Rolling with Bowling

South Texas Field Crop and Pasture Entomology News and Views

July 10, 2016 Vol. 1 Edition 6

Two years ago I moved to south Texas to start a new challenge in my life working as a field crop entomologist. Much of my two years has been filled with challenges managing sugarcane aphid in sorghum. It has been a fast and furious couple of years but I think we have made many excellent strides in finding solutions toward managing this new aphid pest for south Texas sorghum producers.

The most challenging part for me has been cotton. My background has been corn and sorghum in the northern High Plains of

Late instar cotton bollworm, *Helicoverpa zea*, feeding on flower of Bt cotton (Photo by Jason Thomas).

Texas (irrigated corn that was intensely managed to achieve high yield). Not only is cotton new to me but the insect complex in cotton is unique from cotton grown on the northern High Plains in Texas.The stink bug complex was never an issue with the northern High Plains cotton producers. However, I am familiar with CEW/Sorghum Headworm/Cotton bollworm Bollworm but it was primarily a pest in corn and sorghum. In field corn it was rarely, rarely considered an economic pest and farmers never treated them with an insecticide.

One thing south Texas farmers deal with that northern Panhandle farmers don't is multiple genertions of *H. zea* **each** year. In the two seasons I have been here the bollworm has flared in Bt cotton. In 2015 bollworm infestations in Bt cotton were very spotty and easily written off as unusually large populations occurring in mid to late-June. Much of the cotton was seeded late because of record rainfall through the first five months of the season. By late-June/early July the region was enveloped in a drought. In 2015, everything about south Texas production agriculture was certainly unusual.

Dry conditions dominated south Texas in the fall of 2015 and throughout the winter of 2016. Consequently, in the current year, soil temperatures were optimal for early planting in south Texas and into the Lower Rio Grande Valley. Many farmers got an early jump on the season and cotton was seeded in what would be considered a usual time frame. This year cotton in south Texas and in the Valley has been under very little stress (until recently) unlike some of the cotton in the upper Gulf Coast which was growing in saturated soils and standing water…certainly not the best thing for cotton.

The progression of *H.zea* has been interesting to watch this season. Corn acres were way up in south Texas and Rio Grande Valley. This provided an early season host for *H. zea*. Although their populations were not considered large in corn, their movement

and infestations in sorghum was quite large and many fields exceeded the economic threshold for headworm (mainly H. zea). Most sorghum was treated with a pyrethroid to suppress headworm infesting sorghum. The pyrethroids provided an acceptable level of headworm suppression (70% or greater). The next generation moved to cotton and *H. zea* has certainly made its presence known in cotton!

<u>Bollworm in Bt cotton</u>: From this point forward I will refer to *H. zea* as bollworm. In mid- to late-June reports of economic bollworm populations in Widestrike cotton started filtering my way. Unusually large bollworm populations and egg loads were reported around the area and larval populations sometimes exceeded 20% in Widestrike cotton in south Texas. However, there were also many reports of bollworm infestations well below 20% in Widestrike cotton. About a week after the first reports of bollworm in Widestrike cotton, I started receiving reports of economic bollworm populations in Twinlink cotton. We collected bollworm from a Widestrike field. It took us about two hours to collect 35 larvae (3 of us were making collections). "Six people hours" to collect only 35 larvae might suggest that there was not an economic infestation in this Widestrike field. Most bollworm were second and third instar but we found a few 4th and 5th stage bollworm in the same cotton field (images appearing in this newsletter were taken in the Widestrike cotton where samples were collected). Most of the larvae were in the bloom tags (top of plant and tissue where protein expression tends to be lowest in the plant) but larger worms were feeding on and in bolls.

It is common knowledge that the proteins expressed in Widestrike cotton are less effective than other Bt technologies against cotton bollworm. It was a little

Late instar cotton bollworm, *Helicoverpa zea*, feeding on anthers of Bt cotton (Photo by Jason Thomas).

surprising that Twinlink cotton had economic populations of bollworm but, again, it could be written off as unusually large bollworm populations. Personally, given the unusally large population of bollworm in cotton, I was somewhat surprised we did not receive more reports of infestations in all of the Bt cotton technologies. I never heard of BollGard II cotton treated for bollworm in south Texas (although it is possible a few fields may have been treated).

Bollworm insecticide treatments in Bt cotton consisted of several insecticides but most fields were treated with a pyrethroid (a lot of bifenthrin was applied to these fields). Most applications provided an acceptable level of suppression (60% or

greater) while some pyrethroid applications were considered unacceptable necessitating a second insecticide application. I will talk about pyrethroids toward the end of this letter.

For arguments sake, I will put in my five-cents worth on the possible explantions of increasing bollworm populations in Bt cotton grown in south Texas.

Large *H. zea* populations: In 1995 or 1996 I recall economic populations of bollworm on BollGard (cry1Ac) cotton in

Late instar cotton bollworm, *Helicoverpa zea*, feeding on bracts of Bt cotton (Photo by Jason Thomas).

south Texas. This was the second or third year that the technology was commercially available to farmers. Naysayers were hollering resistance in bollworm after two years of Bt cotton commercialization. In its best days the protein killed 85% to 90% of bollworm based on work done by Benedict and Sachs. Unusually heavy populations of bollworm were the leading factor contributing to control failures and, in subsequent years, the population returned to a "normal" level and the issue was very quiet until recent events have renewed concerns around increasing bollworm populations in Bt cotton. Twenty years later this protein is still in these technologies. I am aware that this protein may be losing its kick but it remains a decent protein against other lepidopteran pests on cotton. Cry1F (the second protein in Widestrike cotton, which also has Cry1A) was initially developed for control of fall armyworm in corn; and although still active against against bollworm it is inheriently less active than cry1A and cry2 (BollGard II and Twinlink).

On Saturday (July 9) a conversation with an upper Gulf Coast crop consultant changed my opinon that reports of unexpected injury being simply the result of large bollworm populations. Some of the BollGard II fields he scouts had 30% to 50% live worms and crop injury was easy to find. The number of fields infested and the level of infestations are very unusual for BollGard II cotton in south Texas. This certainly leads me to question other possibilities for the unexpected injury to Bt cotton in south Texas.

Crop stress effecting protein expression levels: This should be common knowledge by most entomologists, consultants and farmers but industry tends not to promote this potental issue until unacceptable injury levels occur…I know this from first hand experiences. Biotic and abiotic stress effects plant growth and, subsequently, protein expression in Bt crops. It is much like the effect of herbicide to

crops in cold, wet soils. When a plant is not growing it is not metabolizing potential toxins or carbohydrates essential for plant growth. This was a common issue in young corn during cold, wet conditions in the northern High Plains of Texas into the northern corn production regions of the U.S. We used to say the plants looked "pukey" but the crop would continue with normal growth once temperatures returned to "normal" with very little impact on yield potential of the crop. So…back to bollworm.

Cotton growing in south Texas and the Rio Grande Valley was under very little stress. In fact, growing conditions were so good that it was very difficult for farmers to contain plant growth. In 2016 record breaking rates of growth regulators were applied to cotton in attempts to contain plant growth. Conversely, cotton growing in the upper Gulf Coast experienced much more stress…not from drought but from extremely saturated soils for an extended period of time. Prolonged cool and wet soils will stress cotton plants (remember that plants breath much like we have to breath…we all know what happens if we are submerged in water too long). The wet climate was subplanted by hot and dry conditions. This was ideal to give cotton more favorable conditions for growth but this dry period also brought extreme heat. One would have to conclude that cotton growing in the upper Gulf Coast has been under a great deal of stress. So, it is plausable that stress has effected normal plant growth, Bt protein expression, and is likely a factor in the heavy bollworm populations in Bt cotton growing in the upper Gulf Coast of Texas.

Bollworm population with reduced susceptibility to Bt proteins: Anytime there are widespread control failures of a pesticide, be it weeds, pathogens, or insects, this has to be considered as a potential cause for unacceptable suppression of a pest. However, this is not a phenomenon that occurs over night. In general, it starts out small…a few misses here and there. These "misses" usually go unnoticed at first but, through time, they become more common and widespread. By then the pest becomes

Late instar cotton bollworm, *Helicoverpa zea*, feeding on boll of Bt cotton (Photo by Jason Thomas).

very difficult to control…especially when one of a few alternative options are used to manage a pest population (think pyrethroids for this discussion). The question becomes "Is reduced suceptibility in the bollworm a possible factor in bollworm infesting Bt cotton?". My simple answer is "It certainly is a possibility.". But, keep in mind that jumping to this conclusion without documentation can be very dangerous…it

creates tensions, distrust, and doubts around the technology. The best solution is working together to find answers to the issue at hand and developing remedial plans to rectify control failures.

In all honesty, I do not know the reason for these control failures but my best guess is that it is a combination of all the factors included in this letter plus some I have not included. But, as long as we can work together I do believe a solution to this issue can be developed.

What about unacceptable bollworm suppression with pyrethroids?:

I told you I would get to this and here we go. This is a repeat but deserves to be stated again. Cotton bollworm utilizes all major crops grown in south Texas. Like most years, in 2016 it built populations on the back of corn and then moved to sorghum then to cotton. Early in the season of 2015 and 2016 bollworm populations in corn were very low and corn escaped the need for insecticide applications to supress this insect. However, the untreated corn allowed the bollworm populations to build. Consequently, moths from corn moved to sorghum. Bollworm populations in sorghum were unusually large this year and much of the sorghum in south Texas was treated to prevent economic injury. Because they are inexpensive and offer an acceptable level of suppression, pyrethroids were the products of choice in sorghum although some farmers used other chemistries. The pyrethroid applications to sorghum were considered successful in most instances with bollworm suppression reaching 70% or greater. Bollworm from sorghum (and to a lesser degree from other sources) moved to cotton. Bollworm reaching economic threshold in many Bt cotton fields were treated with a pyrethroid. While some pyrethroid applications offered “acceptable” levels of bollworm suppression others were consided failures. For you folks that have been involved in south Texas agriculture for ~10 years or more this should spark memories of past bollworm control issues with pyrethroid insecticides. But, our memories tend to be short forcing us to relive past bad experieces over and over! Let’s take a stroll down memory lane to reexamine what should provide insight to what we are experiencing now.

In 2003 and 2004 pyrethoid performance against bollworm was considered fair to good. The first pyrethroid applications (1st to 3rd week of bloom) with mid-to-high rates of pyrethroid applications were effective. However, by the third or fourth week of bloom there were scattered reports of pyrethroid control issues, and some cases control failures even at the highest labeled application rates. In 2005 drought conditions limited bollworm populations and the need for insecticide applications to protect yield potential in sorghum and cotton. Accordingly, pyrethroid perfomance was considered acceptable.

Reasons for unsatisfactory pyrethroid performace was speculated to be ideal growing conditions in 2003 and 2004 resulting in unusually large bollworm populations, extended egg lay created staggered larval ages and sizes, and frequent rainfall delaying optimal insecticide timing hastening loss of even "rainfast" insecticides. It was during this period that bollworm resistance to pyrethroids was documented.

An adult vial test (AVT) was utilized statewide to identify resistance in bollworm populations in 2003. Results of AVT testing from 2003 through 2005 showed the highest levels of pyrethoid resistant bollworm from June through mid-July in south Texas. The cause (this should really ring a bell) was determined to be intense selection pressure occurring in sorghum (i.e. extensive pyrethroid spraying for stink bugs and headworms during May and early June).

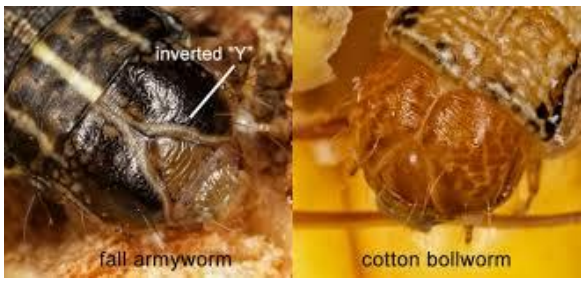
Bollworm resistance to pyrethroids is somewhat reversable (probably the result of fitness cost from resistance alleles) between seasons. However, bollworm resistance to pyrethroids spiked from June to mid-July from 2003 to 2005 and again in 2008 and 2009.

The fact that pyrethroids are the most cost-effective means of managing bollworm is as true today as it was in 2003, particarlarly considering that certain pyrethroids can be used for simeltaneous control of stink bugs, plant bugs, and bollworms in cotton (a characterisitic not shown by the newer alternative chemistries.). Use of best management practices (IPM) are important to limit control failures with pyrethroids. Some of the propose practices offered in 2003 remain excellent options to manage pyrethroid resistance in bollworm. These management suggestions included:

- **Aggressive "action-thresholds"** – target neonates
- **Use highest labeled rates**
- **Be vigilant to determine when to switch chemistry strategy** – bollworm generation following milo spraying (i.e. early June through mid-July) consider tank mixes of pyrethroids (highest labeled rate) with a low rate of an alternative chemistry to pick up stragglers. It is important to remember that the entire bollworm population is not resistant to pyrethroids (prior testing shows 20+% of the population resistant to pyrethroids, and remember in Bt cotton some of these 20% survivors will be taken out by Bt cotton.).
- **Use alternative modes of action**- there have been a few new chemistries on the market that were not available in 2003. One offers

excellent control of bollworm.

Earlier this season I was visiting a farmer that was about to treat his sorghum with an effective but expensive alternative chemistry to control headworm. I asked why he had decided to go this route and he said that (in 2015) he used pyrethroids in an attempt to manage headworm (this was more of a FAW/CEW mix). The initial application failed as-well-as the follow-up pyrethroid application. Three teatments were required to get the population under control. **It is possible that the escaped larvae may have been predominately fall armyworm which are inheriently tolerant to pyrethroids.**



Knowledge of larval identification is imperative to utilize the right insecticide or insecticide mix to effectivly manage a mixed population of headworm. Now that I know more about pyrethroid resistance in bollworm, it makes sense that he had control failures with the pyrethroids or it may have just been due to the surviving headworm complex made up of fall armyworm.

I know that this is a rather lengthy newsletter but I think we really need to address the issues at hand. **In 2017 I will bring back the Adult Vial Test for pyrethroid resistance in bollworm populations.** My guess is that we will see similar results as those in 2003 to 2005 and and in 2008 and 2009. My gut feeling tells me that bollworm will be a minor isses in 2017 but one can never be too careful.

I will end this newletter with a statement from a 2009 report on this issue: "Continued vigelence in future seasons is warranted as higher infestation levels in any given growing season could lead to occassional issues with use of a pyrethroid inseciticide to control bollworm in cotton or corn earworm/headworm in sorghum.".

New Fleahopper Training Video

A new training video created by Jason Thomas briefly teaches how to identify and detect flea hoppers in cotton squares. The video will be featured on Jason's Youtube page here: (http://youtube.com/insecthunterplus).

A direct link to the video can be found here: https://www.youtube.com/watch?v=B0ApDCtkdQk . The technique demonstrated in the video could make your job easier when trying to detect fleahoppers.

For more information on the sugarcane aphid and other field crops topics check out our new website at:

http://betteryield.agrilife.org/

Better Yield in the Field

You can now follow south Texas insect and production news on Facebook and Linkedin (Better Yield in the Field) and our website is coming together http://betteryield.agrilife.org/. Check us out as we grow and expand our offerings.

Robert Bowling, Ph.D.

Assistant Professor and Agrilife Extension Entomology Specialist
Texas A&M Agrilife Research and Extension Center at Corpus Christi
10345 Hwy 44
Corpus Christi, TX 78406
wk. (361) 265-9201