BEHAVIORAL RESPONSE OF TWO STRAINS OF FALL ARMYWORM (*SPODOPTERA FRUGIPERDA* [J.E. SMITH]) ON DUAL-TOXIN BT COTTONS

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Abstract

Two morphologically identical host strains of FAW, fall armyworm (J. E. Smith), exist that differ in plant host use, although both strains can be found in cotton. Little is known about interplant movement and damage potential of FAW larvae from either host strain in cotton, particularly second-generation Bt cotton. Thus, a field study was designed to determine possible behavior differences between the corn- and rice-strains of FAW on non-Bt, Bollgard II, and WideStrike cotton. Third-instar FAW were placed individually onto either white flowers or 7-d-old bolls on individual cotton plants of each variety and were evaluated at 6, 24, and 48 h after infestation. Comparison of larval movement away from infested reproductive structures did not differ among strains, cotton varieties, infested reproductive structure, or time after infestation. An interaction was found with regard to the level of feeding damage to reproductive structures. No difference in damage was found between FAW host strains when infested on non-Bt white flowers or bolls. Averaged across host strains, significantly more structures were damaged at 24 and 48 h after infestation than at 6 h after infestation. For white flowers infested in Bollgard II, the corn-strain caused more damage to reproductive structures at 48 h compared to damage by either strain at other evaluation periods. No differences were observed with regard to FAW damage potential for infested Bollgard II bolls or for infested white flowers or bolls of WideStrike. These results indicate that behavioral differences of the FAW host strains may be difficult to identify on cotton. However, damage to reproductive structures was found in all cotton varieties, particularly for the corn-strain.

Introduction

The fall armyworm (J. E. Smith) is a highly polyphagous pest that causes economic damage to a number of field crops in the U.S. each year. Its polyphagous nature is due to the presence of two morphologically identical host strains, the corn- and rice-strain (Pashley 1986). The corn-strain is typically associated with field corn and grain sorghum, while the rice-strain is associated more with turf. However, these two strains can be found infesting the same crops, including cotton (Nagoshi et al. 2007). Most of the FAW infesting cotton are corn-strain individuals. However, the rice-strain can often be found moving from grassy weeds onto cotton once weeds are killed with herbicides. This phenomenon poses questions about the behavior and damage potential of these two strains on cotton, particularly second-generation Bt cottons such as Bollgard II and WideStrike. Efficacy studies have demonstrated that these Bt cotton technologies provide better control of FAW compared to non-Bt cotton. However, damage to reproductive structures has been observed in both technologies. Differences in susceptibility to insecticides and first-generation transgenic cotton has been observed between the FAW host strains (Adamczyk et al. 1997). Thus, the objective of this study was to identify potential behavioral differences between host strains of FAW regarding movement from infested reproductive structures and damage caused to these structures in second-generation Bt cotton.

Materials and Methods

Cotton varieties consisted of Non-Bt (PHY425), Bollgard II (ST4554), and WideStrike (PHY485).

FAW Host Strains: Corn-strain (collected from field corn) and rice-strain (collected from broadleaf signalgrass).
A single third-instar FAW was infested individually into white flowers or onto 7-d-old bolls on 10 singe plants of each variety.

Whole plant inspections were made at 6, 24, and 48 h after infestation for FAW larvae. Records consisted of structure infested, number of vertical nodes moved, and damage to reproductive structures. The study consisted of 3 replicates.

Results and Discussion

No differences were observed with regard to FAW host strain behavior as measured by interplant movement of larvae away from infested reproductive structures in cotton (Table 1). All recorded movement was below the infested structure. Very little movement was noted at 6 h after infestation and FAW larvae moved only about an average of 1 vertical node below the infested structure at 48 h after infestation. Table 1 showed a possible trend of more movement by the corn-strain on the various cotton varieties. However, percent recovery was considerably higher for the corn-strain (42%) compared to the rice-strain (23%). It is possible that the level of movement was affected by the low recovery rate of the rice-strain.

Table 1. Average number of vertical nodes moved by third-instar fall armyworms across infestations sites (white blooms and bolls)

		Hours after infestation		
Variety	FAW Strain	6	24	48
Non-Bt	Corn	0.5	1.3	1.0
Non-Bt	Rice	0.1	0.5	0.1
Bollgard II	Corn	0.0	0.8	0.8
Bollgard II	Rice	0.0	0.3	0.2
WideStrike	Corn	0.0	0.3	1.3
WideStrike	Rice	0.0	0.8	0.8

No significant differences were detected (Fisher's Projected LSD, P≤0.05).

An interaction was found with regard to the level of feeding damage to reproductive structures. No difference in damage was found between FAW host strains when infested onto bolls of non-Bt, Bollgard II, or WideStrike cotton. This is likely due to the reduced recovery of FAW larvae infested onto bolls. FAW larvae remained on white flowers longer than bolls; thus, only data for white blooms are presented in tables. In Bollgard II cotton, the corn-strain caused 20% damage to reproductive structures at the 48-h evaluation (Table 2).

Table 2. Percent damage to developing bolls by third-instar fall armyworms infested into white blooms of Bollgard II cotton.

FAW Strain	Hours after infestation	% Boll Damage
Rice	6	0.0 b
Corn	6	0.0 b
Rice	24	0.0 b
Corn	24	0.0 b
Rice	48	0.0 b
Corn	48	20.0 a

Means within the same column and followed by the same letter are not significantly different (Fisher's projected LSD, P<0.05).

No damage was recorded at earlier evaluation periods for the corn-strain or at any evaluation for the rice-strain. Averaged across FAW host strains, significantly more reproductive structures in non-Bt cotton were damaged at 24 and 48 h after infestation than at 6 h after infestation (Table 3).

Table 3. Percent damage to developing bolls by third-instar fall armyworms infested into white blooms of non-Bt cotton.

	Hours after infestation			
FAW Strain	6	24	48	Avg
Corn	0.0	23.3	33.3	18.9 a
Rice	0.0	3.3	6.7	3.3 a
Avg	0.0 b	13.3 a	20.0 a	

Means within the same column or row and followed by the same letter are not significantly different (Fisher's Projected LSD, P≤0.05).

No differences were observed between FAW host strains with regard to damage potential in non-Bt cotton. No differences in damage potential were observed between FAW host strains in WideStrike cotton, although only the corn-strain fed on reproductive structures (Table 4). In addition, no differences were observed in time of evaluation in WideStrike cotton when averaged across strains.

Table 4. Percent damage to developing bolls by third-instar fall armyworms into white blooms of WideStrike cotton.

	Hours after infestation			
FAW Strain	6	24	48	Avg
Corn	0.0	6.7	10.0	5.5 a
Rice	0.0	0.0	0.0	0.0 a
Avg	0.0 a	3.3 a	5.0 a	

Means within the same column or row and followed by the same letter are not significantly different (Fisher's Projected LSD, P≤0.05).

Summary

These results indicate that behavioral differences of the FAW host strains may be difficult to identify in cotton, particularly based on larval movement or distribution. However, differences may be evident by evaluating damage caused to reproductive structures. Damage to reproductive structures was found in all cotton varieties with the corn-strain causing more damage (although not significant) to each variety. The rice-strain of FAW caused no damage to reproductive structures in Bollgard II or WideStrike cotton. Additional work is needed in this area to identify potential behavioral differences between the host strains of FAW. Identification of behavioral differences could impact control decisions in cotton.

References

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