

**BOLLGARDII®: INFLUENCE ON PREDACEOUS ARTHROPODS AND ACTIVITY  
AGAINST PESTS UNDER DIFFERENT MANAGEMENT SCENARIOS**

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**Abstract**

Field studies were conducted during 2001 and 2002 to evaluate the impact of the transgenic cotton (*Gossypium hirsutum* [L.] genotype Bollgard II (DP50BII), that expresses two *Bacillus thuringiensis* Berliner (B.t.) insecticidal proteins (Cry1Ac and Cry2Ab), on populations of predaceous arthropods and to determine the importance of these predators in suppressing lepidopterous pests. Predator and lepidopterous pest populations were monitored in 1/8th acre plots of the near isogenic lines DP50BII, DP50B (Bollgard, expresses Cry1Ac) and DP50 (non-B.t.) under untreated and insecticidally disrupted conditions. Arthropod populations were monitored weekly for genotype and treatment effects using 1-meter square beat cloth (3 beat cloth samples per plot). Our field design consisted of two adjacent randomized complete blocks with four replicates per line managed as follows: 1. each line untreated throughout the season and 2. each line treated with acephate during early season to disrupt predators. Overall predator populations were as high or higher in both B.t. genotypes under both untreated and disrupted conditions as compared to non-B.t. (Table 1, 2). In DP50BII, populations of lepidopterous pests under untreated conditions were consistently below economic levels (Table 3), but on 26 July 2002, *Helicoverpa zea* (Boddie) numbers exceeded economic thresholds where predators were disrupted (5 larvae > 1/4 inch per 100 plants). DP50BII provided significantly better control of *Pseudoplusia includens* during 2001 and 2002 and *Spodoptera frugiperda* during 2002 than DP50B under both untreated and acephate-treated conditions (Table 3, 4). Under untreated and acephate-treated conditions, populations of *Helicoverpa zea* were lower in DP50BII compared to DP50B, but differences were not significant. In previous studies, BG50BII has provided excellent control of *H. zea* despite predator disruption. However, during 2002, high bollworm pressure resulted in an increase in escaped larvae in disrupted plots. The survival of five large larvae per 100 plants (1600 larvae per acre) in DP50BII could impact resistance management strategies if those larvae develop into adults that are as fecund as those developing on non-B.t. cotton.

Table 1. Mean  $\pm$  SE<sup>a</sup> numbers of predators<sup>b</sup> per 3 m. row sampled from untreated cotton on various dates during 2001 and 2002.

Genotype	2001			2002		
	Heteroptera <sup>c</sup>	<i>Solenopsis</i>	Spiders	Heteroptera <sup>c</sup>	<i>Solenopsis</i>	Spiders
DP50	14.79 $\pm$ 1.64	5.46 $\pm$ 1.32	11.00 $\pm$ 1.02	10.11 $\pm$ 1.59	35.25 $\pm$ 4.05a	6.43 $\pm$ 0.61
DP50B	20.29 $\pm$ 2.44	6.00 $\pm$ 1.65	13.54 $\pm$ 1.57	13.29 $\pm$ 2.17	38.61 $\pm$ 4.52a	9.07 $\pm$ 1.09
DP50BII	20.17 $\pm$ 2.74	9.04 $\pm$ 2.12	13.04 $\pm$ 1.34	14.43 $\pm$ 2.55	22.43 $\pm$ 4.07b	9.00 $\pm$ 1.15
F value	1.83	1.45	1.05	1.07	4.06	2.37
p value	0.1693	0.2411	0.3569	0.3474	0.0210	0.1004

<sup>a</sup>Means separated using Fishers protected LSD p < 0.05.

<sup>b</sup>Predators sampled: 22 June, 5, 23, 30 July, 6, 13 August during 2001(df = 2,70); 26 June; 8, 15, 20, 26 July; 2,7 August during 2002 (df=2,78).

<sup>c</sup>Includes: *Geocoris punctipes*, *Orius insidiosus*, and *Nabis* sp.

Table 2. Mean  $\pm$  SE<sup>a</sup> numbers of predators<sup>b</sup> per 3 m. row sampled from acephate-treated cotton on various dates during 2001 and 2002.

Genotype	2001			2002		
	Heteroptera <sup>c</sup>	<i>Solenopsis</i>	Spiders	Heteroptera <sup>c</sup>	<i>Solenopsis</i>	Spiders
DP50	7.08 $\pm$ 1.31	5.13 $\pm$ 2.00	8.92 $\pm$ 1.39	3.69 $\pm$ 0.68b	5.11 $\pm$ 1.14	4.46 $\pm$ 0.57
DP50B	7.46 $\pm$ 1.21	4.50 $\pm$ 1.93	8.04 $\pm$ 1.26	9.54 $\pm$ 1.42a	8.54 $\pm$ 1.64	7.00 $\pm$ 0.38
DP50BII	7.88 $\pm$ 1.06	4.63 $\pm$ 2.04	8.71 $\pm$ 1.37	9.64 $\pm$ 0.82a	7.36 $\pm$ 1.28	6.43 $\pm$ 0.69
F value	0.11	0.03	0.11	16.89	1.50	4.08
p value	0.8961	0.9733	0.8944	0.0034	0.2962	0.0761

<sup>a</sup>Means separated using Fishers protected LSD p < 0.05.

<sup>b</sup>Predators sampled: 22 June, 5, 23, 30 July, 6, 13 August during 2001(df = 2,70); 26 June; 8, 15, 20, 26 July; 2,7 August during 2002(df=2,78).

<sup>c</sup>Includes: *Geocoris punctipes*, *Orius insidiosus*, and *Nabis* sp.

Table 3. Mean  $\pm$  SE<sup>a</sup> numbers of lepidopterous pests<sup>b</sup> per 3 m. row sampled from untreated cotton on various dates during 2001 and 2002.

Genotype	2001		2002			
	<i>H. zea</i> <sup>c</sup>	<i>P. includens</i>	<i>H. zea</i> <sup>c</sup>	<i>P. includens</i>	<i>S. exigua</i>	<i>S. frugiperda</i>
DP50	3.44 $\pm$ 0.76a	1.75 $\pm$ 0.36a	18.40 $\pm$ 4.51a	3.10 $\pm$ 0.78a	0.85 $\pm$ 0.41a	1.30 $\pm$ 0.35a
DP50B	0.31 $\pm$ 0.12b	1.56 $\pm$ 0.41a	1.05 $\pm$ 0.26b	2.60 $\pm$ 0.59a	0.35 $\pm$ 0.21a	0.90 $\pm$ 0.20a
DP50BII	0.00 $\pm$ 0.00b	0.0 $\pm$ 0.0b	0.00 $\pm$ 0.00b	0.15 $\pm$ 0.08b	0.15 $\pm$ 0.08a	0.25 $\pm$ 0.10b
F value	20.46	14.14	25.98	13.44	1.75	4.52
p value	$\leq$ 0.0001	$\leq$ 0.0001	$\leq$ 0.0001	$\leq$ 0.0001	0.1843	0.0153

<sup>a</sup>Means separated using Fishers protected LSD  $p < 0.05$ , data analyzed using  $\sqrt{(y + 0.5)}$  transformation, actual means reported.

<sup>b</sup>Lepidopterous pests sampled: 23, 30 July, 6, 13 August during 2001 (df=2, 42); 15, 20, 26 July, 2, 7 August during 2002 (df=2, 54).

<sup>c</sup>Larvae greater than 1/4 inch.

Table 4. Mean  $\pm$  SE<sup>a</sup> numbers of lepidopterous pests<sup>b</sup> per 3 m. row sampled from acephate-treated cotton on various dates during 2001 and 2002.

Genotype	2001		2002			
	<i>H. zea</i> <sup>c</sup>	<i>P. includens</i>	<i>H. zea</i> <sup>c</sup>	<i>P. includens</i>	<i>S. exigua</i>	<i>S. frugiperda</i>
DP50	7.44 $\pm$ 1.33a	1.25 $\pm$ 0.36a	33.40 $\pm$ 7.60a	1.95 $\pm$ 0.50a	1.85 $\pm$ 0.84a	2.50 $\pm$ 0.73a
DP50B	0.94 $\pm$ 0.28b	1.25 $\pm$ 0.36a	3.90 $\pm$ 0.66b	2.15 $\pm$ 0.38a	1.80 $\pm$ 0.41a	2.00 $\pm$ 0.49a
DP50BII	0.00 $\pm$ 0.00b	0.13 $\pm$ 0.09b	0.30 $\pm$ 0.13b	0.00 $\pm$ 0.00b	0.40 $\pm$ 0.17b	0.55 $\pm$ 0.18b
F value	41.45	8.34	21.61	15.89	3.57	5.40
p value	$\leq$ 0.0001	0.0009	$\leq$ 0.0001	$\leq$ 0.0001	0.0349	0.0073

<sup>a</sup>Means separated using Fishers protected LSD  $p < 0.05$ , data analyzed using  $\sqrt{(y + 0.5)}$  transformation, actual means reported.

<sup>b</sup>Lepidopterous pests sampled: 23, 30 July, 6, 13 August during 2001 (df=2, 42); 15, 20, 26 July, 2, 7 August during 2002 (df=2, 54).

<sup>c</sup>Larvae greater than 1/4 inch.