AGRONOMIC EVALUATION OF TRANSGENIC COTTON VARIETIES IN DELICIAS, CHIH., MEXICO

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Abstract

This research was carried out during 1998 to agronomicaly and phenologicaly evaluate four Bt cotton varieties and one conventional cotton variety in Delicias, Chih., México. Weeds and insect (except pinkworm and bud/bollworm) control, fertilizer management, and furrow irrigation were given as needed according to Delicias Region cotton production recommendations. In general, all varieties had similar behavior in plant height, main-stem nodes number, and fully-extended leaves number. DP-33B, DP-90B, and DP-32B obtained the highest yield because they accumulated high numbers of squares and bolls before boll weevil incidence. In contrast, DP-35B and DP-5690 concentrated most of their squares and bolls during boll weevil incidence.

Introduction

Cotton crop is one of the most important crops in the Region of Delicias-Ojinaga, Chih. During 1998, 12,525 ha were planted with this crop. In spite of this fact, the incidence of insect pests as boll weevil (*Anthonomus grandis* Boheman), bollworm (*Helicoverpa zea*), tobacco budworm (*Heliothis virescens*), and armyworm (*Spodoptera frugiperda*) have limited the cotton production. In order to avoid cotton damage by insect pests, it was necessary to evaluate new germ plasm tolerant to insects and able to escape to them. There are two important aspects to consider: earliness and genetic resistance to insect pests.

According to Meredith (1998), earliness represents a good alternative to escape insect and weather cotton losses and to reduce dependency on insecticides. At this point, it is considered that growth and development vary from area to area; however, the rate of growth is related to degree days and should be fairly constant. One of the measures of degree days is DD60s. DD60s measure the amount and rate of growth based solely on temperature at 60º F (Zelinski, 1995). As people think, plants will grow in response to DD60s and not to days after planting. In this context, earliness could be determined based on the number of DD60s accumulated to first bloom. When insect incidence and weather are taken in account, maybe those varieties that reach their maximum number of bolls opened before should be considered more precocious.

In relation to genetic resistance to insect pests, the use of transgenic Bt cotton varieties offers a great potential for protecting the crop, reducing dependency on insecticides, and reducing cost of production in a friendly environment. Thus, Blake et al. (1997) mentioned that the delta endotoxin of *Bacillus thuringiensis kurstaki* contained in Bt cotton is highly specific and non toxic to higher animals. Leonard et al. (1998) mentioned that all transgenic Bt cotton lines evaluated in Louisiana from different seed companies controlled the bollworm and tobacco budworm.

The objective of this research was to agronomicaly and phenologicaly evaluate four Bt cotton varieties versus one conventional cotton variety in Delicias, Chih., México.

Materials and Methods

Five cotton varieties were planted at the Experimental Station of the Faculty of Agricultural and Forestry Sciences, University of Chihuahua in Delicias, Chih., México on April 8, 1998. These varieties were categorized into transgenic Bt cotton (DP-33B, DP-32B, DP-90B, and DP-35B) and non-transgenic Bt cotton (DP-5690). Data (plant height, number of main-stem nodes per plant, number of fully-extended leaves per plant, number of squares per plant, and number of bolls per plant) were taken 72, 87, 94, 111, and 140 days after planting (DAP). Cotton yields (ton/ha and bales/ha) were considered at the time of harvesting. The experiment was analyzed as a randomized complete block design with 10 replicates and using the Tukey's Multiple Range Test at the 0.05 level of probability. The useful plot consisted of two rows, 10 m in length, spaced 0.90 m apart with 5 plants m^{-2}. Weeds and insect control, fertilizer management, and furrow irrigation were given as needed according to Delicias Region cotton production recommendations. Both pinkworm and bud/bollworm were not chemically controlled because this fact was a part of an additional study.

Results and Discussion

Plant Height (cm)

In general, DP-35B obtained the highest plant height in all dates of evaluation followed by DP-5690 and DP-33B. The lowest plant height corresponded to DP-32B (Table 1). As it will be seen later, not only DP-35B but also DP-5690 obtained the lowest yields considering that DP-5690 is the recurrent parent of DP-35B. It means that yield and plant height might be positively correlated.

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Number of Main-Stem Nodes

Practically, there were no significant differences in the number of main-stem nodes among varieties in the different dates of evaluation (Table 2). However, before 140 days after planting, DP-35B showed the highest values for this trait.

Number of Fully-Extended Leaves

In general, this trait shows the same tendency that number of main-stem nodes (Table 3). DP-5690 had the lowest number of fully-extended leaves. In fact, this variety had less leaf area that the others varieties which probably explains the lowest yield shown in Table 6.

Number of Squares

There were significant differences among varieties at 72 DAP, 94 DAP, and 111 DAP. In addition, before 140 DAP, DP-33B shown the highest values in the number of squares followed by DP-32B, and DP-90B (Table 4). Also, the early season to first bloom for this varieties compared to DP-35B and DP-5690 suggests earliness. This fact is strongly related with a high incidence of boll weevil at 140 DAP which explains the high yield obtained by these varieties (Table 6).

Number of Bolls

This trait follows the same tendency than the number of squares (Table 5). It is important to mention that the high value of number of bolls obtained by DP-35B and DP-5690 at 140 DAP does not reflect a high yield. By the contrary, as was described before, the boll weevil incidence seriously affected the DP-35B and DP-5690 yields.

Yield

Cotton yield (ton/ha and bales/ha) is reported in Table 6. There were significant differences among varieties. DP-33B, DP-90B, and DP-32B do not statistically differed among them. Transgenic Bt varieties numerically and statistically overcame to DP-5690. The highest yield was obtained by DP-33B and DP-90B due to their earliness, better leaf area efficiency (data not shown), and ability to escape from boll weevil damage.

References

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Table 1. Mean plant height (cm) by variety related to days after planting (Delicias, Chih., México. 1998).

Variety	Days after planting				
	72	87	94	111	140
DP-33B	37.6 bc	54.8 b	73.0 bc	84.1ab	83.5ab
DP-90B	42.3 bc	57.8ab	72.3 bc	84.4ab	83.8ab
DP-32B	37.0 c	51.7 b	66.9 c	74.7 b	75.8 b
DP-35B	48.2a	70.2a	86.1a	94.7a	92.0a
DP-5690	42.4 b	66.0a	80.1ab	83.9ab	82.8ab

Means within a column followed by the same letter are not significantly different.

Table 2. Mean main-stem nodes number by variety related to days after planting (Delicias, Chih., México. 1998).

Variety	Days after planting				
	72	87	94	111	140
DP-33B	9.8a	12.5ab	15.6a	19.6a	19.0a
DP-90B	9.2a	11.8ab	15.1a	18.8a	17.7a
DP-32B	9.5a	11.5 b	14.7a	19.1a	19.6a
DP-35B	11.2a	14.0a	16.5a	20.0a	19.5a
DP-5690	9.2a	13.6ab	15.4a	17.3a	17.3a

Means within a column followed by the same letter are not significantly different.

Table 3. Mean fully-extended leaves number by variety related to days after planting (Delicias, Chih., México. 1998).

Variety	Days after planting				
	72	87	94	111	140
DP-33B	49.4a	67.4a	86.0a	104.8ab	85.5ab
DP-90B	36.7bc	54.9a	74.0a	88.7ab	77.3ab
DP-32B	46.3ab	64.4a	75.2a	78.0 b	81.8ab
DP-35B	52.9a	76.4a	99.2[a]	119.8a	96.7a
DP-5690	32.8c	58.7a	72.9a	73.6 b	62.7 b

Means within a column followed by the same letter are not significantly different.

Table 4. Mean squares number by variety related to days after planting (Delicias, Chih., México. 1998).

Variety	Days after planting				
	72	87	94	111	140
DP-33B	22.8a	27.4a	33.3a	22.5a	1.0a
DP-90B	13.0 b	26.1a	22.1 b	13.9ab	0.6a
DP-32B	15.4 b	23.2a	21.4 b	11.5 b	0.4a
DP-35B	14.6 b	23.8a	24.1 b	15.6 b	0.3a
DP-5690	9.6 b	20.9[a]	20.0 b	9.2 b	0.1a

Means within a column followed by the same letter are not significantly different.

Table 5. Mean bolls number by variety related to days after planting (Delicias, Chih., México. 1998).

Variety	Days after planting				
	72	87	94	111	140
DP-33B	0	2.9a	9.5ab	24.7a	22.1 c
DP-90B	0	2.5a	9.7ab	23.9ab	19.7 c
DP-32B	0	2.9a	11.0a	18.8ab	19.8 c
DP-35B	0	1.8a	5.3 b	19.9ab	126.8a
DP-5690	0	3.1a	7.6ab	16.6 b	90.6b

Means within a column followed by the same letter are not significantly different.

Table 6. Cotton yield by variety (Delicias, Chih., México. 1998).

Variety	Ton/ha	Bales/ha
DP-33B	6.084a	10.139a
DP-90B	5.842ab	9.737ab
DP-32B	5.540ab	9.234ab
DP-35B	5.334 b	8.889 b
DP-5690	4.699 c	7.831 c

Means within a column followed by the same letter are not significantly different.