ECONOMIC IMPACT OF SECOND-GENERATION BT COTTONS IN ARKANSAS: A TWO-YEAR STUDY

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Abstract

Large-plot experiments were conducted throughout Arkansas to determine economic benefit of Bt cotton varieties in 2007 and 2008. Non-Bt, Bollgard, Bollgard II, and WideStrike varieties were each treated on an as-needed basis with insecticide for all pests. Yield was collected and all locations were subjected to economic analysis. Results from these studies suggest that when considering overall yield, the type of transgenic Bt was not as important as the variety itself. This is likely due to the overall lack of pressure from caterpillar pests across all locations both years. There are obvious advantages to the dual-gene products such as Bollgard® II and WideStrike® for management of lepidopteran pests, but this advantage does not necessarily translate to higher yields, most notably in the absence of these pests. That said, dual-toxin Bt cottons may prove to be more valuable than single-toxin technology during a year that may undergo heavier bollworm flights, or perhaps even a significant fall armyworm or looper migration. As for grower profit, varieties containing WideStrike resulted in the best net revenue across these particular trials. It should be noted, however, that these results may differ with a change in certain variables (e.g., higher bollworm pressure, change in technology fee, yield potential).

Introduction

Since the introduction of transgenic Bt cotton (Bollgard®, Monsanto Company) in 1996, cotton growers in Arkansas and across the Midsouth have adopted and utilized this technology over a significant acreage for control of tobacco budworm and bollworm. Due to resistance management concerns and the need for enhanced efficacy against bollworm and occasional pests (e.g., armyworms, loopers), dual-toxin Bt cotton has more recently been developed and commercialized. Bollgard®II (Monsanto Company) and WideStrike® (Dow AgroSciences) have since been introduced and utilized to address the above concerns with noted success. However, due to associated technology fees, the variable nature of insect pest populations, and thorough scouting by Arkansas consultants (regardless of Bt trait), some have questioned the value of these second-generation Bt cottons compared to that of Bollgard, or even non-Bt cottons in certain areas. Another important consideration is that Bollgard will not be available in Arkansas after 2010.

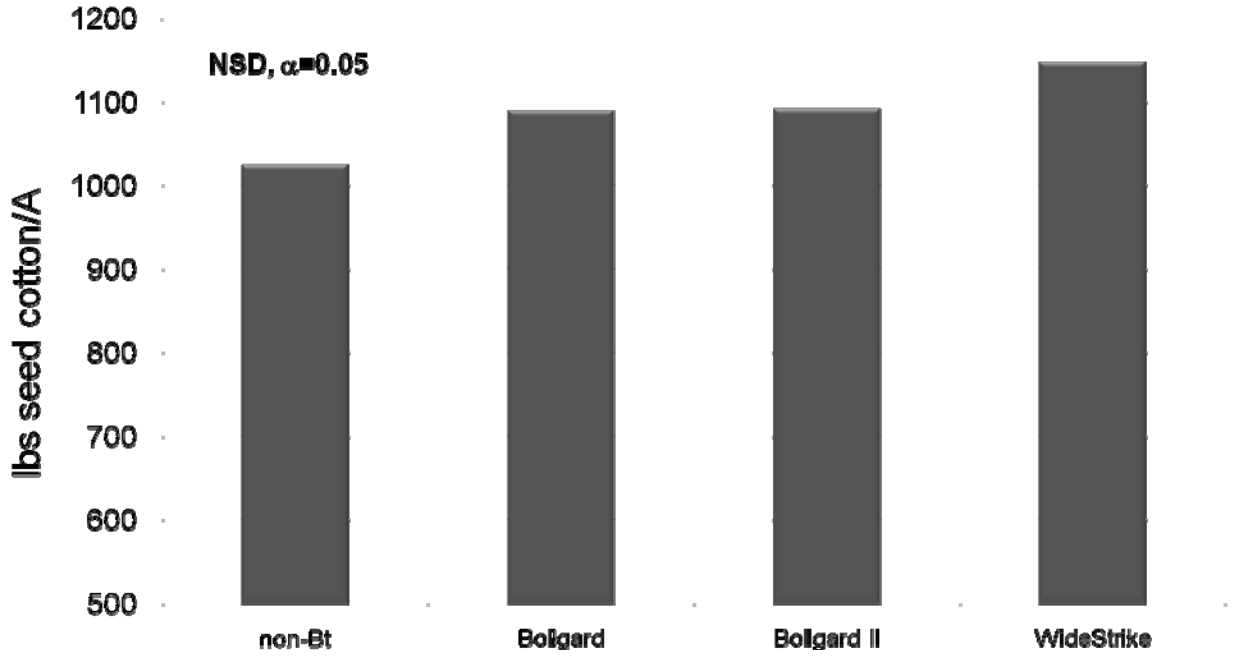
These issues further highlight the importance of investigating the true value of Bt transgenes in Arkansas cotton production. Knowing how these multiple-toxin cottons affect our growers' bottom-line is key to the future of sustainable cotton production in Arkansas. To address this, field trials were conducted to evaluate the economic viability of dual-toxin Bt cottons across the Arkansas landscape. Data from this two-year study (conducted across three locations in Arkansas) were subjected to economic analysis to investigate the potential benefit these second-generation cottons might have to Arkansas cotton producers.

Materials and Methods

Trial had three locations including Rohwer, AR (Southeast), Pine Bluff, AR (Central), and Truman, AR (Northeast). Plot size was 12-24 rows by 150-200' in a randomized complete block design with four replications. Each location used at least one Non-bt, one Bollgard, one Bollgard II, and one WideStrike variety per year. Plots were treated per the threshold recommendations of the University of Arkansas. Plots were scouted once per week and damage and larva data were recorded from terminals, squares, blooms, and bolls. Yield data were collected with grower picker and weighed using a boll buggy equipped with weight sensors. Data were analyzed using SAS (SAS Institute 1998).

Results and Discussion

Efficacy/yield. In order to evaluate the economic advantage of available Bt trait packages statewide, all three locations (both years) were combined for mean seed cotton yield. There was no significant difference in lint yield across all varieties, even the sprayed, conventional non-Bt (Figure 1).



For mean seasonal damage across all locations and both years, both dual-toxin Bt cottons sustained less damage to structures than the conventional non-Bt when averaged over both years and all locations. Additionally, Bollgard varieties were not significantly different from conventional or Bollgard II or WideStrike with respect to seasonal damage. Larval numbers were reduced by the presence of any Bt event in all trials compared to the non-Bt varieties.

Economic Analysis. Data from experimental plots were evaluated for economic returns by applying appropriate commodity and input prices. A partial budgeting method was utilized in which only relevant input costs differences between technologies was included. Costs differences for insect resistance technology were seed costs (including technology fees) and insecticide applications. Revenue was determined by applying plot yields to a price of $0.56/lb. This was the expected price of cotton that included market price and the loan deficiency payment. Stochastic analysis of experimental data provides average net economic returns and probability distributions of seed technologies. Utilizing the empirical distribution of Simetar leads to statistical analysis without imposing an assumed probability distribution such as a normal distribution (Richardson, Schumann, and Feldman 2006). The empirical distribution generates a probability distribution based on experimental data results. Net revenue for each plot was calculated by multiplying yield and cotton price. Seed costs and insecticide expense, including aerial application, for each plot were then deducted from gross revenue. Seed costs and insecticide expenses were derived from cotton production budgets developed by the University of Arkansas (Stiles and Barber 2008). Table 7 reports averages of 500 simulations for each insect resistance technology. WideStrike and Bollgard had the largest yields and revenue. Seed costs included technology fees and were identical for each technology over all respective plots. Insecticide expenses included chemical cost and aerial application. Reported expenses are averages for all plots of a technology which have no expenses in some cases. Plots with no insecticide resistance technology had the greatest insecticide expense that averages $16.53/acre. WideStrike had the greatest net revenue per acre that is $4.85 more than Bollgard, and $32.73 more than Bollgard II in this case.

Table 1. Average Yield, Revenue, Seed Costs, Insecticide Expense, Net Revenue, and Coefficient of Variation from Stochastic Simulation, by Insect Technology.

	LY	Dollars per Acre				Percent
Technology	Lbs/A	Revenue	Seed Cost	Expense	Net Revenue	C.V.
None	1,047	586.49	75.84	16.53	494.22	25.7
Bollgard	1,118	625.86	80.12	2.28	543.23	21.8
Bollgard II	1,094	612.84	97.52	0.00	515.35	13.1
WideStrike	1,150	643.93	93.31	2.28	548.08	18.8

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