BOLLGARD II IN THE SOUTHERN SAN JOAQUIN VALLEY

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Abstract

A field study was conducted in 2000 to evaluate insect population dynamics and the efficacy of cotton (*Gossypium hirsutum* L.) varieties expressing none, one or two *Bacillus thuringiensis* proteins on various chewing pests. Overall, insect pest populations were very low. Only aphid populations reached a treatable threshold. Late bollworm damage was significantly higher on the non-*Bt* variety, but that did not significantly reduce lint yields. Less looper feeding damage was observed on the two-*Bt* protein variety during the initial infestation. The one-*Bt* varieties keep looper populations in check while feeding continued on the non-*Bt* variety. Leaf damage did not have a negative effect on lint yield.

Introduction

Bacillus thuringiensis is a naturally occurring bacteria found in soil all over the world. Scientists have identified over 20,000 strains, which are grouped into sub-species. Each of these sub-species produces a protein that is toxic only to pest insects, including Coleoptera, Diptera and Lepidoptera. *Bt* products for insect control were marketed in Germany early as 1927. Through biotech transfer, plants that manufacture the *Bt* protein have been developed, thus enabling them to be protected for the entire growing season.

Bt cotton is a transgenic crop in which a gene from *Bacillus thuringiensis* is infused into their own genetic material. 1996 marked the first year that *Bt* cotton became available commercially for U.S. farmers. As of 1996, the *Bt* cotton dramatically reduced the effects of cotton pests by 90%, well over the 60% effectiveness of the typical insecticide.

A two-toxin *Bt* cotton has recently been under development. The currently available *Bt* cotton varieties express only one endotoxin, CryIAc. The new, second generation variety expresses not only CryIAc, but also CryX. This product is commonly referred to as Bollgard II®. Our objective in this research was to compare the efficiency of Bollgard, Bollgard II and non-*Bt* cotton in protecting the cotton plants from lepidopteran damage and to evaluate their effect on insect population dynamics.

Materials and Methods

In 2000, field research was completed to determine the effects of none, one or two plant produced insecticidal proteins of *Bacillus thuringiensis* on a variety of pests. The four varieties planted were DP50BII, DP50B, DP50, and NuCotton 33B. The study included three replications of each for a total of twelve plots. The cotton was planted at a density of 46,000 seeds per acre on May 16, 2000 in a randomized complete block design at the UC Shafter Research and Extension Center. Plot size was 8-40" rows by 50 feet. Plant mapping was completed on September 20 to measure boll retention, height, and number of nodes. The two center rows were machine harvested on October 25.

Insect populations were monitored using sweep-net, leaf collection and visual inspection. Samples were collected once per week. Fifty sweeps per plot to check for worms, mobile insect pests and beneficial insects. Twenty leaves from the 5th node from the terminal were collected to check for aphids. Leaves were then washed in a bleach-water solution to monitor mite and thrip populations. Beginning in mid July, 20 of the top 5 bolls were visually inspected for damage. Estimations of leaf feeding damage were also taken once per week. This was done by estimating the percent leaf damage on individual leaves and estimating the percent of total leaves damaged.

Results

Cabbage looper populations did become high enough to determine that plant expressed *Bt* proteins were successful in protecting against looper damage. During the initial infestation, the two protein variety was more effective in limiting leaf feeding. For the rest of the season there was more damage in the non-*Bt* variety.

Overall, pest insect populations were very low throughout the year. Aphid populations reached treatable levels across all varieties in early August. No other insect pests reached treatable levels. Mite populations flared following the aphid spray which also affected beneficial insect populations.

Bollworm populations did not become evident until late in the season. However, it did finally become evident from samples of the top 5 bolls taken late in the season that there was a significant difference in the amount of damage found on the non-*Bt* cultivar when compared with varieties containing *Bt* proteins. On average, 20% of the bolls collected from the DP50 plots were damaged compared to 1.3% of the DP50BII. The single protein varieties were not significantly different from the two- protein variety. Because bollworm populations occurred late in the season and because most of the damage occurred at the top of the plant, this difference in boll damage was not enough to cause a significant difference in lint yield. There was not a significant difference in top 5 boll retention or the number of total bolls.

Conclusions

DP 50BII, which contains two *Bt* proteins was the most effective in keeping looper populations and damage down. The varieties containing just one *Bt* protein were also more effective than the non-*Bt* cultivar. Our data also show that the *Bt* cotton was significantly more effective in preventing bollworm damage. Unfortunately, we did not have high enough populations to be able to determine how this would affect yield. Pink bollworm is controlled in the San Joaquin Valley through a host free period and sterile moth release. Potential problems with other chewing insects are a localized problem depending on adjacent crops. The use of *Bt* cotton in these areas would be beneficial.

Table 1. Boll count and lint yield.

Variety	Total Bolls	Top 5 Bolls	Top 5 Damage	Lint Yield
			-- % --	-- lbs/A --
DP50BII	60	1	1.3	1663
DP50B	59	3	4.0	1658
DP50	65	2	20.0	1672
33B	54	2	2.7	1650
$LSD_{0.05}$	NS	NS	4.4	NS

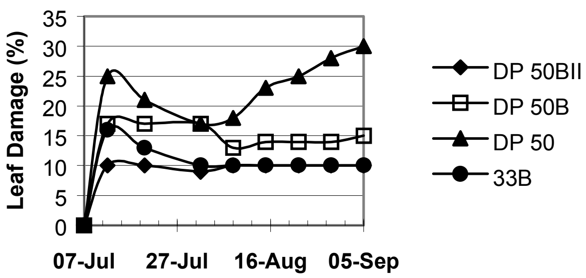

Figure 1. Looper Damage.

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