ECONOMIC ANALYSIS OF COTTON INTEGRATED PEST MANAGEMENT STRATEGIES: REPLY

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Scott, Cochran, and Nicholson (SCN) present three criticisms of our analysis (Liapis and Moffitt) presented in the July 1983 edition of the *Southern Journal of Agricultural Economics* . We address each criticism in turn.

First, SCN object to the EUMGF approach to stochastic efficiency. The main objection seems to be that this approach runs a higher risk than some alternative stochastic efficiency criteria of erroneously identifying a useful technology as inefficient. The cost of such a mistake, referred to as Type I error, presumably accrues because a useful production technology is not utilized. Costs can also be incurred due to Type II error, i.e., erroneous use of multiple production technologies when a single technology is actually efficient. With respect to Type I and Type II error trade-offs, it can be argued that when comparing new technologies, such as biological control of agricultural pests, to established techniques, avoidance of Type II errors—acceptance of the null hypothesis that the expected utility of one alternative is equal to the expected utility of another alternative when it is false—is more important. In such cases, the likelihood of the established technology being abandoned erroneously as a result of a single study is practically insignificant. Much more significant is the likelihood that development of a new technology will be challenged if results do not appear promising even in the short run.

In the context of our analysis, minimizing Type II error lowers the likelihood that an experimental technology, such as biological control, will be erroneously abandoned at the research stage. Until a model selection procedure is devised that resolves all computational and theoretical concerns, a variety of models will continue to be used depending on researchers' beliefs of which model is "best" given the problem at hand and binding constraints. For the purpose of our analysis, we regard the EUMGF approach as attractive because it is tractable and theoretically reasonable.

Second, SCN express concern about the data underlying our analysis. All relevant data available were analyzed with the expectation that useful information could be gained. There was also concern about the data's limitations which is why we included an explicit caution to this effect in the paper (Liapis and Moffitt, p. 100). However, SCN present an interesting point regarding "free riders." The community pest management strategy provides an incentive for producers to "free ride." Since the total pest population should be reduced after all community members institute controls, it may pay for a grower not to apply controls because such actions only affect pest population density marginally. For the community pest management strategy to be effective, therefore, a method must be devised to assure compliance. If enforcement methods are necessary, control costs may be higher and these costs may not be reflected in chemical and application costs. Of course, problems with "free riders" also exist with the biological control technology since the wasps are mobile. Our data did not permit investigation of the longrun implications of these effects. However, we fail to see the connection between "free riders" and the assertion by SCN that the untreated fields outside the community, strategy T4, is not viable. On the contrary, the data indicate that when *Heliothis* infestations are low, the use of chemical controls may not be warranted. Under these circumstances, sufficient control

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may be provided by natural enemies. Given possible problems with resistance buildup over time, this strategy may have some long-run benefits.

Third, SCN claim that our model's prediction is faulty. This assertion is not only incorrect but also revealing of a misunderstanding of the purpose of our analysis. Our analysis determines the rational choice among alternative pest management strategies according to economic criteria. It makes no attempt to predict what actual choices of farmers will be since actual choices will depend to a large extent on farmers' perceptions which are in turn related to the promotional campaign mounted for or against particular strategies. For example, suppose that actual risk preferences of farmers were in the range identified in Table 1 of Liapis and Moffitt such that Trichogramma releases were the rational *Heloithis* management strategy. In point of fact, we would not be the least bit surprised to learn that this new, biology-based pest control technique had not achieved widespread adoption. In this regard, we note that the integrated control concept and scientific studies documenting its advantages existed for decades before this knowledge had a significant impact on agricultural pest management.

REFERENCES

Liapis, P. S. and L. J. Moffitt. "Economic Analysis of Cotton Integrated Pest Management Strategies." *So. J. Agr. Econ.*, 15,1(1983): 97-102.

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