Comparison of Insect Damage, Aflatoxin, and Yields of Corn Hybrids Grown in South Texas

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Introduction

The summers in South Texas are usually characterized by high temperatures, variable rainfall, and a large pest presence. Corn planted under these conditions raises plant stress resulting in increased host susceptibility to pathogens (Hedayati, 2007). Increased plant stress can also induce attack from Lepidopteran species to be a source of *A. flavus* inoculum and promote inoculum production (Diener, 1987). Modern seed developers have sought to combat these issues by developing and incorporating genetic traits designed to reduce damages and improve yields. However, comparisons of the cost to benefit aspect of these traits require an objective evaluation. Under the conditions tested there may be no yield advantage of Bt hybrids in comparison with their conventional counterparts. The only exception was in hybrids that incorporated DroughtGard and Bt technology.

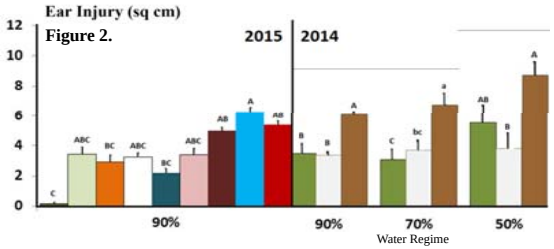
Materials and Methods

Figure 1.

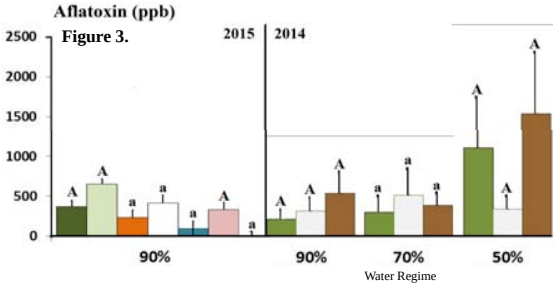
	Hybrid		Value-Added Trait	Bt Protein	Drought Tolerance	Days to Maturity
2014	DK 66-97		GENVT2P	cry1A.105 x cry 2Ab2	N/A	116
	DK 65-81		GENDGVT2P	cry1A.105 x cry2Ab2	DroughtGard	115
	DK 66-94		RR	N/A	N/A	116
2015	NK N78S		3111	cry1Ab x vip3Aa20	N/A	116
	DK 64-69		GENVT3P	cry1A.105 x cry 2Ab2	N/A	114
	BH 8688		DG2P	cry2Ab2	DroughtGard	114
	DK 65-81		GENDGVT2P	cry1A.105 x cry 2Ab2	N/A	115
	DK 62-08		GENSS	cry1A.105 x cry1Fa2 x	N/A	112
	BH 8700		SS	cry1A.105 x cry1Fa2 x	N/A	115
	DK 67-55		RR2	N/A	N/A	117
	BH 8700		RR	N/A	N/A	115
	NK N78S		GT	N/A	N/A	116

We compared ear injury, aflatoxin levels, and yield/economic value of 3 hybrids in 2014; along with 9 hybrids in 2015 that varied in Bt-based insect protection and drought tolerance (see Figure 1). These were also grown under three water stress conditions as well. Late plantings occurred the first week of April in both 2014 and 2015 in order to increase natural insect ear feeding pressure. Measurements were taken for insect injury on both leaves and ears. Soil moisture monitoring verified the water-limiting conditions in both trials. For insect and plant growth evaluation, the inner rows of each plot were used for non-destructive plant injury and yield evaluations. The outer rows were used for initial detection and identification of larvae as well as for damage. For yield, primary ears was harvested by hand, threshed, and grain yield adjusted to 15% moisture content. For each two-row plot, one row was designated for in-season evaluations of plant stress, damage from insects, environmental stress (wind, heat, and low soil moisture) with the other row being reserved for harvest to evaluate aflatoxin content and yield/agronomic performance. Hybrids grown in 2014 were manipulated by above ground drip irrigation to achieve three water regimes: non-limiting water conditions targeting ~90% crop ET replacement, slightly to moderately limiting water conditions targeting 70% crop ET, and moderately to severely limiting water conditions targeting 50% crop ET. Results from 2015 did not include water regime treatments since rainfall was abnormally high, preventing water levels from being manipulated. An analysis of variance (ANOVA) was performed for the insect, aflatoxin, and yield data. Some hybrid and water regime interactions were observed, and most variation seen across water regimes in 2014; therefore hybrid means comparisons were done within water regimes (see letters in graphs), and water regimes were compared averaging across hybrids (see horizontal bars in graphs).

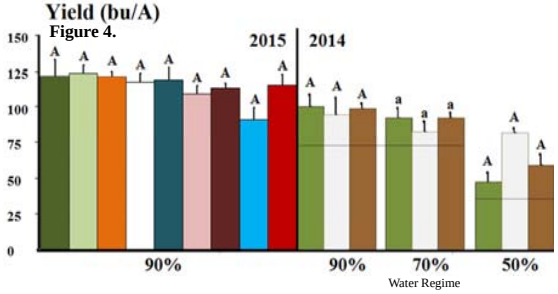
Results



Ear injury caused by the fall armyworm and the corn earworm in 2015 was highly variable, although NK N78S 3111 (far left, green color) had significantly less ear injury than the other hybrids. In 2014 insect damage increased as water stress increased, with the 50% crop ET treatment showing significantly more ear injury than the other water stress levels. The exception to this rule is the DK 65-81 with DroughtGard and Bt technology, which remained relatively consistent in ear injury through varying levels of water stress. The benefits of the Bt technology used for insect control did not appear to provide substantial economic benefit under the moderate pressure recorded in 2014. Sensitivity to insect feeding may be occurring under heavy water stress, we see the pattern but its significance remains intangible.

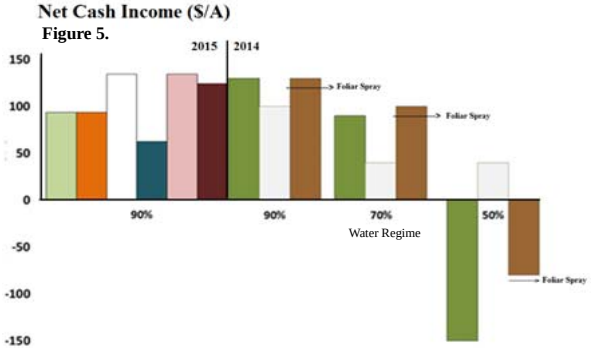


In 2014 aflatoxin levels increased as water availability decreased except again for DK 65-81 GENDGVT2P which has the DroughtGard trait. In 2015 aflatoxin levels were extremely variable and levels commonly exceeded levels of commercial concern. Aflatoxin levels in 2015 were unusually high and extremely variable, one possible explanation for this is that *A. flavus* was distributed in a nearby plot and this may have elevated our aflatoxin levels.



Results continued

In years when water is abundant all varieties, with a few exceptions, perform at a similar scale in yield, insect resistance, and amounts aflatoxin produced. In 2015, under low water stress, all hybrids produced 90 to 125 bu/acre corn with no differences detected. In 2014, hybrid yields grown under 70% to 90% crop ET water replacement had fairly consistent yields. However, the yields were lower when grown under irrigation targeting 50% crop ET. In 2014 Bt traits had similar yields under all levels of water stress.



In 2015 BH 8700 had the highest net cash income when water was non-limiting (~90%), followed by DK 65-81. NK 78S GT beat DK 66-94 for third highest net income after adding in the cost of the foliar spray. When water was severely limited (50%) foliar spray The benefits of the Bt technology used for insect control did not show consistent economic benefit under the moderate pressure recorded in both years, including NK N78S3111 which had reduced ear injury but a higher seed cost than other hybrids. DK 65-81 was the only hybrid that maintained profitability under severely limiting crop ET (~50%).

Conclusion

In areas that have limited irrigation or rainfall, DroughtGard technology should be considered an option due to its consistency in yield, aflatoxin levels, and insect injury during drought conditions. The benefits of the Bt technology used for insect control did not appear to provide substantial economic benefit under the moderate pressure recorded. There was no apparent relationship between aflatoxin and ear injury. Highly variable and abnormally high aflatoxin levels inhibited our ability to detect significance between ear injury and aflatoxin production.

References

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Acknowledgements

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