Performance of native insect-based resistant corn exposed to corn earworm (H. zea) and fall armyworm (S. frugiperda)

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Abstract

Native insect resistance in corn can add durability to the current transgenic commercial varieties that are resistant to corn earworm (Helicoverpa zea Boddie) and fall armyworm (Spodoptera frugiperda L.E. Smith). Several breeding lineages at Texas A&M have putative insect resistance based on observations from field breeding nurseries. To verify native insect-based resistance, nine nontransgenic bred corn lines and six hybrid comparators (one being a Bt-hybrid) was evaluated in an open field to assess their susceptibility to corn earworm and fall armyworm feeding and their agronomic performance (yield). Putative insect resistance was confirmed by lower ear and leaf damage to nontransgenic lineages when compared with Bt-hybrid comparators. The benefits of nontransgenic bred lines and hybrids were observed, with differences attributed to hybrid vigor and not related to insect damage. Overall, native insect-based resistance was confirmed among the nontransgenic bred lines and hybrids as expressed by lesser corn earworm damage to the ears, and the most resistant lineages have been identified for entry into a corn breeding program to improve their agronomic performance.

Introduction

The damaging effects of larvae of the corn earworm (H. zea) and fall armyworm (S. frugiperda) on corn decreases yield and is problematic due to the high cost of repeated insecticide applications and variable efficacy. Insecticide use and economic control of the larvae is seldom recommended and achieved in commercial field corn (Biles et al., 2010). Plant resistance is a viable alternative in controlling corn earworm and fall armyworm (Abel et al., 2008). The benefits of insect-based resistant plants include environmental safety and target specificity. Transgenic Bt-corn resistant to leaf and ear feeding lepidopteran insects are available (Castro, 2002). Here, we consider native insect-based resistant corn to these pests as a means to add durability to current transgenic Bt-corn.

Objective

Evaluate nine nontransgenic bred corn lines and six hybrid comparators (one being a Bt-hybrid) in an open field to assess their insect susceptibility to corn earworm and fall armyworm feeding and their agronomic performance (yield).

Experimental Approach

Design/Analysis:

Randomized Complete Block, 4 Replications,
Duncan's Mean separation when P=0.05 for
the entry main effect.

Entries:

9 nontransgenic bred lines and 6 hybrids
(one a Bt-hybrid) (Table 1)

Planting Date:

April 10, 2012

Plot:

2 rows[38 in.] X 27 ft.

One row used for in-season insect feeding measurements
The other row reserved for harvest to evaluate agronomic quality

Insect Feeding Measurements:

Foliar: Fall armyworm feeding damage was evaluated using the 0-9 leaf feeding scale, Guthrie et al. (1960) on 20 random plants of each plot every two weeks beginning whorl stage and continuing to beginning of silking (Fig. 1).

Ear: Corn earworm feeding damage was measured by
(1) Deepest penetration of corn earworm larva (length from ear tip to the deepest feeding damage, milk to soft dough stage (Fig. 2).)
(2) Area of kernel feeding damage, milk to soft dough stage (Fig. 3).

Plant Measurements:

Yield (adjusted to 15% moisture) (Fig. 4), hand harvested, thrashed, and analyzed using Dickey-john GAC 500XT

Table 1: Corn Entries with corresponding lineage information.

Results: Insect Feeding Damage

Leaf Damage Pre-Tasseling

Fig. 1: Fall armyworm feeding was light with an average damage score of 1.15 to 3.33 among the lineages and hybrids. Consequently no differences among entries were detected (P=0.22).

Depth of Ear Damage

Fig. 2: A significant difference in deepest penetration of the ear was observed across the entries (P=0.0001). Deepest penetration ranged from 7.53 to 1.61 cm of ear feeding damage. Putative resistance was confirmed and significantly lowest in the nontransgenic line Entre 6 with 2.77 cm of damage along with the Bt-hybrid comparator Entre 14, which received 1.61 cm of damage.

Area of Ear Damage

Fig. 3: A significant difference in the total area of ear feeding damage was observed across the entries (P=0.0001). Pre-harvest ear damage ranged from an average of 1.44 to 14.16 cm² per ear. Putative resistance was confirmed by significantly lowered feeding area damage to nontransgenic line Entre 6 (3.38 cm²) and Bt-hybrid comparator Entre 14 (1.44 cm²).

Results: Agronomic Quality

Fig. 4: The yield (lbs/acre) adjusted to 15% moisture expressed a significant difference across the entries (P=0.0001), in which hybrid comparators consistently out performed the nontransgenic lines. Hybrid Entries 19, 16, and Bt-hybrid 14 expressed the highest yields (2318.57, 2154.04, and 2052.6 lbs/acre) compared to nontransgenic bred line Entries 6, 4, and 3 (668.50, 614.70, and 601.6 lbs/acre).

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Literature Cited

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