Chapter 16

Market Development of Bollgard Cotton

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Bollgard Demonstration Field in MS in 1995 unsprayed for Lepidopterous pests. Non-Bt cotton on the left. Bollgard cotton (NuCotton 33B) on the right. Insect damage to the cotton on the left reduced the number of bolls and delayed maturity of the cotton.

Monsanto commercialized *Bt* cotton (Bollgard) containing the *cry1Ac* gene in 1996. As the first transgenic insecticidal technology to be developed for cotton, several unique market development challenges arose for this new technology and for cotton.

How does one ensure that the grower understands and stewards this new technology?

How would quality control for this novel product be conducted?

How do the trait producer and the seed companies and germplasm providers divide the responsibilities for the production, promotion, sales, and service of the product that represents a varietal germplasm *and* a biotechnological trait?

How does one establish the value of this insect control technology and a venue to sell it?

The Technology License

Growers who purchased Bollgard cotton were required to sign a technology license before purchasing the seed. The technology license had two primary purposes: first, to ensure that licensees would not save their seed for replanting or sell it to another grower; and second, to ensure that growers would implement the EPA-required resistance management plan designed to delay the development of resistance to the *Bt* toxin by target lepidopterans. This technology license serves a purpose similar to that of a traditional pesticide label. It is a legal agreement between Monsanto and the licensee, proscribing the product stewardship responsibilities of each party. Although EPA requires that Bollgard be "labeled" in a regulatory sense, there is no requirement for the grower to be in possession of the Bollgard label, as with traditional pesticide products. A grower who signs a technology license is provided a license number, which in turn must be provided to the retailer when purchasing seed containing the Bollgard trait.

Quality Control

The Bollgard trait was initially offered in two varietal backgrounds and later in many more. To ensure that the trait was performing to standards in each new variety, Monsanto instituted "gene equivalency" trials. For the initial years of commercialization, all new candidate varieties were required to pass two years of field testing under natural and/or artificial infestation conditions at several locations where the product would be commercially available. These tests were conducted to determine whether the insecticidal properties of the candidate varieties were equal to those of the standard Bollgard variety, Coker 312/531 (the original transformed variety). Insect control, plant damage, and yields were quantified, and all comparisons were made to the standard Coker Bollgard variety. However, because field tests rarely resulted in sustained, high insect infestation levels [particularly for the more tolerant bollworm, *Helicoverpa zea* (Boddie)], the sensitivity of this type of equivalency testing was questioned.

Beginning in 1999, a new type of gene equivalency test was instituted. Candidate Bollgard varieties, including the standard Bollgard variety, were grown at several locations. Fruit and leaf tissue samples were taken from each variety at regular intervals throughout the season. The tissue samples were immediately frozen and stored until processed. At a central laboratory, each sample was lyophilized, ground to fine powder, diluted, and tested in a sensitive tobacco budworm, *Heliothis virescens* (F.), feeding bioassay that quantitatively measured the level of Cry1Ac