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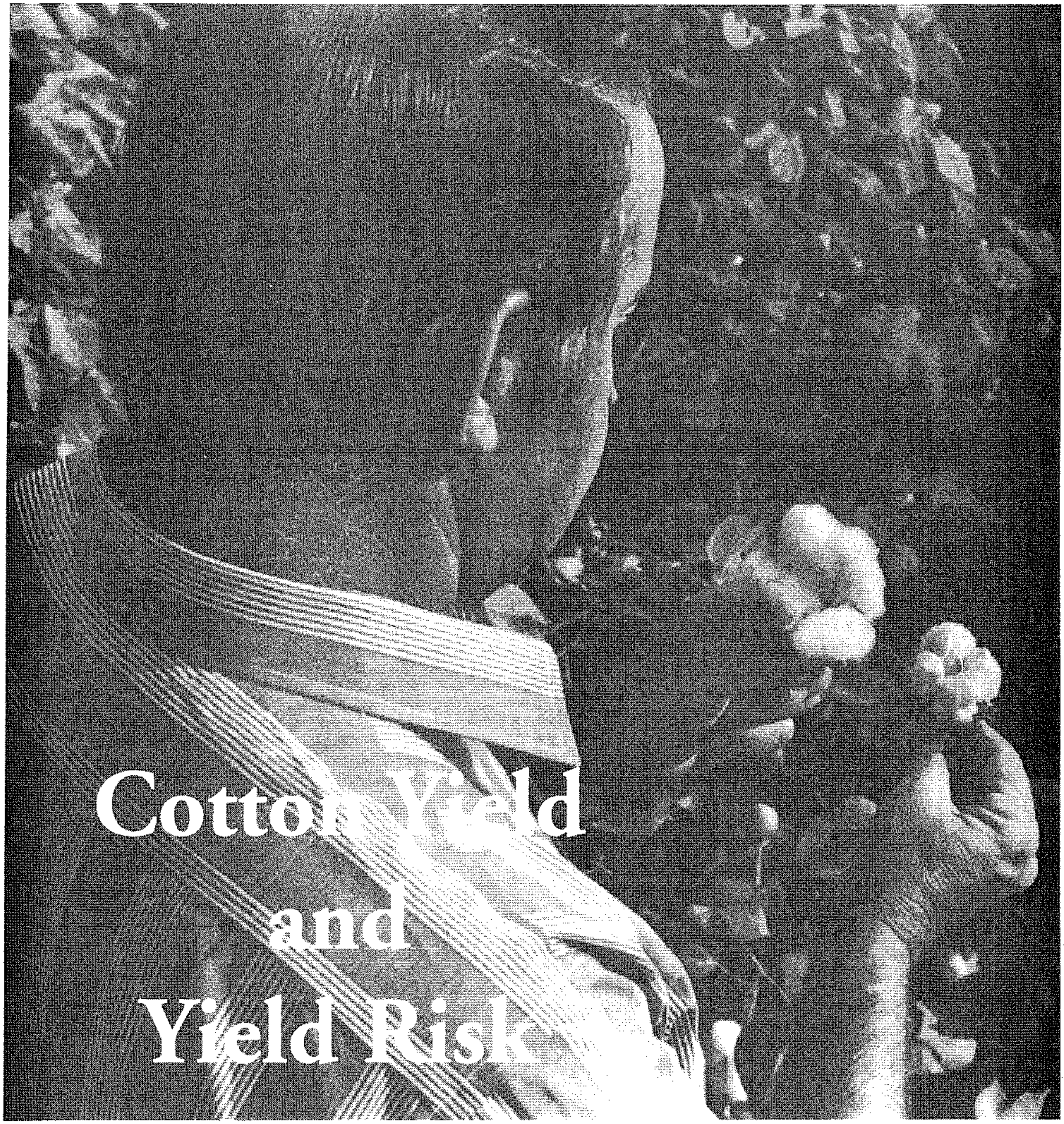

Cotton Yield and Yield Risk of Mississippi Farmers Using Professional Scouting Services

MAFES
MSU
MISSISSIPPI AGRICULTURAL & FORESTRY EXPERIMENT STATION Verner G. Hurt, Director Mississippi State, MS 39762
Donald W. Zacharias, President Mississippi State University R. Rodney Foil, Vice President

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Walter Ferguson
Economist
Resources & Technology Division
ERS/USDA
Washington, DC

Jet Yee
Economist
Resources & Technology Division
ERS/USDA
Washington, DC

David Parvin
Professor and Economist
Department of Agricultural Economics
Mississippi State University

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Abstract

In 1989, Mississippi cotton farmers participating in a professional scouting program had significantly higher yields and lower yield risk than nonparticipants. While there was no significant difference between participants and nonparticipants in terms of the number of insecticide treatments, participants used significantly more herbicide, fungicide, defoliant, and growth retardant treatments. Similar results were obtained for the Delta States (Arkansas, Louisiana, Mississippi, Missouri, and Tennessee) as a whole.

Introduction

Mississippi is a major cotton producing state with current cotton acreage of approximately 1.4 million acres. Primarily because of differences in yield potential and insect pressure Mississippi's production is divided into two regions. The Yazoo-Mississippi River Delta (typically called the Delta region) has larger yields and different insect pressure than in the rest of the state or the non-Delta region (commonly called the Hill region). For example, for the 7-year period 1986-92, the Hill region was outyielded by the Delta region by an average of 189 pounds of lint per acre (Table 1). Boll weevil pressure and percent loss is higher in the Hill region than the Delta, while the reverse is true for the budworm/bollworm complex. Total insect percent loss has ranged from a low of 1.50 percent in the Delta in 1991 to a high of 19.17 percent in the Hill region in 1989.

For the period 1983-92, nominal insect control cost increased by 57.1 percent while total specified cost increased by 12.7 percent (Table 1). Insect control cost as a percentage of total specified cost has shown an upward trend for the period increasing by 48.1 percent, from 13.70 percent in 1984 to 20.29 percent in 1992.

In a relatively few number of years, the cotton scout in Mississippi has developed from simply monitoring boll weevils and making boll weevil control recommendations to monitoring all insect pests and beneficial insects, and making recommendations on all insect management. Recently, the profession of cotton scout has developed such that the current professional scout routinely makes recommendations on insecticides, herbicides, plant growth regulators, fungicides, defoliants, fertilizer, irrigation, (i.e., all phases of cotton production).

Professional scouting is widely used in cotton production – on 55 percent of the acreage nationally and on 70 percent in the five Delta States (not to be confused with the Mississippi Delta region). The professional scout has a strong influence on the farmer's use of pesticides and nonchemical control strategies. This bulletin examines the association between use of the professional scout and yield, yield-risk, pesticide use, and employment of nonchemical pest management practices using data on Mississippi cotton farmers from a U.S. Department of Agriculture survey [9]. The survey of nearly 1,500 cotton farmers was conducted in 1989 and included the 14 major cotton states.

The professional scout was defined in the survey as an employee of a consulting firm or of the Cooperative Extension Service responsible for visiting the cotton field, reporting on the presence and population levels of various insects and other pests, and making recommendations on specific control measures to the farmer.

The term "professional scouting" referred only to scouting under the supervision of the Extension Service or a private firm and thus excluded scouting done by the farmer. Nonparticipant farmers generally used on-farm employees as scouts.

A major tactic used by professional scouts is the application of chemical controls at the economic threshold level, the level at which the benefits of control are expected to exceed the cost of control [4]. Nonchemical tactics against cotton pests (insects, nematodes, plant pathogens, and weeds) may include

The views expressed are the authors' and do not necessarily represent the policies or views of the U.S. Department of Agriculture or Mississippi State University.

Table 1. Acres harvested and yield, yield loss, and control cost in cotton. Mississippi, 1983-92.

				% Loss			Cost[1]		
Year	Region	Acres Harvested	Yield (lb)	Boll Weevil	Budworm/ Bollworm	All Insects	Insect Control Cost/Acre	Total Specified Cost/Acre[2]	%
83	State	675,000	640	4.00	2.00	6.50	59.12	406.11	14.56
84	State	1,032,000	767	0.20	0.80	6.60	58.29	425.52	13.70
85	State	1,040,000	764	0.85	1.30	6.70	58.80	408.17	14.41
86	Delta Hill	766,130 222,092	585 500	1.78 4.86	5.33 3.40	10.43 10.58	67.41	412.84	16.33
87	Delta Hill	742,586 230,655	875 580	3.45 7.86	4.82 3.72	10.53 13.14	67.19	394.39	17.04
88	Delta Hill	821,136 289,721	850 600	3.36 8.41	5.28 4.01	15.56 15.97	68.96	412.52	16.72
89	Delta Hill	826,660 260,986	640 580	4.52 12.86	4.81 3.84	3.93 19.17	73.75	418.95	18.65
90	Delta Hill	909,204 273,354	780 585	1.18 5.87	4.67 3.59	10.94 13.30	75.38	427.61	17.63
91	Delta Hill	740,000 500,000	1,030 730	0.41 3.00	0.66 0.60	1.50 3.80	80.79	447.87	18.04
92	Delta Hill	850,000 500,000	850 710	0.71 2.50	5.18 1.35	7.39 4.38	92.88	457.67	20.29

Source: 2, 5, 6, 7
[1]Data for state only.
[2]Direct and fixed cost (excludes land cost)

biotechnology strategies, i.e., biological controls and plant genetics [10]. Other nonchemical tactics include use of computer simulation models, crop residue destruction, crop rotation, crop site selection, fertility management, intensive scouting, natural enemy preservation, short-season production, tillage, time of harvest, time of planting, trapping, and water management. Increased emphasis on use of nonchemical systems of pest control may be perceived by some farmers to require more managerial expertise, result in lower yield, and cause greater variability of yield (increase yield risk).

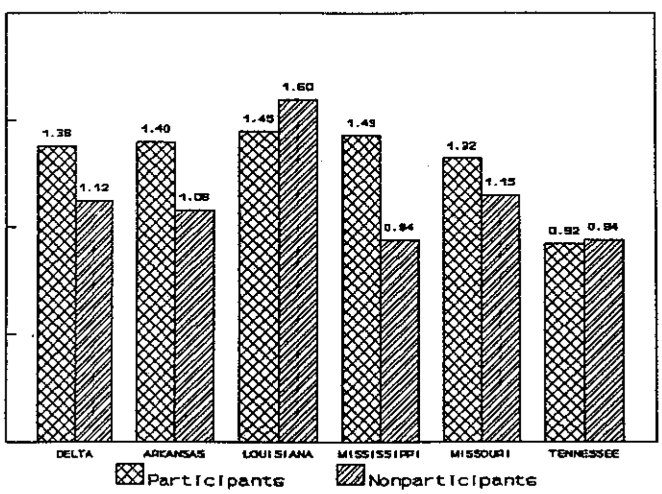

Figure 1. Yield (bales per acre), participants and nonparticipants.

Survey Results

For the Delta States as a whole, and Mississippi in particular, farmers in a professional scouting program had higher mean yields than farmers not participating (Figure 1). However, the higher yield of farmers in a professional scouting program in the Delta States was accompanied in 1989 by a significantly higher number of pesticide treatments, which were defined to include desiccants/defoliants and growth regulators, as well as herbicides, fungicides, and insecticides (Figure 2). A notable exception is that although Mississippi participants applied slightly more insecticide treatments than nonparticipants, the difference was not significant (Table 2).

Statistical tests were performed to assess the significance of differences between participants and nonparticipants in a professional scouting program in terms of yield, number of pesticide treatments, use of nonchemical control practices, and farmer characteristics (education, age, tenure). To perform the tests, the following criteria were employed:

(1) Reject the null hypothesis of equal means if $z < -1.96$ or $z > 1.96$; accept the null hypothesis if $-1.96 \leq z \leq 1.96$, as follows:

$$z = \frac{\bar{x}_p - \bar{x}_{np}}{\sqrt{\frac{S_p^2}{n_p} + \frac{S_{np}^2}{n_{np}}}}$$

where $\bar{x}_p$ and $\bar{x}_{np}$ are the sample means for participants and nonparticipants, respectively, s_p and s_{np} are the standard deviations, and n_p and n_{np} are the sample sizes. This test was used to assess significance of differences in yield and number of pesticide treatments [8, p. 36-40].

(2) Reject the null hypothesis of equal proportions if $\chi^2 > \chi^2_{.05}$, or 3.84 [8, Table A.5, p. 435] (95% confidence level); accept the null hypothesis if $\chi^2 \leq \chi^2_{.05}$, where χ^2 is calculated,

$$\chi^2 = \sum_{i=i}^{2} \frac{(o_i - e_i)^2}{e_i}$$

where o_i and e_i are the observed and expected frequencies respectively, and χ^2 is calculated using 1 degree of freedom. This test was used to assess significance of differences in use of nonchemical control practices, irrigation, enrollment in the Acreage Reserve Program (ARP) and Federal Crop Insurance (FCI), and farmer characteristics (education, age, tenure) [8, p. 355-358].

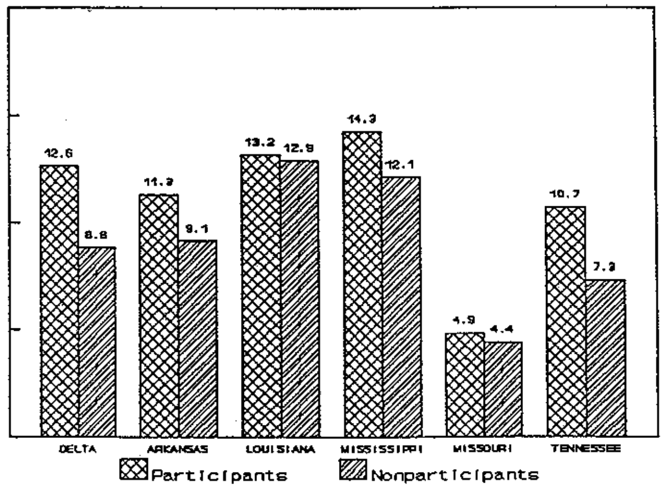

Figure 2. Pesticide treatments, participants and nonparticipants.

Table 2. Means and standard deviations, Delta States[1] and Mississippi, 1989

	Delta States				Mississippi			
	Participants		Nonparticipants		Participants		Nonparticipants	
Variable	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Yield (bales/acre)	1.38*	0.54	1.12	0.78	1.43*	0.62	0.94	0.91
Chemical Pest Controls (Number of Treatments per Acre)								
Herbicide	3.45*	1.44	2.97	1.35	3.42*	1.19	2.74	0.96
Insecticides	6.36*	3.69	3.93	3.61	7.48	3.23	7.26	3.26
Fungicides	2.50*	2.49	1.17	1.97	3.40*	2.47	1.61	1.97
Defoliant	1.18*	0.67	0.74	0.76	1.38*	0.06	0.61	0.72
Growth Retardant	1.65*	1.87	0.78	0.96	2.52*	2.26	1.17	1.47
Nonchemical Pest Controls (Proportion Using Control)								
Pest-resistant Plant Varieties	0.36	0.48	0.43	0.50	0.28	0.45	0.05	0.51
Stalk Destruction	0.90*	0.30	0.72	0.45	0.90	0.39	0.78	0.42
Pheromone Traps	0.48*	0.50	0.17	0.38	0.58*	0.50	0.22	0.42
Socioeconomic Characteristics (Proportion)								
Operator age <35	0.23	0.42	0.19	0.39	0.25	0.44	0.43	0.51
Operator age >60	0.07	0.26	0.10	0.30	0.08	0.27	0.13	0.34
High School Only	0.56	0.50	0.70	0.46	0.42	0.50	0.70	0.47
College Degree	0.38*	0.49	0.16	0.37	0.52*	0.50	0.13	0.34
Owner-manager	0.60*	0.49	0.40	0.49	0.78	0.42	0.52	0.51
Other Characteristics (Proportion)								
Uses Irrigation	0.34*	0.48	0.14	0.35	0.33*	0.47	0.00	0.00
Enrolled in ARP	0.96	0.20	0.91	0.29	0.99	0.09	0.96	0.21
Enrolled in FCI	0.17	0.38	0.16	0.37	0.13	0.33	0.17	0.39
No. of Observations	298		136		126		23	

[1]Arkansas, Louisiana, Mississippi, Missouri, and Tennessee.
*Indicates that the mean of participants is significantly different from the mean of nonparticipants at the 0.05 level.

Mississippi farmers in a professional scouting program reported 0.5-bale higher yield and no significant difference in insecticide treatments (7.48 vs. 7.26) as compared with nonparticipants (Table 2). However, participants applied a significantly higher number of treatments of herbicides, fungicides, defoliants, and growth retardants. Participants also used more nonchemical controls (pest-resistant plant varieties, stalk destruction, and pheromone traps).

For the Delta States as a whole, farmers in a professional scouting program reported significantly higher yields and significantly higher pesticide use, at the 95 percent level of confidence, than farmers who did not participate. These same general results, higher yields and higher pesticide use, were obtained in 1989 at the U.S. level [3]. Regionally, yield was significantly higher among participants in comparison to nonparticipants in every region, with the exception of the West, which was nearly significant [3]. Farmers in the Delta States, Southern Plains, and West in a professional scouting program reported significantly higher use of nearly every type of pesticide. Thus, the generally higher use of pesticide by participants holds across different geographical areas with varying pest population densities, weather, cotton varieties, and other growing conditions.

In Mississippi, participants were significantly more likely to be college graduates than nonparticipants. Further, participants were more likely to be owners than nonparticipants. Participants also were more likely to be in the middle age category of over-35 and under-60. These same relationships also held in general for the Delta States as a whole.

In the selection of a pest control system, the variability of yield as well as the level of yields also should be considered. Risk responses of cotton producers include the use of irrigation, enrollment in the Acreage Reduction Program (ARP), and the purchasing of Federal Crop Insurance (FCI). On average, participants employed more of these risk-reducing programs than did nonparticipants in the Delta States. However, the only significant difference for Mississippi and the Delta States as a whole was that participants reported using more irrigation than nonparticipants. In the sample, no nonparticipants in Mississippi reported use of irrigation.

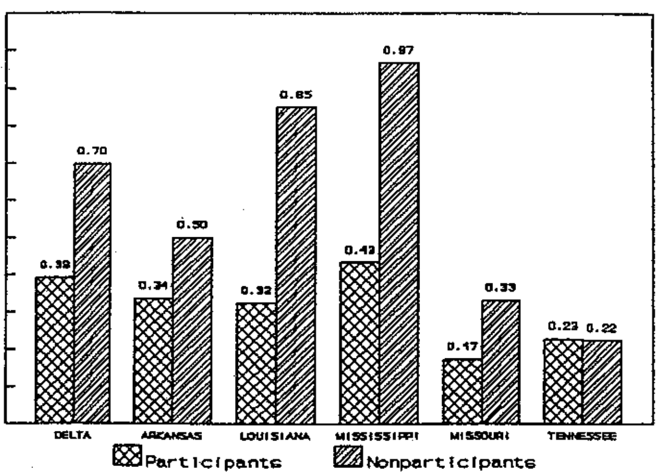

Figure 3. Yield risk, participants and nonparticipants.

One measure of yield risk is the coefficient of variation, which is the ratio of the standard deviation of yield to the mean yield. The coefficient of variation provides a uniform measure that can be used to examine yield risk across States because it standardizes the variability of yields by average yield, which may vary substantially by state.

Figure 3 presents this measure of yield risk for the Delta as a whole and for each state. Except for Tennessee, the yield risk was lower for participants in each state. This suggests that participation in a scout program helps to reduce the risk associated with yield. Participants may face lower yield risk than nonparticipants because participants tend to use more chemical control, more nonchemical control, make greater use of irrigation, and are more likely to be college graduates and owner-operators. However, participants probably have lower yield risk than nonparticipants simply because they time the application of pesticides (and other inputs) more effectively.

Economic Value of Professional Scouting

Utilizing the yield and other differences reported in Table 2 for Mississippi participants and nonparticipants in combination with current prices and costs from the Mississippi cotton cost of production report [2], an estimation of the value of professional scouting in Mississippi under 1989 conditions can be obtained. Results are reported in Table 3.

The major contributor to the value of professional scouting is the yield increase of the participants of 235 pounds of lint per acre (715 vs. 480). The lint price employed (73 cents per pound) included the deficiency payment. Hauling and ginning charges are related to pounds of lint. They are 2 cents per pound for hauling and 8 cents per pound for ginning [2]. Other costs were estimated by multiplying the difference in the number of treatments by the average cost of that practice. For example, the average cost of a herbicide application was $10.47 [2]. The calculations were: (2.76−3.42) (10.47) = 6.91.

While cost was increased by more than $51.00, $23.50 or 46 percent was associated with hauling and ginning the additional seed cotton. The estimated

Table 3. The estimated value per acre of professional scouting, 1989 conditions, cotton, Mississippi.

	Participants	Nonparticipants	Value (Dollars)
Income			
Lint, Lb.	715	480	+171.55
Seed, Lb.	1,108	744	+ 14.56
		TOTAL	+186.11
Cost			
Herbicide, No.	3.42	2.76	−6.91
Insecticide, No.	7.48	7.26	−1.84
Defoliant, No.	1.38	0.61	−5.68
PGR, No.	2.52	1.17	−8.71
Irrigation-Prop.	0.33	0.00	−4.74
		Subtotal	−27.88
Hauling-Lb.	715	480	−4.70
Grinning-Lb.	715	480	−18.80
		Subtotal	−23.50
		Total	−51.38
		Difference	+134.73

value of professional scouting in Mississippi is approximately $135.00 per acre.

Similar implications of the effect of increased scouting on net return and control cost were obtained in a 1987 case study of Mississippi cotton producers [1]. In this study, net return and control cost were indicated for high and low users of integrated pest management (IPM), with classification of users defined primarily by the proportion of crop acreage scouted. The case study differences indicated a $49/acre higher net return for high IPM users, although the high IPM users averaged $18 more pesticide expenditures per acre.

Conclusions

In 1989, Mississippi participants in a professional scouting service obtained higher mean cotton yields and lower yield risk than did nonparticipants. Mississippi participants also used significantly more treatments of herbicide, fungicide, defoliant, and plant growth regulators, but not significantly more treatments of insecticides. Comparatively, for the Delta States as a whole, participants had significantly higher yields and used significantly more of each type of pesticide treatment (herbicide, insecticide, fungicide, defoliant, and growth retardant). The survey results may vary from year to year depending on pest population pressures, and may also vary by location within a region or state. However, the generally higher use of pesticides by participants across different geographical areas with varying pest population densities, weather, cotton varieties, and other growing conditions strongly suggests the generality of the findings concerning cotton scouting and pesticide use.

The use of an economic threshold criterion to determine pesticide applications is the primary procedure employed by professional scouting services at the present time. As new and improved nonchemical control methods and strategies, or superior chemical technologies are developed, they will be adapted into production systems that: (1) optimize yields, (2) minimize yield risk, and (3) maximize profits. Because of their advisory capacity and expertise, professional scouts can encourage the rapid adoption of improved production strategies and risk management techniques.

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