2005 Beltwide Cotton Conferences, New Orleans, Louisiana - January 4 - 7, 2005

FIELD EVALUATION OF VIPCOTTM AGAINST HELIOTHINES UNDER NATURAL AND ARTIFICIAL INFESTATIONS

Tony Burd, Brad Minton, Scott Martin, Gary Cloud and Charlie Grymes
Syngenta
Greensboro, NC
Dave Dickerson
Syngenta Biotechnology, Inc.
Cordova, TN

Abstract

In 2004, trials were conducted throughout the cotton belt to test the efficacy of three VipCot™ lines against tobacco budworm, *Heliothis virescens* (Fabricius), and cotton bollworm, *Helicoverpa zea* (Boddie). The three VipCot™ lines, Cot102, Cot202 and Cot203, were compared to a conventional variety, Coker 312. All VipCot™ lines suffered less square and boll damage due to heliothines than did Coker 312, but the Cot200 lines performed significantly better than Cot102 against tobacco budworm. VipCot™ lines also provided excellent control of other lepidopteran pests, including pink bollworm, beet armyworm, cabbage looper and soybean looper. These results indicate the broad spectrum of activity that VipCot™ lines provide.

Introduction

Transgenic cottons, specifically those containing the *B.t.* endotoxin, have become more widespread in recent years. The introduction of Bollgard® cotton was an important step in managing heliothine pests in the cotton belt. However, Bollgard® cotton did show some weakness against *Helicoverpa zea* (Boddie) (Burd et al. 1999, Lambert et al. 1997, and Mahaffey et al. 1995). In recent years, new technologies have enabled *B.t.* cottons to target a more broad pest spectrum. The introduction of Bollgard II® and WideStrike®, which each contain two different *B.t.* genes, shows enhanced control over that of Bollgard® cotton (Jackson et al. 2004).

Recently, Syngenta has been testing a novel *B.t.* protein (Estruch et al. 1996 and Lee et al. 2003), Vip3A, which is contained in all VipCot™ lines. These VipCot™ lines, which contain only the one gene, Vip3A, have been shown to exhibit a similar spectrum of activity to that of the 2-gene products (Mascarenhas et al. 2003 and Mascarenhas 2004). The addition of this novel gene with a broad spectrum of control into the market will benefit resistance management of heliothines across the cotton belt. If indeed there is no cross resistance between Vip3A and Cry proteins, as early studies have indicated, then this will provide growers with another opportunity for controlling heliothines.

This paper will report on trials conducted across the cotton belt with several VipCot™ lines in 2004. The objective was to compare the efficacy of the VipCot™ lines to one another and to the conventional variety, Coker 312, for lepidopteran control.

Materials and Methods

Trials were conducted throughout the cotton belt to assess insect efficacy of various cotton lines. The four cotton lines tested were Cot102, Cot202, Cot203 (VipCot™ lines) and Coker 312 (non-*Bt*). Trials were planted and maintained according to practices and guidelines for that particular area. Plots were arranged as a randomized split block with half the field receiving pesticide applications to keep these plots insect free. Only efficacy data from the unsprayed plots is included in the current report. All plots were 4 rows by 30-40 feet.

If needed, control of non-lepidopteran pests was accomplished over all tests with applications of appropriate pesticides that had little to no activity on heliothines. In some cases, insecticide applications were also made to disrupt natural enemies and to encourage increased survival of heliothines. Also, some trials were artificially infested with tobacco budworm and/or bollworm. Infestations were made using a CO_2 backpack sprayer at 10-11psi. A solution of water and gum xanthan was prepared to be sprayed over the plots. Eleven grams of gum xanthan was added to 3000 ml of water and the solution was mixed in a blender. Eggs were added to the solution just prior to application. The solution containing the eggs was sprayed in the terminal portion of the plants.

Assessments of heliothine damaged fruit and live larvae were made during the period of pest occurrence. Depending upon pest pressure, 20-50 fruit per plot were sampled for damage and live larvae. If secondary pests were present (i.e. loopers), they were sampled according to local procedures, which in this case was done using a beat sheet. All data were analysed and means were separated using LSD. In some cases, an average of mean data was used and therefore no mean separation was performed on such data.

Results

Average overall heliothine square damage ranged from 14.8-86.2% for the non-*B.t.* Coker 312 (Table 1). Overall percent damaged squares due to bollworm ranged from 3.0-23.9 in Cot102 plots, 0-2.8 in Cot202 plots and 0-1.5 in Cot203 plots. Overall percent damaged squares due to tobacco budworm ranged from 3.3-19.3 in Cot102 plots, 0.4-4.8 in Cot202 plots and 0.9-3.1 in Cot203 plots.

Late season boll damage ratings showed excellent control of bollworm at three locations with no more than 1.5% damaged bolls for either of the Cot200 events (Table2). Cot200 events also provided >98% control of looper species, > 94% control of beet armyworm and >98% control of pink bollworm (Table3).

Discussion

All VipCot™ lines provided enhanced protection against heliothines and other lepidopteran pests compared to the Coker 312. However, with regards to tobacco budworm, the Cot200 events were significantly more efficacious in controlling square damage than was Cot102. The Cot200 events also provided similar and in most cases greater control of bollworm than Cot102.

We have also seen that these VipCot™ lines provide excellent control of secondary pests such as pink bollworm, beet armyworm, and looper species. In addition, data from late season ratings show that boll damage was extremely low due to bollworm. Robust late season insecticidal activity would be quite helpful in areas of the south that receive a late season bollworm flight. Overall, all VipCot™ lines performed well in controlling lepidopteran pests. With regards to certain pests, the Cot200 events exhibited enhanced protection over that of Cot102. In the future, VipCot™ lines will provide another tool for cotton growers to use that will sustain *B.t.* technologies without creating an insect resistance management problem.

Literature Cited

Burd, T., J.R. Bradley, Jr., and J.W. Van Duyn. 1999. Performance of selected Bt cotton genotypes against bollworm in North Carolina, pp. 931-934. *In* Proceedings 1999 Beltwide Cotton Conference. National Cotton Council, Memphis, TN.

Estruch J.J., G.W. Warren, M.A. Mullins, G.J. Nye, J.A. Craig and M.G. Koziel. 1996. Vip3A, a novel *Bacillus thuringiensis* vegetative insecticidal protein with a wide spectrum of activities against lepidopteran insects. Proceedings National Academy of Science USA. Vol. 93(11): 5389-94.

Jackson, R. E., J. R. Bradley, Jr., and J. W. Van Duyn. 2004. Bollworm population production and associated damage in Bollgard and Bollgard II cottons under insecticide-treated and non-treated conditions, pp. 1022-1025. *In* Proceedings 2004 Beltwide Cotton Conference. National Cotton Council, Memphis, TN.

Lambert, A. L., J. R. Bradley, Jr., and J. W. Van Duyn. 1997. Interactions of *Helicoverpa zea* and BT cotton in North Carolina, pp. 870-873. *In* Proceedings 1997 Beltwide Cotton Conference. National Cotton Council. Memphis, TN.

Lee, M.K., F. S. Walters, H. Hart, N. Palekar and J. S. Chen. 2003. The mode of action of Bacillus thuringiensis vegetative insecticidal protein Vip3A differ from that of Cry 1Ab delta-endotoxin. Applied and Environmental Microbiology. Vol. 69 (8): 4648-4657.

Mahaffey, J. S., J. R. Bradley, Jr., and J. W. Van Duyn. 1995. B.t. Cotton: Field Performance in North Carolina under conditions of unusually high bollworm populations. Pp. 796-798. *In* Proceedings 1995 Beltwide Cotton Conference. National Cotton Council. Memphis, TN.

Mascarenhas, V. J., R. Boykin, F. Shotkoski. 2003. Field performance of Vip cotton against various lepidopteran cotton pests in the U.S., pp. 1316-1322 *In* Proceedings, 2003 Beltwide Cotton Conference. National Cotton Council, Memphis, TN.

Mascarenhas, V. J. 2004. Field performance of VipCot™ in elite germplasm, pp. 132-137 *In* Proceedings, 2004 Beltwide Cotton Conference. National Cotton Council, Memphis, TN.

Table 1. Average percent damaged squares for VipCot™ lines and Coker 312 due to cotton bollworm and tobacco budworm in 2004.

	Percent Damaged Squares From Tobacco Budworm			Percent Damaged Squares From Cotton Bollworm			
Line	**MS**	**TX**	**LA**	**MS**	**TX**	**LA**	**GA**
Coker 312	79.5	30.5	14.8	77.0	16.3	16.2	86.2
Cot 102	19.3	6.7	3.3	7.0	3.0	7.0	23.9
Cot 202	4.8	4.2	0.4	1.3	2.8	0.0	2.8
Cot 203	2.6	3.1	0.9	1.3	1.5	0.0	3.3

Table 2. Average percent late season damaged bolls (90-110 DAP) for VipCot™ lines and Coker 312 due to heliothines in 2004.

	Percent Damaged Bolls due to Heliothines		
Line	**GA**	**TX**	**LA**
Coker 312	83.0	4.6	10.0
Cot 102	10.5	1.6	2.0
Cot 202	1.3	0.6	0.0
Cot 203	1.5	0.0	0.0

Table 3. Control of secondary pests with VipCot™ lines in 2004.

Line	Cabbage Loopers/6 row feet[1]	Percent Control	Soybean Loopers/6 row feet[2]	Percent Control	Percent damaged squares BAW[3]	Percent Control	Percent damaged bolls PBW[4]	Percent Control
Coker 312	4.5 a	--	19.3 a	--	25.0 a	--	77.2 a	--
Cot 102	0.5 b	88.9%	0.0 b	100%	4.0 b	84%	5.0 b	93.5%
Cot 202	0.0 b	100 %	0.3 b	98.4%	1.5 b	94%	1.4 b	98.2%
Cot 203	0.0 b	100%	0.0 b	100%	0.5 b	98%	0.3 b	99.6%

[1] Data collected from Beasley, TX
[2] Data collected from Winnsboro, LA
[3] Data collected for beet armyworm from GA
[4] Data collected for pink bollworm from Seminole, TX