BT COTTON IN ALABAMA: 25 YEARS LATER

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Background

Cotton production in Alabama can be traced back to the late 1700s. Through the mid-1800s, production was primarily focused on the Black Belt soils in the west central part of the state. Alabama cotton changed forever following the introduction of the Boll Weevil in Mobile County in 1910.

In the mid-1940s, the chlorinated hydrocarbons (or organochlorines), known as DDT, toxaphene and BHC, were introduced and growers were able to reduce losses by making sprays on 4- to 7-day intervals. After about a decade, the weevil developed resistance and a shift to the organophosphates was made in the early to mid-1970s. Widespread use of OPs controlled weevils, but the 5-day spray intervals led to tobacco budworm resistance and often flared secondary pests. The registration of pyrethroids in the 1970s was pivotal for Alabama producers.

Pyrethroids provided control of nearly every cotton insect pest and allowed for a 7-day spray interval for several years. The Boll Weevil Eradication Program reached Alabama in 1987 and by 1995 no economic losses to boll weevil was recorded for the first time in over 80 years. However, as is often the case, a new pest arose to dominance.

Rise of the Caterpillar

The bombardment of insecticides needed to control and eradicate the boll weevil led to the development of resistance of tobacco budworms, bollworms and beet armyworms. Economic losses to caterpillar pests were high from 1987 to 1995. This lasted until the first *Bacillus thruengiensis* (Bt) transgenic cotton varieties were introduced.

Bollgard Era

In 1996, a new variety of cotton producing the Bt toxin Cry1Ac, also known as Bollgard, was introduced to the market. Alabama growers readily adopted this technology, planting Bollgard cotton on 77% of the acres, more than any other state. The economic impacts of this adoption were immediately seen, as costs and losses to caterpillar pests were drastically reduced (Figure 1). In 1995, Alabama cotton producers averaged 7.8 applications for caterpillar pests, totaling $74.10 per acre with 34.04% losses and average yield of just 385 lb. lint. The following year, with Bollgard cotton, producers averaged only 0.13 insecticide applications for caterpillars, with a cost of just $1.01 per acre and an average yield of 776 lbs. of lint.

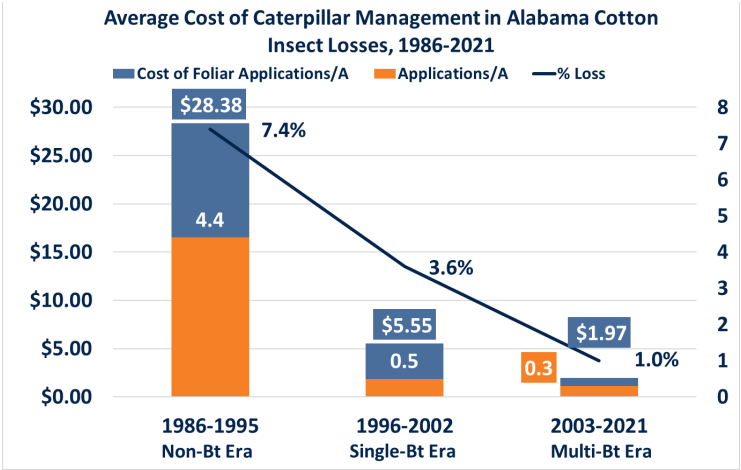

Figure 1. Average cost of caterpillar management in Alabama during the non-Bt era (1986-1995), the single-Bt era (1996-2002) and the multi-Bt era (2003-2021).

With the bombardment of insecticides needed to eradicate the boll weevil came the elimination of beneficial insects and the rise of resistance, leading to high populations of tobacco budworms and beet armyworms. These pests were responsible for up to $40 million dollars in loss annually during the late 1980's and early 1990's. Everything changed in 1996 with the introduction of the first genetically modified organism (GMO) cotton varieties to the market. This GMO technology referred to as "Bollgard," expressing the Bacillus thruingiensis (Bt) toxin Cry1Ac was readily adopted in Alabama. In the first year of commercial availability, Bollgard cotton was planted on 77% of the cotton acres statewide. The economic impacts of this adoption were immediately seen, as costs and losses to caterpillar pests were drastically reduced. In 1995, Alabama cotton producers averaged 7.8 applications for caterpillar pests, totaling $74.10 per acre with 34.04% losses and average yield of just 385 lb. lint. The following year, with Bollgard cotton, producers averaged only 0.13 insecticide applications for caterpillars, with a cost of just $1.01 per acre and an average yield of 776 lbs. of lint. Although growers no longer needed to spray for beet armyworms or tobacco budworms, issues with escaped bollworms became prevalent. As understanding of the Bt technology increased, growers were able to effectively manage 'escaped' bollworms with a well-timed application of a pyrethroid. The following decade provided Alabama cotton producers with a low spray, high yielding environment with reduced input costs.

Multigene Era

The "Bollgard Era" ushered in a new day in cotton IPM and each additional Bt toxin added has further reduced insecticides for bollworm/budworm. Bollgard II (Cry1Ac+Cry2Ab) was introduced in 2003, followed by WideStrike (Cry1Ac+Cry1F) in 2005, TwinLink (Cry2Ab+Cry2Ae) and WideStrike 3 (Cry1Ac+Cry1F+Vip3a) in 2014 and finally TwinLink+ (Cry2Ab+Cry2Ae+Vip3A) and Bollgard 3 (Cry1Ac+Cry2Ab+Vip3A) in 2017. The bollworm/budworm complex is no longer a consistent threat for Alabama cotton producers; however, a new pest complex has filled the void.

Alabama Cotton IPM Today

By the 2021 growing season, Alabama cotton producers were primarily planting varieties that express three Bt toxins and sprays for 'escaped' bollworms are rarely needed. However, the low spray environment in the decades following the introduction of Bt cottons, other pests have filled the void. The "bug complex" is annually the most yield limiting insect issue for Alabama cotton producers. Across most of North Alabama, the tarnished plant bug is the dominant insect pest. Adult plant bugs infest fields in early June, during the squaring period and begin feeding on pinhead squares and laying eggs that will develop into embedded populations as the cotton begins flowering. When left untreated, plant bugs can lead to devastating yield losses. In central and south Alabama, it is the stink bug that is the key insect pest. Unlike plant bugs, stink bugs do not infest fields at economic levels until around the 3rd or 4th week of bloom. This pest, which is hard to find in a field due to its 'skittish' nature, targets developing seed in small bolls. Since cotton cannot compensate for this mid to late season loss of developing bolls, timely insecticide use is critical for stink bug control. With proper scouting and the use of thresholds, Alabama cotton producers are able to effectively manage the "bug complex" and yield losses to these pests are effectively reduced.

Sucking pests, such as thrips, aphids, silverleaf whiteflies and spider mites annually require monitoring and management. Additionally, a shift to reduced tillage and cover cropping systems has led to sporadic early season pests such as grasshoppers, cutworms, snails, slugs and early season spider mites. Although these secondary and sporadic pests require attention, just a few key pests cause major concern for Alabama cotton.

Acknowledgements

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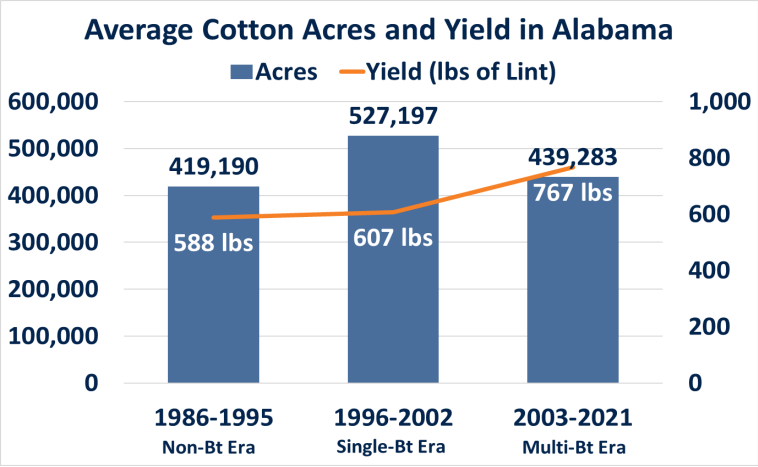

Figure 2. Average cotton acres and yield in Alabama during the non-Bt era (1986-1995), the single Bt-era (1996-2002) and the multi-Bt era (2003-2021).