

EVALUATION OF INSECTICIDES ON NON-TRANSGENIC AND TRANSGENIC B.t. COTTON CULTIVARS FOR IMPACT ON TOBACCO BUDWORM, APHIDS AND SPIDER MITES

Texas Agricultural Experiment Station, Nueces County, 2000

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SUMMARY: Tobacco budworm larval numbers were very low in all DPL 33B (transgenic B.t.) Cotton treatments, and in Tracer, Steward (.09 lb ai/acre rate) and Denim (.01 lb ai/acre rate) treated DPL 5415 (non-transgenic) cotton. Only the Tracer treatment and Denim (0.1 lb ai/acre) on 3 Jul maintained damaged terminals in DPL 5415 at a level that was not significantly different from the DPL 33B counts. These results were also reflected in damaged squares, caterpillar leaf feeding and damaged bolls. Aphid numbers were greater in the Karate treatment and lowest in the Leverage treatment. Denim at both rates provided excellent spider mite control. Lint production was adversely affected by drought which was compounded by late planting. Numerically, the DPL 33B cultivar produced more lint for each insecticide treatment compared to the corresponding DPL 5415 treatments.

OBJECTIVES: The study was a comparison between a cotton variety genetically expressing caterpillar B.t. toxin and a non-transgenic variety. The objectives were to (1) measure caterpillar numbers and a damage in varieties, (2) compare insecticides for effectiveness and (3) determine impact on cotton production.

MATERIALS/METHODS: The experiment was conducted on the Texas Agricultural Experiment Station, Meaney Annex, in Nueces County. Test varieties were planted 17 Apr 2000 in alternating 8-row plots and then subdivided for insecticide treatment in order that each foliar treatment was applied to 4 rows of DPL 5415 (non-transgenic) and 4 rows of DPL 33B (transgenic B.t.) cotton. Insecticide treatments were arranged in a randomized complete block design with 4 replications and plots were 50 ft in length with rows spaced on 38-inch centers. Cotton varieties were planted at 56,000 seed/acre in soil with marginal moisture. Total rainfall during the production season amounted to 4.84 inches with none after 18 Jun. Due to the late planting date, cotton production was adversely affected by the dry conditions. Fertilizer applied was 100-14-0 + 0.6 Zn/acre. Treflan 4HFP (1 qt/acre) was incorporated for weed control on 9 Nov 1999. Insecticides were applied to all 8 rows in each plot with a self-propelled Lee Company Spider Sprayer Trac on 16, 22 and 28 Jun in a total spray volume of 5.7 gpa through two 8X hollow cone nozzles 1 row at 40 psi at 4 mph.

Treatment effects were assessed by (1) examining 20 terminals/plot on 24 Jun and 3 Jul for heliothine eggs, larvae and damage, (2) examining 20 approximately ½ grown squares per plot on 24 Jun and 3 Jul for caterpillar damage, (3) assigning a visual caterpillar leaf feeding score (1 = none observed up to 5 = 20% leaf loss) on 2 dates, (4) determining the number of caterpillar damaged bolls in 20 examined on 1-Jul, (5) estimating average aphid numbers from 5 leaves on 7 and 10 Jul, (6) assigning a mite damage rating (1 = no damage to 5 = severe damage) by examining 5 leaves per plot on 3 and 10 Jul, (7) counting spider mites on 10 leaves and estimating % leaf damage from 10 leaves per plot on 6 Jul and, (8) harvesting 10 ft row from one of the two center rows in each 4 row plot on 4 Aug. Seed cotton was ginned on a 10-Saw Eagle laboratory machine.

RESULTS/DISCUSSION: All caterpillars examined on 24 Jun and 3 Jul were tobacco budworm but occasional beet armyworms and loopers were observed on each inspection date. Heliothine eggs, larvae, damage to terminals, and damaged square data are provided in Table 1. Egg numbers were not statistically different 2 days after the 2nd treatment (24 Jun) but they were relatively low and not evenly distributed in plots 5 days after the 3rd treatment (3 Jul). Caterpillar numbers were very low in DPL 33B (transgenic B.t.) cotton and in Tracer, Steward (.09 lb ai/acre) and Denim (.01 lb ai/acre) treated DPL 5415 cotton. These counts were not statistically different from the DPL 33B results. Only the Tracer treatment and Denim (.01 lb ai/acre) on 3 Jul maintained damaged terminals in DPL 5415 to a level not significantly different from DPL 33B counts. These results were also reflected in damaged squares with the addition of Steward at the .09 lb ai/acre rate included in the lowest damage category. Caterpillar leaf feeding damage rating was reduced compared with untreated cotton by all treatment except for Karate and Leverage (Table 2). Tracer, Steward and Denim treated DPL 5415 cotton sustained significantly less damage to bolls by caterpillars compared to the Karate, Leverage and untreated plots. Aphid numbers were greater in the Karate treatments and lowest in the Leverage treatment (Table 3). Denim at both rates provided excellent spider mite control (Tables 3 and 4). The Karate spider mite damage rating was not statistically different from Denim. Boll and lint production data are provided in Table 5. Numerically, the DPL 33B cultivar produced more lint for each insecticide treatment compared to the corresponding DPL 5415 treatments.

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Table 1. Caterpillar infestation and damage in non-transgenic (DPL 5415) and transgenic B.t. (DPL 33B) cotton cultivars treated with various insecticides, Texas Agricultural Experiment Station, Nueces County, TX, 2000.

Treatment	Rate lb ai/acre	Number/100 terminals							
		eggs		larvae		damage		% damaged squares	
		6/24	7/3	6/24	7/3	6/24	7/3	6/24	7/3
-----DPL 5415 (non-transgenic)-----									
Karate 1E	.03	22.5 a	8.75 a	11.3 cd	21.3 a	38.8 b	51.3 ab	3.8 b	16.3 b
Leverage 2.75E	.08	25.0 a	3.75 ab	13.8 bc	16.3 ab	38.8 b	57.5 a	3.8 b	12.5 bc
Tracer 4SC	.06	19.0 a	0.00 b	1.3 e	0.0 d	10.0 cd	5.0 ef	1.3 bc	0.0 g
Steward 1.25SC	.075	17.5 a	3.75 ab	20.0 ab	6.3 c	33.8 bc	45.0 bc	3.8 b	7.5 cde
Steward 1.25SC	.09	15.0 a	2.50 ab	6.3 de	2.5 cd	25.0 bc	22.5 d	1.3 bc	6.3 def
Denim 0.16EC	.0075	14.0 a	3.75 ab	1.3 e	6.3 c	23.8 bc	38.8 c	2.5 bc	11.3 bcd
Denim 0.16EC	.01	12.5 a	0.00 b	3.8 e	2.5 cd	22.5 bc	15.0 de	1.3 bc	2.5 efg
Untreated		25.0 a	0.00 b	21.3 a	15.0 b	56.3 a	60.0 a	11.3 a	28.8 a
-----DPL 33B (transgenic B.t.)-----									
Karate 1E	.03	22.5 a	5.00 ab	0 e	0 d	1.3 d	7.5 ef	0 c	1.3 fg
Leverage 2.75E	.08	22.5 a	3.75 ab	0 e	0 d	0.0 d	3.8 f	0 c	1.3 fg
Tracer 4SC	.06	16.5 a	0.00 b	0 e	0 d	1.3 d	1.3 f	0 c	0 g
Steward 1.25SC	.075	15.0 a	1.25 b	0 e	0 d	1.3 d	3.8 f	0 c	0 g
Steward 1.25SC	.09	14.0 a	1.25 b	0 e	0 d	0.0 d	3.8 f	0 c	0 g
Denim 0.16EC	.0075	11.5 a	3.75 ab	0 e	0 d	1.3 d	6.3 ef	0 c	0 g
Denim 0.16EC	.01	22.5 a	0.00 b	0 e	0 d	0.0 d	5.0 ef	0 c	0 g
Untreated		29.0 a	3.75 ab	0 e	0 d	1.3 d	10.0 ef	0 c	0 g
LSD (P = 0.05)		NS	6.32	7.46	5.12	14.91	10.22	3.685	5.88
P > F		.0689	.0357	.0001	.0001	.0001	.0001	.0001	.0001

Means in a column followed by the same letter are not significantly different by ANOVA (LSD).

Table 2. Caterpillar leaf feeding rating and damaged bolls in non-transgenic (DPL 5415) and transgenic B.t. (DPL 33B) cotton cultivars treated with various insecticides, Texas Agricultural Experiment Station, Nueces County, TX, 2000.

Treatment ^a	Rate lb ai/acre	Caterpillar leaf feeding rating ^b		% damaged bolls (7/10)
		7/3	7/10	
-----DPL 5415 (non-transgenic)-----				
Karate 1E	.03	2.50 ab	2.50 b	6.3 b
Leverage 2.75E	.08	3.00 a	3.00 a	10.0 a
Tracer 4SC	.06	1.00 e	1.00 c	0.0 c
Steward 1.25SC	.075	1.25 de	1.00 c	2.3 c
Steward 1.25SC	.09	1.25 de	1.00 c	2.3 c
Denim 0.16EC	.0075	1.00 e	1.00 c	2.3 c
Denim 0.16EC	.01	1.00 e	1.00 c	0.0 c
Untreated		2.25 bc	2.50 b	8.8 ab
-----DPL 33B (transgenic B.t.)-----				
Karate 1E	.03	1.75 cd	1.25 c	0 c
Leverage 2.75E	.08	1.00 e	1.00 c	0 c
Tracer 4SC	.06	1.00 e	1.00 c	0 c
Steward 1.25SC	.075	1.00 e	1.00 c	0 c
Steward 1.25SC	.09	1.00 e	1.00 c	0 c
Denim 0.16EC	.0075	1.00 e	1.00 c	0 c
Denim 0.16EC	.01	1.00 e	1.00 c	1.3 c
Untreated		1.50 de	1.00 c	0 c
LSD (P = 0.05)		.628	.334	2.84
P > F		.0001	.0001	.0001

Means in a column followed by the same letter are not significantly different by ANOVA (LSD).

^a Insecticides were applied 16, 22 and 28 Jun in a total spray volume of 5.7 gpa through 8x hollowcone nozzles at 40 psi at 4 mph.

^b Caterpillar leaf feeding ratings range from 1 = none observed up to 5 = 20% leaf loss.

Table 3. Aphid and mite damage in non-transgenic (DPL 5415) and transgenic B.t. (DPL 33B) cotton cultivars treated with various insecticides, Texas Agricultural Experiment Station, Nueces County, TX, 2000.

Treatment ^a	Rate lb ai/acre	Aphids/leaf		Mite da. rating ^b	
		7/3	7/10	7/3	7/10
-----DPL 5415 (non-transgenic)-----					
Karate 1E	.03	46.3 a	2.3 a	1.0 c	1.3 d
Leverage 2.75E	.08	0.5 g	0 b	3.3 b	2.8ab
Tracer 4SC	.06	4.3 fg	0 b	4.0 ab	3.0 ab
Steward 1.25SC	.075	15.3 bc	0 b	3.5 ab	3.0 ab
Steward 1.25SC	.09	13.8 bcd	0 b	4.3 a	2.8 ab
Denim 0.16EC	.0075	4.5 fg	0 b	1.0 c	1.0 d
Denim 0.16EC	.01	5.5 efg	0 b	1.0 c	1.0 d
Untreated		10.0 cdef	0 b	3.8 ab	3.3 a
-----DPL 33B (transgenic B.t.)-----					
Karate 1E	.03	20.0 b	0 b	1.3 c	1.5 cd
Leverage 2.75E	.08	0.0 g	0 b	3.3 b	2.3 bc
Tracer 4SC	.06	4.0 fg	0 b	3.8 ab	3.5 a
Steward 1.25SC	.075	16.5 bc	0.3 b	4.3 a	3.3 a
Steward 1.25SC	.09	13.3 bcde	0 b	3.8 ab	2.8 ab
Denim 0.16EC	.0075	2.8 fg	0 b	1.0 c	1.3 d
Denim 0.16EC	.01	6.0 defg	0 b	1.3 c	1.0 d
Untreated		7.3 defg	0 b	4.3 a	3.3 a
LSD (P = 0.05)		7.794	^c	.834	.848
P > F		.0001	.0159	.0001	.0001

Means in a column followed by the same letter are not significantly different by ANOVA (LSD).

^a Insecticides were applied 16, 22 and 28 Jun in a total spray volume of 5.7 gpa through 8x hollowcone nozzles at 40 psi at 4 mph.

^b Mite damage ratings range from 1 = no damage to 5 = severe damage.

^c The P > F is based on transformed, [square root (x + 1)] , data values; it is inappropriate to list LSD values based on transformed data.

Table 4. Spider mite number and percentage leaf damage in DPL 5415 cotton treated with various insecticides for caterpillars, Texas Agricultural Experiment Station, Nueces County, TX, 2000.

Treatment ^a	Rate lb ai/acre	Spider mites ^b	
		No./10 leaves	% leaf damage ^c
Leverage 2.75E	.08	59.5 a	45.25 a
Tracer 4SC	.06	32.0 b	44.25 a
Denim 0.16EC	.0075	0.0 c	0.22 b
Denim 0.16EC	.01	0.3 c	0.88 b
Untreated		38.8 b	41.00 a
LSD (P = 0.05)		14.62	5.175
P > F		.0001	.0001

Means in a column followed by the same letter are not significantly different by ANOVA (LSD).

^a Insecticides were applied 16, 22 and 28 Jun in a total spray volume of 5.7 gpa through 8x hollowcone nozzles at 40 psi at 5 mph.

^b The spider mite population had declined significantly by this evaluation date (6 Jul).

^c Leaf damage is % of the leaf damaged by spider mite feeding based on an average of 10 leaves/plot.

Table 5. Cotton production in non-transgenic (DPL 5415) and transgenic B.t. (DPL 33B) cotton cultivar treated with various insecticides, Texas Agricultural Experiment Station, Nueces County, TX, 2000.

Treatment ^a	Rate lb ai/acre	Bolls (1000's/acre)		% lint	Lint lb per acre
		Green	Harvested		
-----DPL 5415 (non-transgenic)-----					
Karate 1E	.03	39.9 ab	104 ef	38.5 ab	265 e
Leverage 2.75E	.08	46.1 a	101 f	38.2 ab	257 e
Tracer 4SC	.06	31.4 a-c	130 b-f	38.2 ab	304 de
Steward 1.25SC	.075	26.1 b-e	148 a-e	39.1 ab	357 a-e
Steward 1.25SC	.09	22.0 b-f	145 b-f	38.7 b	337 b-e
Denim 0.16EC	.0075	21.3 c-f	161 a-d	38.8 ab	386 a-d
Denim 0.16EC	.01	27.9 b-d	116 d-f	39.3 a	324 cde
Untreated		28.9 a-d	121 c-f	37.7 ab	311 cde
----- DPL 33B (transgenic B.t.) -----					
Karate 1E	.03	9.6 ef	162 a-c	35.3 c	365 a-e
Leverage 2.75E	.08	17.9 c-f	174 ab	35.2 c	406 a-d
Tracer 4SC	.06	15.5 c-f	171 ab	35.0 c	361 a-e
Steward 1.25SC	.075	8.9 ef	170 ab	35.6 c	440 ab
Steward 1.25SC	.09	12.4 d-f	166 a-c	35.4 c	366 a-e
Denim 0.16EC	.0075	6.9 f	175 ab	35.4 c	455 a
Denim 0.16EC	.01	5.9 f	191 a	35.5 c	417 abc
Untreated		13.8 c-f	154 a-d	35.7 c	359 a-e
LSD (P = 0.05)		17.95	33.79	1.37	109.9
P > F		.0001	.0003	.0001	.0027

Means in a column followed by the same letter are not significantly different by ANOVA (LSD).

^a Insecticides were applied 16, 22 and 28 Jun in a total spray volume of 5.7 gpa through 8x hollowcone nozzles at 40 psi at 4 mph.