabilities from Logistic Regression (variables at means)		
Premium Level (\$/bushel)	N	P(Yes = 1)
0.20	100	0.3500
0.40	93	0.5218
0.60	89	0.6886
0.80	94	0.8175
Turner Lower Bound = \$0.48 per bushel		

Note: N is the number of observations.

Table 3 shows the Turner Lower Bound estimates based on both estimated probabilities from sample data and predicted probabilities from the logistic regression. These results suggest that the average producer would plant IP soybeans at a premium of 46 cents per bushel. This seems high, especially given recent quotes on High Oil Corn contracts being offered a premium of \$0.25 per bushel (Kalaitzandonakes and Maltsbarger).<sup>6</sup> These authors, however, quote potential value-added to IP soybeans (depending on the underlying genetic traits) of between \$25 and \$50 per acre. Assuming a yield of 30 bushels per acre, this would imply a potential added value of between \$0.83 and \$1.67 per bushel, a value more than sufficient to offer the required premiums of \$0.46.

Table 3 can be interpreted in another way. If it is assumed that producers will only produce IP soybeans when the stated premium is greater than or equal to their cost of production, one could interpret the percentages in Table 3 to represent the percentages of producers who believe that their cost is at or below the stated premium. For example, about 35 per-

cent of the soybean producers in Mississippi believe they can produce IP soybeans for \$0.20 per bushel or less. This is a somewhat crude measure of the added cost of production, but provides some idea of added costs if producers behave rationally.

The expected supply response to various premium levels is shown in Table 4 under the extreme assumption that producers responding "Yes" would devote all of their acreage to IP soybean production. Thus, the values in Table 4 represent upper-bound estimates of the supply response. Under these conditions, Mississippi producers would be expected to allocate between 735,000 and 1.7 million acres to IP soybeans, depending on the offered premium. The simple arc elasticities between points shows that the expected supply is somewhat responsive to price changes, but inelastic.

## Conclusions

As the demand for more specific end uses of food products has expanded, science has responded with biotechnology. The marketing system has evolved, at least in part, through the use of inducements or premiums to entice producers to grow these non-traditional crops. Theory clearly shows that offering a premium will induce producers to plant different vari-

<sup>6</sup> It should be noted, however, that additional premiums were being offered for on-farm storage, which would defray the added cost to the producer for handling.

**Table 4.** Expected Supply Response to Various Premium Levels for IP Soybeans in Mississippi

Premium Level	Expected Acreage <sup>a</sup>	Expected Production <sup>b</sup>	Arc Elasticity <sup>c</sup>
0.20 \$/bu	735,000	22,050,000	0.60
0.40 \$/bu	1,095,780	32,873,400	0.70
0.60 \$/bu	1,446,060	43,381,800	0.63
0.80 \$/bu	1,716,750	51,502,500	

<sup>a</sup> Expected acreage is derived assuming that a response of "Yes" indicates that the producer converts all previous non-IP soybean acreage to IP soybeans.

<sup>b</sup> Expected production is expected acreage times an assumed yield of 30 bushels per acre.

<sup>c</sup> Computed as the arc elasticity between referenced row and row immediately below.

eties, but the premiums offered must cover the added costs of production to the producer in order to attract a sufficient supply. However, there is little reliable information about added costs because at least a portion of these costs are opportunity costs and risk premiums and are, thus, difficult to observe.

A contingent valuation framework was used to estimate the probability that a producer would plant IP soybeans at various premium levels. Producers were offered various hypothetical premium levels and then had to decide whether the offered premium was sufficient to cover their added cost. Posing the question in this manner allowed producers to "reveal" their cost through their accepting or rejecting of the offered premium.

As expected, higher premiums increase the probability of planting IP soybeans. The resulting mean willingness-to-accept of \$0.46 per bushel is well within the range of expected added value from IP soybeans. This suggests that the average producer in Mississippi perceives that the added cost of production for IP soybeans is less than or equal to \$0.46 per bushel. Although beyond the scope of this paper, future research will need to address the issue of optimal premium or contract design (Salanie) to induce desired response levels.

There are two primary limitations of this study with regards to the price-quantity combination that will need to be addressed in future research. First, this study did not attempt to identify the proportion of the producers' land they would be willing to devote to IP production. To develop accurate models of supply response, an accurate measure of the diversion from non-IP to IP soybeans will

need to be developed. Second, the potential interactions between non-IP soybeans, IP soybeans, and alternative crops will also need to be explored.

In addition to the price-quantity relationships, models of the different types of IP products will need to be explored. That is, this model addressed the willingness to plant a "generic" variety of IP soybeans. As the number of different IP varieties (different stacked genes) increases, this creates potential competition between the different varieties for land area. Generally speaking, the more genes that are stacked the more valuable the crop. However, there will likely be markets for IP varieties with fewer stacked genes even after the introduction of the newer varieties (Kallitandonakes and Maltsbarger). Thus, an examination of the interactions of the demands for different IP products in the market is warranted.

The desire to learn more about IP production appears to be a strong mitigating factor. Those producers who expressed no desire to learn more about IP production were much less likely to want to plant IP soybeans. This suggests producers may perceive experimentation with IP production is the best avenue to learn more. By contrast, those with previous IP experience or who considered themselves knowledgeable about IP were less likely to plant IP across all premium levels. It is difficult to disentangle whether these respondents' previous experiences were "bad" (e.g., failed crop, did not perform as advertised, difficulty in dealing with buyers, etc.) or whether this knowledge has led them to the conclusion that the benefits do not outweigh the costs. These

results, however, suggest a need to investigate what may have led these producers to prefer not to produce IP soybeans.

## References

- Ahmadi-Esfahani, F. and R. Stanmore. "Quality Premiums for Australian Wheat in the Growing Asian Markets." *Australian Journal of Agricultural Economics* 38(1994): 237-250.
- Bale, M. and M. Ryan. "Wheat Protein Premiums and Price Differentials." *American Journal of Agricultural Economics* 59(1977): 530-532.
- Barnett, B. and B. Gibson. "Economic Challenges of Transgenic Crops: The Case of Bt Cotton." *Journal of Economic Issues* 33 (1999): 647-659.
- Bierlen, R. and O. Grunewald. "Price Incentives for Commercial Fresh Tomatoes." *Journal of Agricultural and Applied Economics* 27(1995): 138-148.
- Boehlje, M. "Structural Changes in the Agricultural Industries: How Do We Measure, Analyze and Understand Them?" *American Journal of Agricultural Economics* 81(1999): 1028-1041.
- Bolton, P. and C. Harris. "Strategic Experimentation." *Econometrica* 67(1999): 349-374.
- Brester, G., A. Biere, and J. Armbrister. "Marketing Identity Preserved Grain Products: The Case of American White Wheat Producers." *Agribusiness* 12(1996): 301-308.
- Brown, J., D. Ethridge, D. Hudson, and C. Engels. "An Automated Econometric Approach for Estimating and Reporting Daily Cotton Market Prices." *Journal of Agricultural and Applied Economics* 27(1995): 409-422.
- Centner, T., S. Turner, J. Bryan, and W. Mizelle. "Product Differentiation Protection: Vidalia Onions as a Case Study of Regional Specialty Crops." Georgia Agricultural Experiment Station Research Report 576, November 1989.
- Cooper, J. "Combining Actual and Contingent Behavior Data to Model Farmer Adoption of Water Quality Protection Practices." *Journal of Agricultural and Resource Economics* 22(1997): 30-43.
- Cooper, J. and R. Keim. "Incentive Payments to Encourage Farmer Adoption of Water Quality Protection Practices." *American Journal of Agricultural Economics* 78(1996): 54-64.
- Dobbs, T. "Price Premiums for Organic Crops." *Choices*, Second Quarter 1998, pp. 39-41.
- Dobbs, T. and J. Cole. "Potential Effects on Rural Economies of Conversion to Sustainable Farming Systems." *American Journal of Alternative Agriculture* 7(1992): 70-80.
- Ethridge, D. and B. Davis. "Hedonic Price Estimation for Commodities: An Application to Cotton." *Western Journal of Agricultural Economics* 7(1982): 156-163.
- Gao, X., T. Spreen, and M. DeLorenzo. "A Bio-Economic Dynamic Programming Analysis of the Seasonal Supply Response by Florida Dairy Producers." *Southern Journal of Agricultural Economics* 24(1992): 211-220.
- Gerber, J. "Farmer Participation in Research: A Model for Adaptive Research and Education." *American Journal of Alternative Agriculture* 7(1992): 118-121.
- Greene, W. *Econometric Analysis*. Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2000.
- Guzman, R. and G. Ventura. "A Model of Experimentation with Information Externalities." *Journal of Economic Dynamics and Control* 23(1998): 9-34.
- Hennessy, D. and S. Devadoss. "Quality Premiums and the Firm's Production Decision." *Southern Economic Journal* 62(1995): 107-115.
- Hill, L., J. Brophy, and W. Florkowski. "Production Response of Illinois Farmers to Premiums for Low-Temperature Dried Corn." *Agribusiness* 4(1988): 197-209.
- Hudson, D., D. Ethridge, and J. Brown. "Producer Prices in Cotton Markets: Evaluation of Reported Price Information Accuracy." *Agribusiness* 12(1996): 353-362.
- Hudson, D., D. Ethridge, and E. Segarra. "Incorrect Price Information for a Heterogeneous Commodity: A Conceptual Synthesis." *Review of Agricultural Economics* 20(1998): 365-376.
- Jolly, D. "Differences Between Buyers and Non-Buyers of Organic Produce and Willingness to Pay Organic Price Premiums." *Journal of Agribusiness* 9(1991): 97-111.
- Kalaizandonakes, N. "Agrobiotechnology and Competitiveness." *American Journal of Agricultural Economics* 82 (2000): 1224-1233.
- Kalaizandonakes, N. and B. Bjornson. "Vertical and Horizontal Coordination in the Agro-Biotechnology Industry: Evidence and Implications." *Journal of Agricultural and Applied Economics* 29(1993): 129-139.
- Kalaizandonakes, N. and R. Maltsbarger. "Biotechnology and Identity-Preserved Supply Chains: A Look at the Future of Crop Production and Marketing." *Choices*, Fourth Quarter 1998, 15-18.
- Klein, K., J. Hobbs, and W. Kerr. "Farmer Acceptance of Biotechnology and Marketing Strategies: Implications for Agribusiness from Surveys in Western Canada." *Journal of International*

- Food and Agribusiness Marketing* 6(1994): 71–88.
- Lancaster, K. "A New Approach to Consumer Theory." *Journal of Political Economy* 74(1966): 132–157.
- Leask, B. and R. Anderson. "Riding the Third Wave: Implications of Biotechnology for the Canadian Seed Crop Industry." *Canadian Journal of Agricultural Economics* 46(1998): 455–462.
- Lentz, T. and J. Akridge. "Economic Evaluation of Alternative Supply Chains for Soybean Peroxidase." *Journal of Food Distribution Research* 28(1997): 28–41.
- Lohr, L. and T. Park. "Discrete/Continuous Choices in Contingent Valuation Surveys: Soil Conservation Decisions in Michigan." *Review of Agricultural Economics* 16(1994): 1–15.
- Lyon, F. "How Farmers Research and Learn: The Case of Arable Farmers of East Anglia, UK." *Agricultural and Human Values* 13(1996): 39–47.
- McGuirk, A. W. Preston, and G. Jones. "Introducing Foods Produced Using Biotechnology: The Case of Bovine Somatotropin." *Southern Journal of Agricultural Economics* 24(1992): 209–223.
- Pannell, D. "Optimal Herbicide Strategies Given Yield and Quality Impacts of Weeds." *Review of Marketing and Agricultural Economics* 63(1995): 311–317.
- Renkowski, M. "Marketing Strategies of Biotechnology Firms: Implications for U.S. Agriculture." *Journal of Agricultural and Applied Economics* 29(1997): 123–128.
- Rosen, S. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82(1974): 34–55.
- Salanie, B. *The Economics of Contracts: A Primer*. The MIT Press, Cambridge, MA, 1998.
- Spiess, J. "Using Experimentation as Experimental Learning." *Agricultural Education Magazine* 65(1992): 13–15.
- Trelawny, P. and D. Stonehouse. "The Effects of Introducing Supplemental Bovine Somatotropin to the Canadian Dairy Industry." *Canadian Journal of Agricultural Economics* 37(1989): 191–209.
- Updew, N., J. Bullock, and T. Nichols. "Pricing Soybeans on the Basis of Oil and Protein Content." *Southern Journal of Agricultural Economics* 8(1976): 129–132.
- Waugh, F. *Quality as a Determinant of Vegetable Prices*. Columbia University Press, New York, 1929.