STRUCTURAL CHANGES TO CONSIDER IN THE VALUATION OF BOLL WEEVIL ERADICATION PROGRAMS

John R. C. Robinson and Oscar Vergara
Department of Agricultural Economics
Mississippi State University
Mississippi State, MS

Abstract

A review of cost benefit studies of boll weevil eradication programs identifies boll weevil-related yield and insecticide cost savings as the major elements. The widespread adoption of Bt cotton and increased incidence of late-season tarnished plants bugs have implications for the valuation of benefits of boll weevil eradication during and after implementation.

Literature Review

The purpose of this paper is to discuss new developments in the valuation of boll weevil eradication programs. These developments include new technologies like Bt cotton and new pest status for the tarnished plant bug.
Since 1975, many southern states and USDA-APHIS have initiated regional boll weevil eradication (BWE) programs. A number of cost benefit analyses have demonstrated that BWE has been (would be) a profitable investment from an *ex post* (*ex ante*) perspective. For example, Carlson et al. (1989) and Ahouissoussi et al. (1993) demonstrated positive net returns and a high internal rate of return from the Southeastern BWE program. These *ex post* studies included the obvious federal state, and farmer program expenditures as costs. *Ex post* benefits are calculated by comparing baseline yield and insecticide cost data with post-eradication survey data. These studies assumed no price effects resulting from BWE.

Ex ante studies of BWE range in scope from the representative farm level to the regional/national level. The typical methodology for aggregate studies is collection of expected yield and cost impacts in a Delphi-based approach (Taylor et al. (1983). The Taylor study applied such data in a general equilibrium simulation model to generate impacts on crop prices, supplies, consumers surplus, and producers surplus. The Taylor study predicted higher net total surplus for BWE scenarios compared to the status quo. However, BWE scenarios had a net negative impact on producer incomes due to lowered cotton prices which dominated the positive effect of higher cotton yields and lower production costs.

In contrast to the general equilibrium approach, most farm-level or regional-level studies assume no price impact from increased cotton production as a result of BWE. This assumption is questionable given the national scope of BWE program expansion. Surprisingly, recent aggregate studies have also assumed no price-depressing supply effect in their benefit projections for BWE expansion across the Cotton Belt. (Kamere and Vo, 1994; NCC, 1994).

In practice, most *ex ante* studies of BWE use simple partial budgeting and/or investment simulations to evaluate expected yield and cost savings from BWE. These studies compare the status quo with expected changes under BWE. The basis for estimating expected changes in yield or insecticide patterns typically include extension budgets and expert opinion (Sanders et al. (1997), aggregate insect loss estimates (Paxton et al., 1995); extensive farmer survey data (Robinson and Lacewell, 1993); farm analysis association records (Duffey et al. 1994), or biophysical simulation. (Szmedra et al., 1991). The key elements of these evaluations are the expected direct effects involving direct savings in boll weevil-related control costs and yield losses.

There are also significant indirect yield and cost effects following BWE associated with improved natural control of secondary pests. *Ex post* studies presumably capture some of the indirect effects by measuring total insecticide changes before, during, and after BWE (Carlson et al. ,1989; Ahouissoussi et al., 1993)). Most *ex ante* studies have taken a conservative approach and do not try to estimate future indirect pest impacts, although such effects are typically discussed verbally (e.g., Mississippi Cooperative Extension Service, 1996).

Table 1 shows a typical *ex ante* investment framework for evaluating expected changes for BWE in the Delta region of Mississippi. Based on extension budgets and insecticide use surveys, Table 1 displays positive expected benefits from BWE based solely on expected savings in boll weevil-induced yield losses and boll weevil insecticide treatments. On the basis of these conservative benefits estimates, BWE appears to be a profitable investment for Delta cotton growers, despite the negative net benefits of the program during the five year implementation phase (Table 1). Despite the apparent investment profitability, a majority of Delta growers have failed to approve BWE. Part of the reason for this may the be a cash-flow constraint during BWE implementation.

Other seldom included BWE impacts in *ex ante* studies include:

- supply effects on price (Taylor et al. 1983)
- direct macroeconomic effects (e.g., wages, value-added)
- indirect and induced macroeconomic effects in other sectors
- BWE-implementation effects (secondary pest resurgence)

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:321-324 (1999)
National Cotton Council, Memphis TN

- risk considerations (Szmedra et al. 1991)
- non-market impacts (Robinson and Lacewell, 1993).

The remainder of this paper concentrates on two developments that will affect the valuation of expected benefits form BWE. These developments are the changing pest status of tarnished plant bug impacts and the adoption of low-insecticide production systems like Bt cotton.

New Developments

Tarnished plant bug (TPB) has historically been an occasional pest of cotton in the Mid-South, most notably in Arkansas, Mississippi and Alabama. (Freeman, 1998; O'Leary, 1998). Until the mid-1980s, TPB was mostly an early season pest. Since that time TPB has developed into a later-season pest, causing damage to plant terminals and fruiting forms, including young bolls (O'Leary, 1998). The reasons for this shift in TPB incidence may be related to development of insecticide resistance, changes in cropping patterns, changes in weed/cultivation patterns, reduced insecticide environments with Bt cotton, and reduced insecticide following (but not during) implementation of BWE (Freeman, 1998; Snodgrass, 1998).

Table 2 summarizes ten years of loss data (control costs and yield losses) from TPB and boll weevils for Arkansas, Mississippi and Alabama (Beltwide Cotton Insect Losses, 1986-97). The insecticide control cost data indicate an increasing trend in TPB related costs (Table 1). Current observations of TPB control costs in the Mississippi Delta indicate a wide range between $5 and $40 per acre, with an average cost exceeding $20 per acre (Figure 1, from Cooke, 1998).

BWE affects TPB control in two opposite ways. First, there is increasing evidence to suggest that TPB populations are effectively suppressed by ULV malathion treatments *during* BWE implementation. Thus partial TPB suppression is an apparent and straightforward additional benefit of BWE during the five year implementation period (Freeman, 1998; Smith 1994). Informal county agent reports from the Mississippi Brown Loam region in 1998 ascribed varying levels of TPB suppression by ULV malathion treatments for BWE (Pepper, 1998; Winter, 1998). Partial TPB control benefits would effectively off-set some of the grower's cash outlay during the five year BWE implementation phase. For example, the negative cash flows in Table 1 would be mostly eliminated by conservatively crediting BWE with $5 worth of TPB control cost (i.e., about 25% of the average TPB cost shown in Figure 1).

The second way that BWE affects TPB management is in the reduced insecticide, post-eradication phase. Under these conditions, TPB and other occasional pests can develop into damaging populations and require treatment. The latter situation is especially relevant with reduced-insecticide systems such as Bt cotton. For example, Smith (1998) reported that Bt cotton in eradicated areas of Alabama received 2 to 4 sprays for TPB, stink bugs and fall armyworms. TPB is expected to increase its pest status in this post-eradication environment (Smith, 1994), although TPB infestations remain variable from year to year.

It is therefore uncertain whether post-eradication TPB control costs will be similar or higher than the pre-BWE status quo. In theory, uncertainty about pest infestations or pesticide efficacy (both relevant to TPB) will cause producers with constant absolute risk aversion to increase pesticide use beyond the risk neutral, profit maximizing level (Pannell, 1991). This is depicted graphically by the curve VMP** for a risk reducing pesticide input lying to the right of the risk neutral expected value of marginal product curve, EVMP (Figure 2). Without supporting evidence, economists must make assumptions about the effects of pesticides (i.e., risk reducing or increasing) and the risk preferences of cotton farmers.

In summary, controlling TPB is a potential benefit during BWE implementation. Conversely, TPB then become a source of future uncertain costs during BWE maintenance. *Ex ante* evaluations of BWE in the Mid-South should not gloss over these issues.

References

Ahouissoussi, N. B. C., M E. Wetzstein and P. Duffy. "Economic Returns to the Boll Weevil Eradication Program." Journal of Agricultural and Applied Economics 25:46-55.

Antle, J. M. 1988. *Pesticide Policy, Production Risk, and Producer Welfare: An Econometric Approach to Applied Welfare Economics*. Resources for the Future: Washington, D. C. 134 pp.

Beltwide Cotton Insect Losses. 1986-97. Proceedings of the Beltwide Cotton Conference. National Cotton Council, Memphis, TN.

Carlson, G. A., G. Sappie, and M. Hammig. 1982. "Economic Returns to Boll Weevil Eradication." USDA-ERS *Agric. Economic Report No. 621.* Washington, D. C.

Cooke, Jr., F. T. 1998. MAFES, Delta Research and Extension Center. Personal communication.

Duffy, P. A., D. L. Cain, G. Young and M. E. Wetzstein. 1994. "Effects of the Boll Weevil Eradication Program on Alabama Cotton Farms." *Journal of Agribusiness* 12:1-14.

Freeman, Barry. 1998. University of Auburn. Personal communication.

Haney, P. B. and W. J. Lewis. 1996. "Cotton Production and the Boll Weevil in Georgia B History, Cost of Control and Benefits of Eradication." USDA-ARS internal report.

Kamere, P. and T. Vo. 1994. "A Benefit-Cost Analysis of the Boll Weevil Eradication Program." USDA-APHIS internal report.

Mississippi Cooperative Extension Service. 1996. "Mississippi Boll Weevil Management Program: Background." Unpublished agency report.

National Cotton Council. 1994. "Boll Weevil Eradication" "National Strategy for Success." Published report by the NCC.

Pannell, D. J. 1991. "Pests and Pesticides, Risk and Risk Aversion." *Agricultural Economics* 5:361-383.

Paxton, K. W., J. B. Graves and T. A Burch. 1995. "Economic Implications of Boll Weevil Eradication in Louisiana." *Louisiana Rural Economist* 57:5-9.

Pepper, T. 1998. Yazoo County Extension Agent. Personal communication.

Robinson, J. R. C. and R. D. Lacewell. 1993. "Texas Gulf Coast Boll Weevil Eradication Survey: A General Summary of Results." Texas A&M University Dept. of Ag. Economics Technical Report No. 94-2.

Sanders, L. D., M. Karner, J. C. Banks et. al. 1997. "Evaluation of Boll Weevil Losses and the Boll Weevil Eradication Program in Oklahoma." Unpublished working paper.

Smith, R. 1994. "Changes in Secondary Pests During and After Boll Weevil Eradication." *IN Proc. 1994 Beltwide Cotton Conferences*, pp. 796-797. National Cotton Council, Memphis, TN

Smith, R. 1998. "Year Two of Bollgard Behind Boll Weevil EradicaitonB Alabama Observations." *IN Proc. 1998 Beltwide Cotton Conferences*, pp. 965-966. National Cotton Council, Memphis, TN

Snodgrass, G. USDA-ARS Entomoligst, Stoneville, MS. Personal communication.

Szmedra, P.I., R. W. McClendon and M. E. Wetzstein. 1991. "Economic Risk Efficiency of Boll Weevil Eradication." *Southern Journal of Agricultural Economics* 23:237-244.

Taylor, C. R., G. A. Carlson, and K. Reichelderfer. 1983. "An Aggregate Economic Evaluation of Alternative boll Weevil Management Strategies." *Agricultural Economic Research* 35:604-609.

Winter, S. 1998. Yalobusha County Extension Agent. Personal communication.

Table 1. Investment Analysis of Boll Weevil Eradication for Typical Cotton Acreage in the Upper Delta Region of Mississippi.

dollars per acre

	Program Cost	BW Spray Cost Savings	Value of BW Yield Savings	Net Benefit
Year 1	$22.00	$3.00	$9.75	($9.25)
Year 2	$22.00	$9.21	$9.75	($3.04)
Year 3	$22.00	$9.21	$9.75	($3.04)
Year 4	$22.00	$9.21	$9.75	($3.04)
Year 5	$22.00	$9.21	$9.75	($3.04)
Year 6	$4.00	$9.21	$9.75	$14.96
Year 7	$4.00	$9.21	$9.75	$14.96
Year 8	$4.00	$9.21	$9.75	$14.96
Year 9	$4.00	$9.21	$9.75	$14.96
Year 10	$4.00	$9.21	$9.75	$14.96
Year 11	$4.00	$9.21	$9.75	$14.96
Year 12	$4.00	$9.21	$9.75	$14.96
Year 13	$4.00	$9.21	$9.75	$14.96
Year 14	$4.00	$9.21	$9.75	$14.96
Year 15	$4.00	$9.21	$9.75	$14.96

15-Year Rate of Return: $0.44 return on every $1.00 invested.
Net Present Value: $44.91 gain per acre

Table 2. Loss Estimates for Boll Weevils and Tarnished Plant Bugs for AL, AR and MS (source: Ann. Proc. Beltwide Insect Control Conf.)

	CHEM. TMTS		YIELD LOSS	
	BW	*TPB*	*BW*	*TPB*
1986	$8.62	$1.56	3.99%	0.36%
1987	$19.84	$1.48	5.59%	0.55%
1988	$11.83	$1.28	4.86%	0.64%
1989	$12.46	$1.98	3.12%	2.19%
1990	$2.88	$1.63	0.75%	0.78%
1991	$1.45	$3.42	0.28%	2.06%
1992	$10.83	$3.65	2.23%	0.57%
1993	$11.15	$3.22	2.27%	1.53%
1994	$10.63	$9.63	2.05%	4.36%
1995	$12.74	$2.80	1.53%	1.56%
1996	$9.48	$10.67	1.48%	1.67%
1997	$9.91	$6.43	1.08%	1.82%
AVERAGE	$10.15	$3.98	2.44%	1.51%

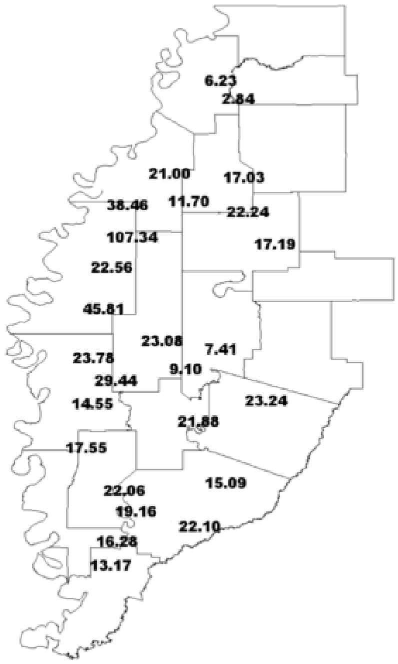
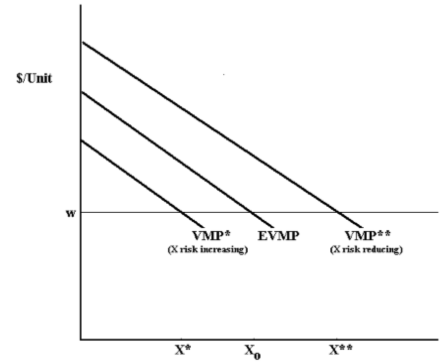


Figure 1. Plant Bug Control Costs Per Acre, 1998.



Source: Antle, 1988

Figure 2. Optimal Input Use Asuming Constant Absolute Risk Aversion.