

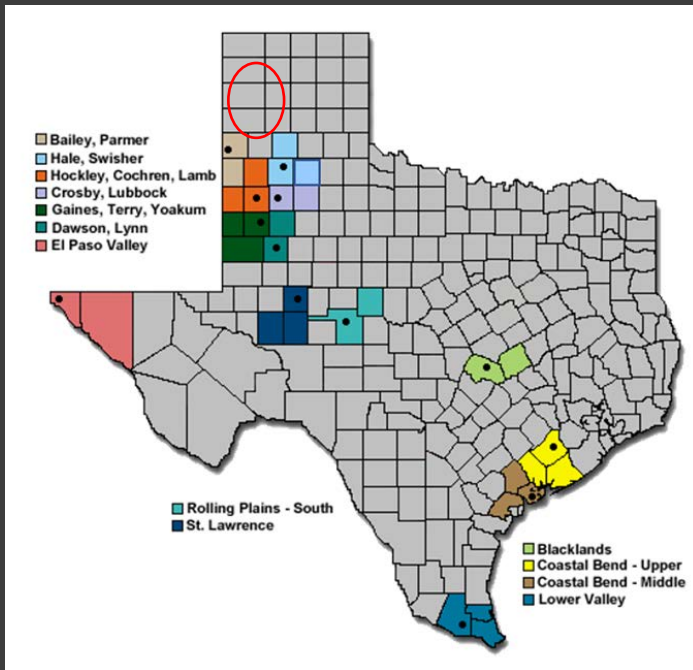
IPM Update: 2018

Blayne Reed, EA-IPM Hale, Swisher, & Floyd / WTACI Annual Conference

September 11, 2018



1. Wireworms in Cotton – a rough start



Wireworms



Click beetle



Darkling beetle

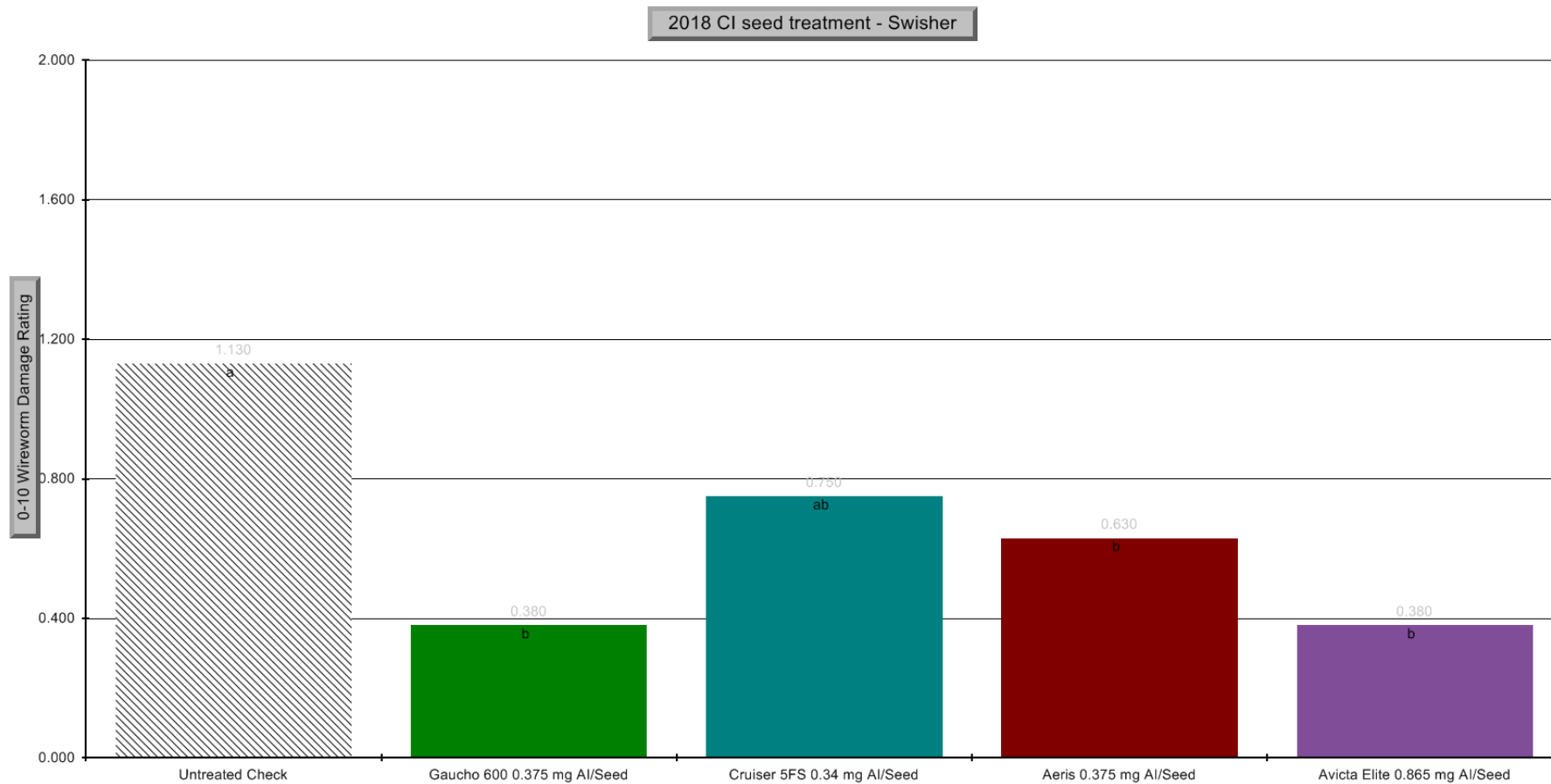




Wireworm Injury



1. Wireworms on Cotton – Field Trials: 2018 C.I. Swisher Seed Treatment Efficacy

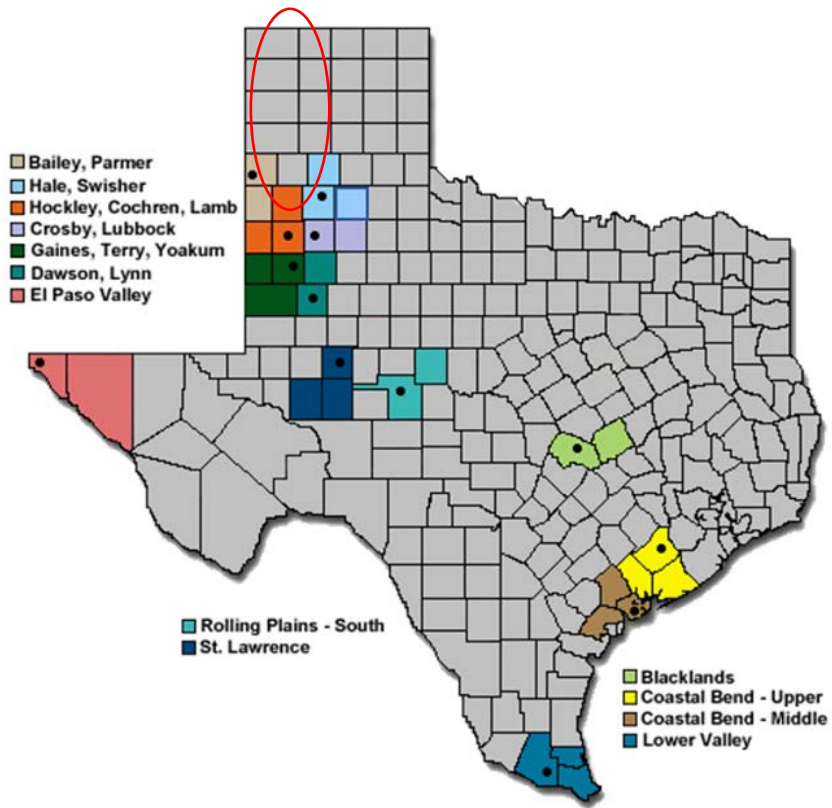


Additional seed-box treatments can be added for additional efficacy.

1. Wireworms on Cotton – Control & Scouting



- Prevention is the only proven treatment
 - Controlling the pest after the crop has failed is not helpful
- Scouting shortly after germination and seedling sprouting is needed
 - Catching a situation early can save time and crop earliness
- Standard seed insecticidal seed treatments for thrips have decent efficacy
- Seed-box treatments are difficult, but do add to control in heavy situations.



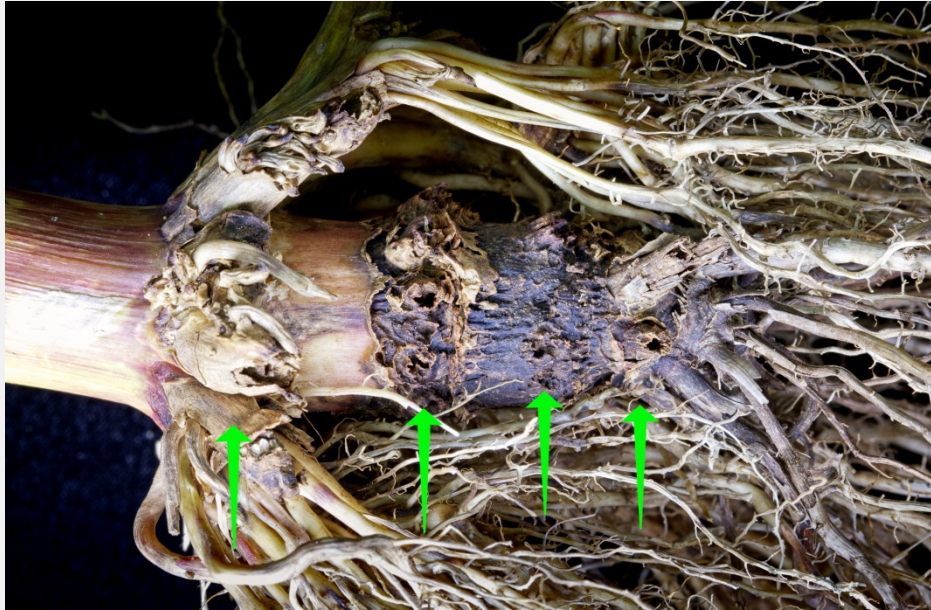
2. Texas Panhandle Corn Rootworm Probably Resistant to Some Bt Corn

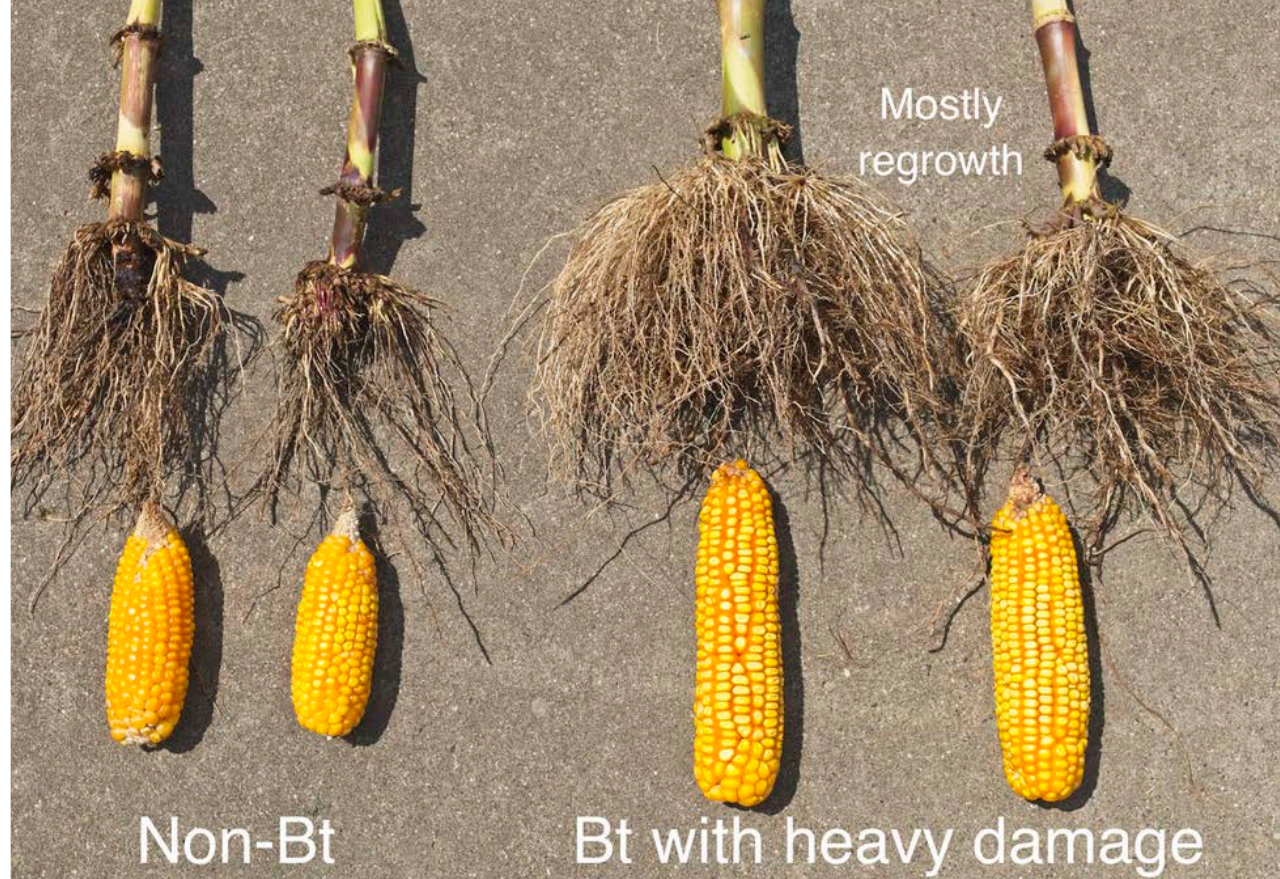
2. Texas Panhandle Corn Rootworm Probably Resistant to Some Bt Corn – situation

Dr. Ed Bynum and Dr. Pat Porter

- Western Corn Rootworm (Mexican)
 - Continuous corn fields
 - Damage done as larva to roots
 - Single generation per year
 - Silk clipping and bad pollination as adults
- crazy amount of western corn rootworm beetles emerging this summer in the Texas Panhandle
 - Dalhart in the north to Hart in the south
 - extensive damage to Bt corn with the toxin mCry3a with textbook symptoms of resistance
 - Cry34/35 corn; only slight damage was observed
 - 1,200 beetles from the mCry3a field sent them to a USDA-ARS lab for resistance screening
 - **calling it probable resistance.**

Corn Rootworm Damage





2. Texas Panhandle Corn Rootworm Probably Resistant to Some Bt Corn – mCry3a 2018 Performance

2. Texas Panhandle Corn Rootworm Probably Resistant to Some Bt Corn – Rootworm Bt Traits

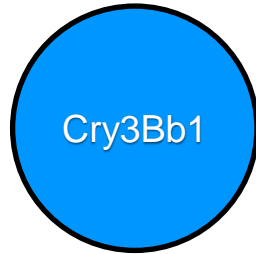
- mCry3a
- eCry3.1Ab
- Cry3Bb1
- Cry34/35
 - known cross resistance between the first three toxins listed above
- resistance to the Cry3s is widespread
- resistance to Cry34/35 is only known in localized pockets – for now
- Corn rootworm has the ability to become resistant to single toxins in four seasons when the same toxin is used in consecutive years

Single Cry Toxin Products



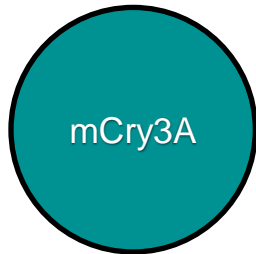
DowDupont/Pioneer

Herculex Rootworm, Herculex XTRA, AcreMax RW, AcreMax 1, Intrasect Xtra, AcreMax Xtra



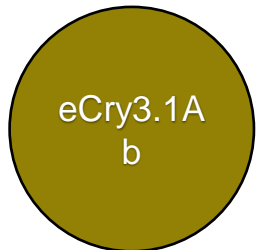
Monsanto

YieldGard VT Rootworm, YieldGard VT Triple, YieldGard VT Triple Pro or RIB Complete, SmartStax



Syngenta

Agrisure 3000GT, 3011A, Agrisure Viptera 3111, TRIssect, Intrasect TRIssect, AcreMax TRIssect

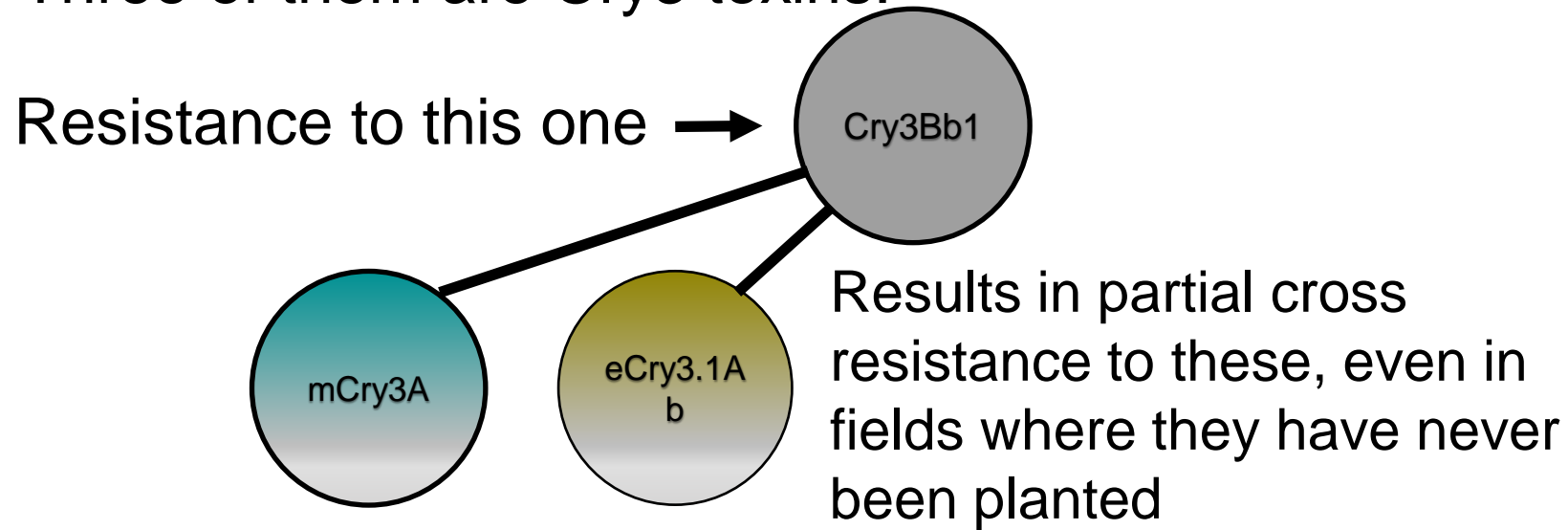


Syngenta

Only used in combination with other toxins

But rootworms do not treat these as 4 distinct toxins

Three of them are Cry3 toxins:



Cry34/35 binary toxins:



Significantly different from the other three

2. Texas Panhandle Corn Rootworm Probably Resistant to Some Bt Corn – Recommendations

- rotate to a non-corn crop
 - larvae will hatch next year and starve
- rotate to an entirely different toxin the following season
 - Remember that mCry3a, eCry3a.1Ab and Cry3Bb1 are not very different
- is no known resistance in Texas to Cry34/35
- Standard treatments available
 - soil applied insecticides

2. Texas Panhandle Corn Rootworm Probably Resistant to Some Bt Corn – Available Traits

Type of Cry3-based Bt corn and corn rootworm toxin profile

Company	Name	mCry3a	eCry3.1a b	Cry3Bb1
Pioneer	TRIssect (CHR)	x		
	AcreMax TRIssect (AMT)	x		
	Intrasect TRIssect (CYHR);	x		
Syngenta	Agrisure 3000GT	x		
	Agrisure 3011A	x		
	Agrisure Viptera 3111	x		
	Agrisure Duracade 5122 EZ Refuge	x	x	
	Agrisure Duracade 5222 EZ Refuge	x	x	
Monsanto	Yieldgard Rootworm (YGRW)			x
	Yieldgard VT Triple			x
	Yieldgard VT Triple PRO			x

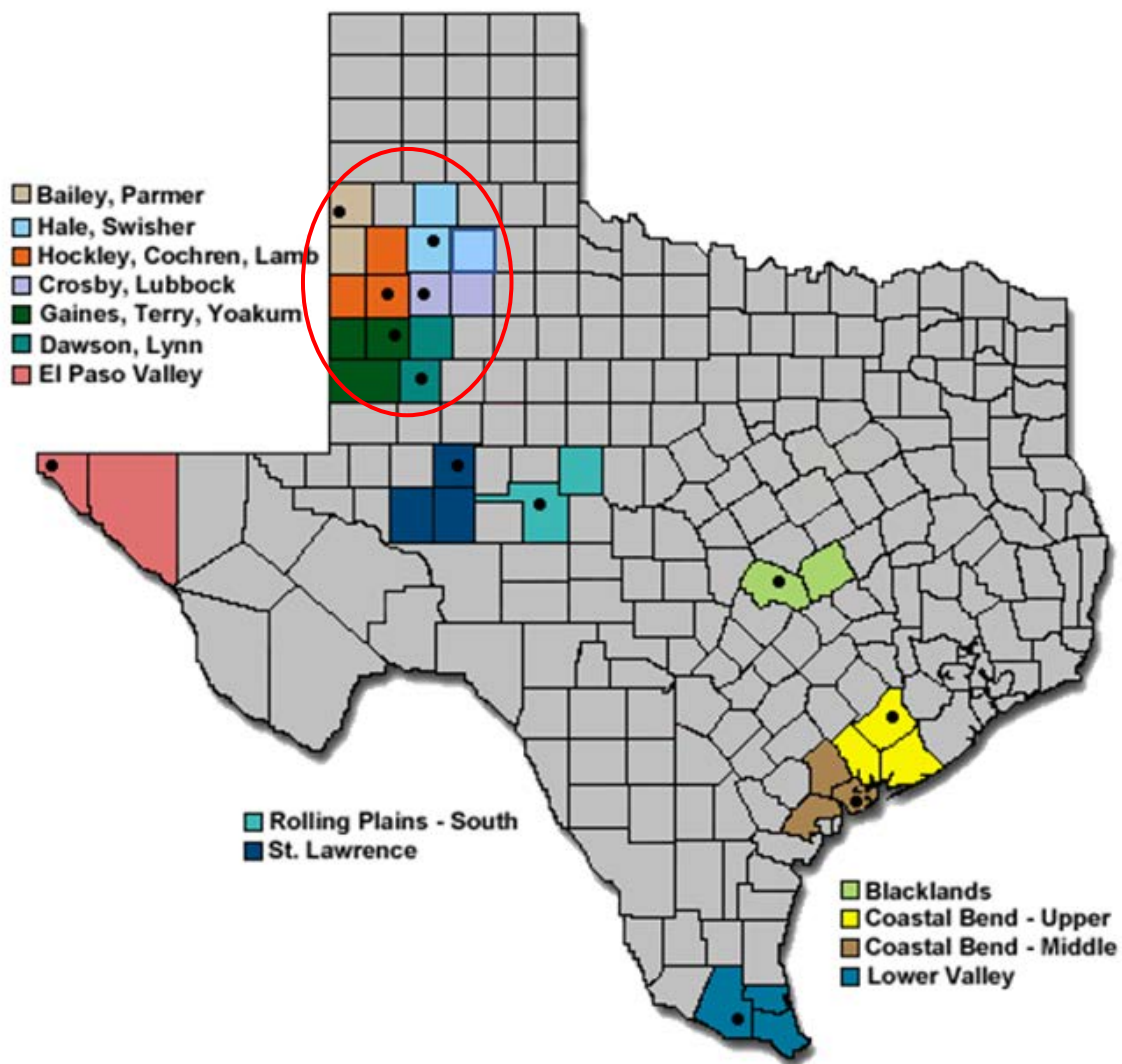
Type of rootworm Bt corn that contains Cry34/35

Company	Name	Cry34/35	Some Cry3-type toxin
Corteva*	AcreMax CRW (AMRW)	x	
	AcreMax 1 (AM1)	x	
	AcreMax Xtra (AMX)	x	
	AcreMax Xtreme (AMXT)	x	x
	Herculex RW (HXRW)	x	
	Herculex XTRA (HXX)	x	
	Intrasect Xtra (YXR)	x	
	Intrasect Xtreme (CYXR)	x	x
Syngenta	QRome	x	x
	Agrisure 3122	x	x
Bayer**	SmartStax	x	x

Determining the types of Bt toxins present in hybrids from every seed company is easy to do, just visit the Handy Bt Trait table.

<https://lubbock.tamu.edu/files/2018/01/BtTraitTableJan2018.pdf>

3. Cotton Bollworm Resistance Update



- Bt Resistance
 - Known Status
 - Notable Local Research Trials
- Field Observations
 - IPM Field Scouting
- Pyrethroid Resistance
 - Areawide Resistance Trials

VALUE OF BT TECHNOLOGY FOR BOLLWORM MANAGEMENT: CURRENT SITUATION AND FUTURE SUSTAINABILITY

DAVID L. KERNS

TEXAS A&M UNIVERSITY, COLLEGE STATION, TX

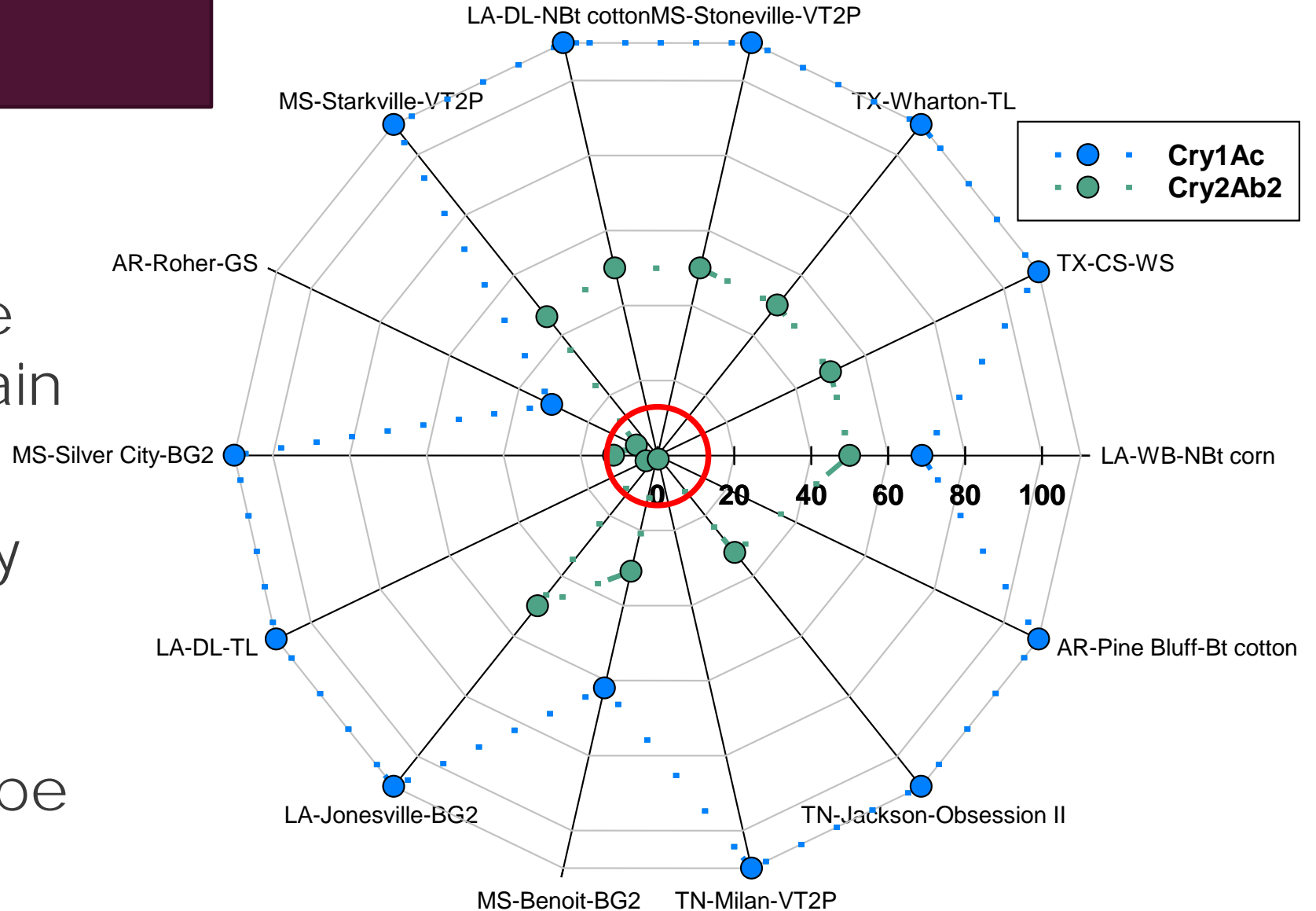


TEXAS A&M
AGRILIFE
EXTENSION

CRY1AC & CRY2AB2

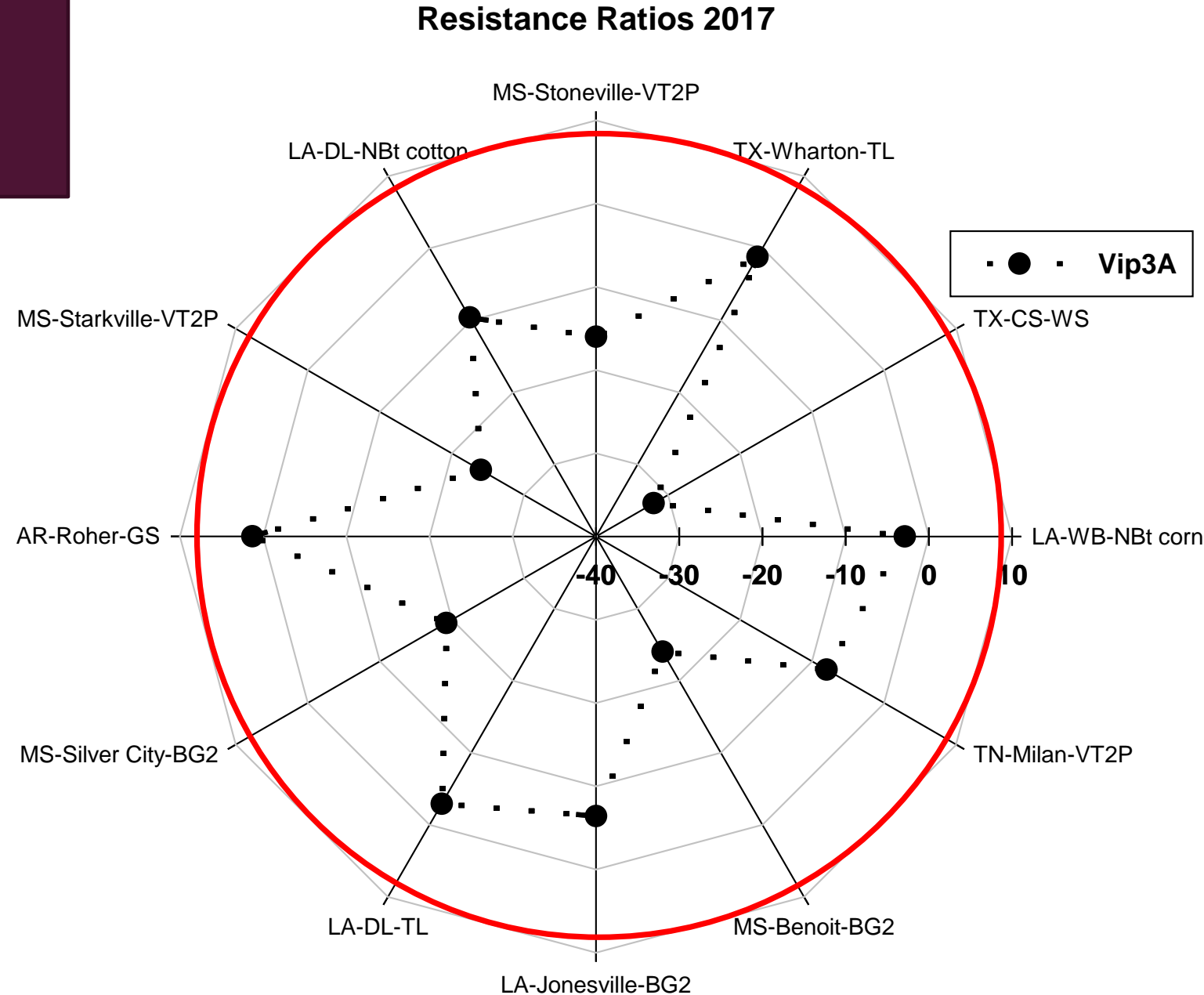
- Resistance ratios based on susceptibility relative to the Benzon SS strain
- Resistance ratios for Cry1Ac of 109.8 may be higher
- Resistance ratios for Cry2Ab2 of 50 may be higher

Resistance Ratios 2017

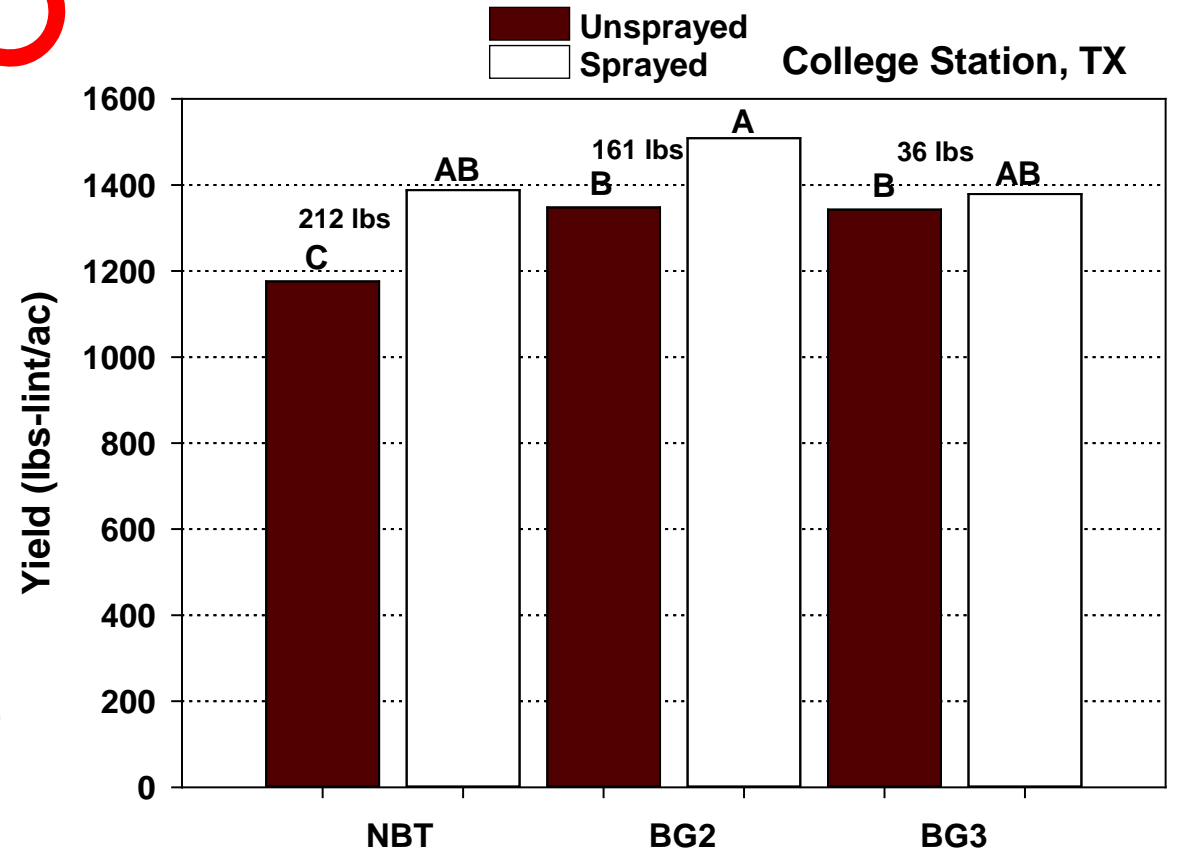
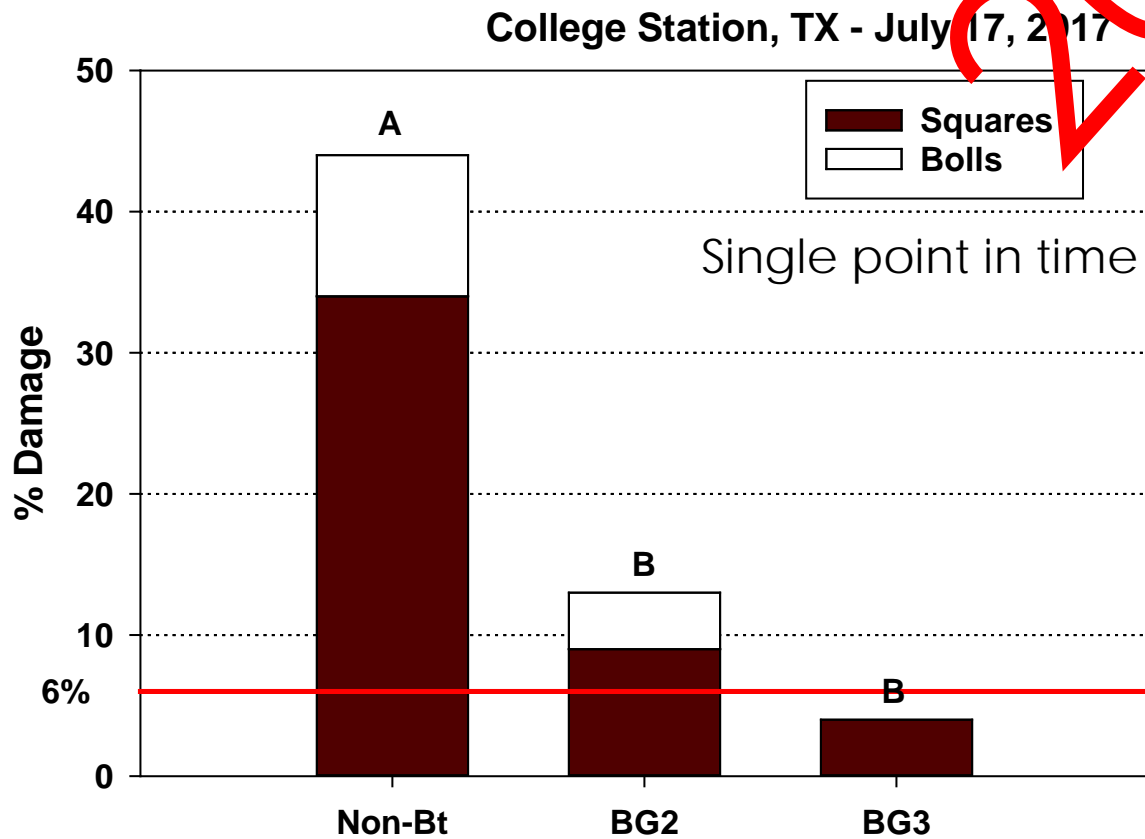


VIP3A

- Resistance ratios based on susceptibility relative to the Benzoin SS strain
- Field-collected populations typically more susceptible to Vip3A than the Benzoin SS strain

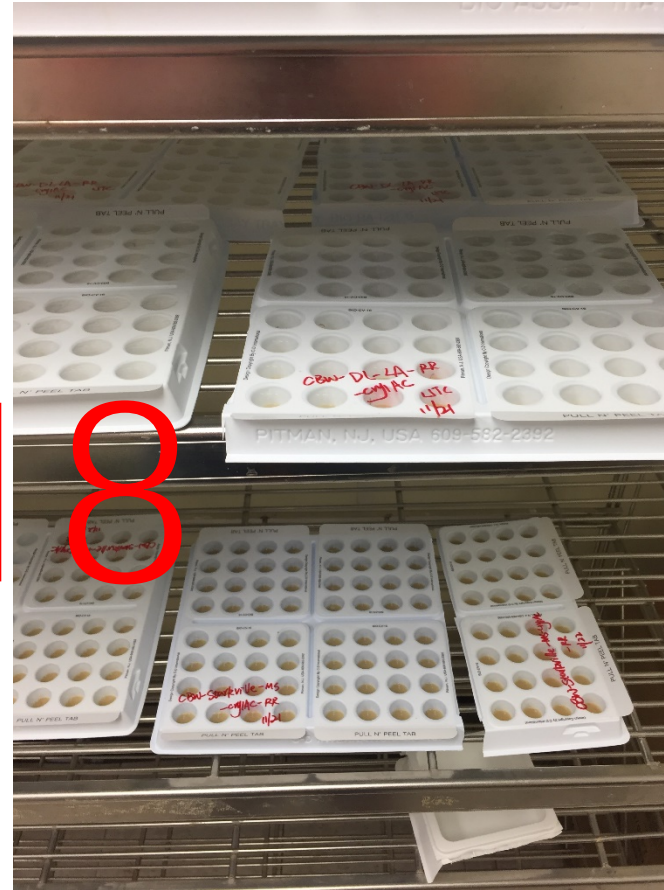


PERFORMANCE OF BOLLGARD 3 – COLLEGE STATION, TX





2018



BIOASSAY DATA

CRY1AC, CRY2AB2, CRY1F & VIP3A



3. Cotton Bollworm Resistance Update – Field Trials: 2018 Floyd County BCS Sentinel Trial, a snapshot of Bt Performance in West Texas

August 14, 2018 – 2.8 NAWF

	non-Bt	TwinLink	TwinLink Plus
% plants with damaged bolls	38%	22%	10%
% plants with damaged squares	30%	8%	12%
% plants with damaged blooms	12%	10%	0%
% plants with damaged fruit TOTAL	80%	40%	22%
% plants with live bollworms	26%	8%	0%
% plants with foliage feeding worms	6%	0%	0%

August 20, 2018 – < 1 NAWF

	non-Bt	TwinLink	TwinLink Plus
% plants with damaged bolls	92%	32%	0%
% plants with damaged squares	6%	4%	0%
% plants with damaged blooms	46%	12%	2%
% plants with damaged fruit TOTAL	100%	48%	2%
% plants with live bollworms	24%	12%	0%
% plants with foliage feeding worms	8%	0%	0%

August 14 Treatment decision:

Non-Bt: (33,500PPA) .24 = 8,040 bollworms per acre.

TwinLink; (33,500PPA) .08 = 2,680 bollworms per acre.

As an advisor, if faced with this in a field, I would recommend the Non-Bt for treatment, but not the TwinLink.

3. Cotton Bollworm Resistance Update – Field Trials: C.I. Cotton Technology

Bollworm Efficacy - Terry, Gains, & Yoakum, Tyler Mays

Percent Damaged Fruit from Bloom (Squares plus Blooms)

Technology	30-Jul-18	6-Aug-18	13-Aug-28	20-Aug-18	27-Aug-18
B2XF Treated	0 (0.00) b	0.0 (0.00) c	0.5 (0.5) bc	0.0 (0.0) c	0.0 (0.0)
B2XF Untreated	0 (0.00) b	0.5 (0.50) bc	0.0 (0.0) c	0.5 (0.5) bc	0.0 (0.0)
B3XF Treated	0 (0.00) b	0.0 (0.00) c	0.5 (0.5) bc	0.0 (0.0) c	0.0 (0.0)
B3XF Untreated	0 (0.00) b	0.5 (0.50) bc	0.5 (0.5) bc	0.5 (0.5) bc	0.0 (0.0)
WFE Treated	0 (0.00) b	0.5 (0.50) bc	0.0 (0.0) c	0.0 (0.0) c	0.0 (0.0)
WFE Untreated	0 (0.00) b	0.0 (0.00) c	1.5 (1.0) bc	3.0 (1.9) ab	0.0 (0.0)
W3FE Treated	0 (0.00) b	0.0 (0.00) c	0.5 (0.5) bc	0.0 (0.0) c	0.0 (0.0)
W3FE Untreated	0 (0.00) b	0.0 (0.00) c	0.0 (0.0) c	0.0 (0.0) c	0.0 (0.0)
GLT Treated	0 (0.00) b	0.5 (0.50) bc	0.5 (0.5) bc	0.0 (0.0) c	0.0 (0.0)
GLT Untreated	0 (0.00) b	1.5 (1.00) b	2.0 (1.4) b	5.0 (2.4) a	2.0 (2.0)
GLTP Treated	0 (0.00) b	0.5 (0.50) bc	0.5 (0.5) bc	0.5 (0.5) bc	0.0 (0.0)
GLTP Untreated	0 (0.00) b	0.0 (0.00) c	1.5 (0.5) bc	0.0 (0.0) c	0.0 (0.0)
GL Treated	1 (1.00) b	1.5 (1.00) b	0.5 (0.5) bc	0.5 (0.5) bc	0.0 (0.0)
GL Untreated	3 (1.90) a	4.0 (1.20) a	4.0 (1.4) a	4.0 (0.8) a	2.0 (2.0)
LSD	1.64	1.49	2	2.59	2.08
F-value	2.067	4.312	2.385	3.469	1
p-value	0.04	0.0002	0.0182	0.0013	0.469

Percent Damaged Fruit from Bloom (Squares plus Blooms) Untreated Only

Technology	30-Jul-18	6-Aug-18	13-Aug-28	20-Aug-18	27-Aug-18
B2XF	0 (0.00) b	0.5 (0.50) bc	0.0 (0.0) c	0.5 (0.5) bc	0.0 (0.0)
B3XF	0 (0.00) b	0.5 (0.50) bc	0.5 (0.5) bc	0.5 (0.5) bc	0.0 (0.0)
WFE	0 (0.00) b	0.0 (0.00) c	1.5 (1.0) bc	3.0 (1.9) ab	0.0 (0.0)
W3FE	0 (0.00) b	0.0 (0.00) c	0.0 (0.0) c	0.0 (0.0) c	0.0 (0.0)
GLT	0 (0.00) b	1.5 (1.00) b	2.0 (1.4) b	5.0 (2.4) a	2.0 (2.0)
GLTP	0 (0.00) b	0.0 (0.00) c	1.5 (0.5) bc	0.0 (0.0) c	0.0 (0.0)
GL	3 (1.90) a	4.0 (1.20) a	4.0 (1.4) a	4.0 (0.8) a	2.0 (2.0)

3. Cotton Bollworm Resistance Update – Field Trials: 2018 Dr. Kerns / Kate Harrell BCS Sentinel Trials, a snapshot of Bt Performance in Southern Texas

Thrall, TX 7/2/2018

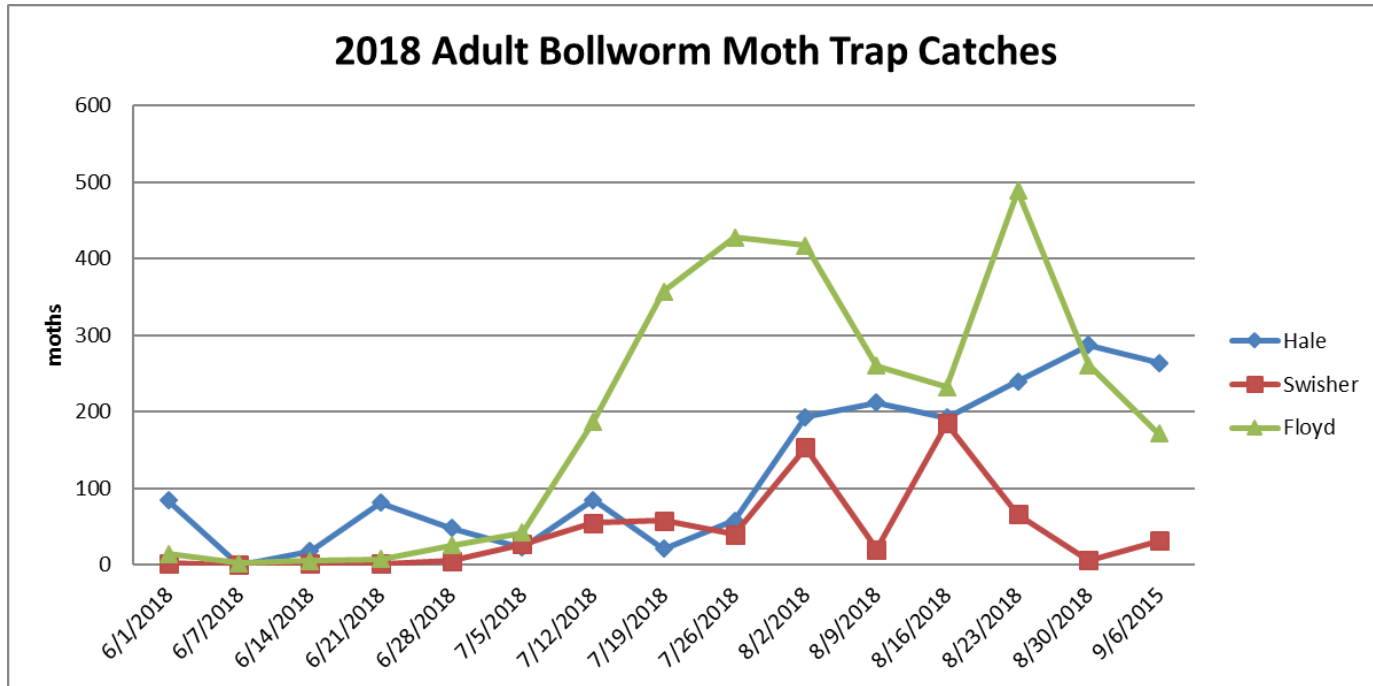
	non-Bt	TwinLink	TwinLink Plus
% damaged bolls	3%	1%	0%
% damaged squares	1%	1%	1%
% damaged blooms	2%	3%	0%
% damaged fruit TOTAL	6%	5%	1%
% plants with live bollworms	4%	2%	0%

College Station, TX 7/20/2018

	non-Bt	TwinLink	TwinLink Plus
% damaged bolls	47%	4%	1%
% damaged squares	29%	3%	1%
% damaged blooms	10%	3%	0%
% damaged fruit TOTAL	86%	13%	2%
% plants with live bollworms	36%	2%	0%

West Plains -Hockley, Cochran, & Lamb Observations of *H. zea*, by Kerry Siders

- Cotton bollworm egg laying (3000-12,000/acre) became most noticeable in IPM scouting fields starting on July 16th in all technologies
- Good mix of beneficials, hot temperatures, and relatively small statured cotton at the time; egg and small worm mortality very high
- By July 23rd a few (1,000-4,000/acre) small to medium worms noted in some acres of all technologies
- July 31 Treating non-Bt cotton acres for +7,000/acre small to medium sized bollworms, plus +2,000 large worms. Very successful with Privation.
- Treatments continued in non-Bt cotton through the third week of August; majority of non-Bt treated; NO Bt cotton sprayed for worms that I am aware of



Plains Pest Management, Hale, Swisher, & Floyd Observations of *H. zea*, by Blayne Reed

- Bollworm moth flights and subsequent egg lay in began about July 12 in eastern 'hot spot' areas and continued for an extended period of time through late August.
- Western areas started some weeks later but not as severe.
- Alternate crop hosts such as corn and sorghum absorbed most of the 2018 egg lay leaving a reduced number to spill into cotton
- Good mix of beneficials, hot temperatures, and relatively small statured cotton at the time; egg and small worm mortality in cotton very high
- As a result of the several factors reducing cotton bollworm pressure only some non-Bt fields reached economic levels and needed to be treated.

High Plains, Palmer, Bailey, & Castro, Observations of *H. zea*, by John David Gonzalez

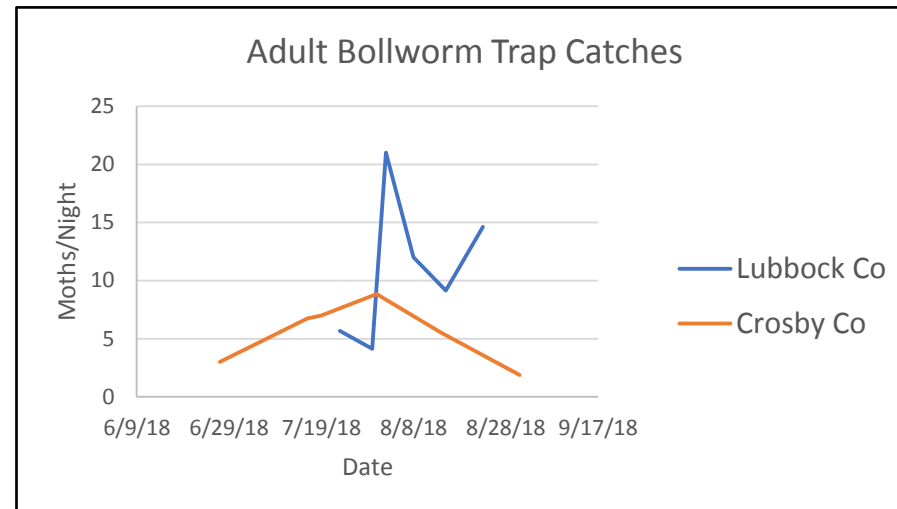
- Moth flights and subsequent egg lay in cotton started later than other areas
- Alternate crop hosts such as corn and sorghum absorbed most of the 2018 egg lay leaving a reduced number to spill into cotton
- Good mix of beneficials, hot temperatures, and relatively small statured cotton at the time; egg and small worm mortality in cotton very high
- As a result of the several factors reducing cotton bollworm pressure very few non-Bt fields reached economic levels and needed to be treated.
- No Bt fields of any type required treatment in 2018 that we are aware

Southwest Plains IPM, Terry, Gains, & Yoakum, Observations of *H. zea*, by Tyler Mays

- Present in both Bt and non-Bt fields
- Pressure varied between areas, and plant growth
 - fields with lusher canopies had higher populations
- some non-Bt cotton fields were sprayed in early August
- Bt fields held up ok, not aware of any Bt fields in my area that needed to be sprayed

Southern High Plains IPM, Lubbock & Crosby, Observations of *H. zea*, by Dr. Katelyn Kesheimer

- Consistent, but patchy pressure throughout region
- Sprays made on non-Bt **and** Bt cotton
 - Still making applications (as of Sept. 7)
 - A handful of fields sprayed twice
 - Some fields completely worm free (regardless of technology)
- Bollworms were often part of a ‘worm complex’
 - Fall armyworm, beet armyworm, yellowstriped armyworm, garden webworm



Crop Management IPM, Dawson & Lynn, Observations of *H. zea*, by Tommy Doederlein

- Drought seriously impacted cotton, and insect populations.
- Very few pests in the area, period.
- Some mild scare about bollworms on the few irrigated fields surviving that dissipated quickly.



3. Cotton Bollworm Resistance Update – Pyrethroid Resistance Studies and Alternate Chemical Control Option Efficacy

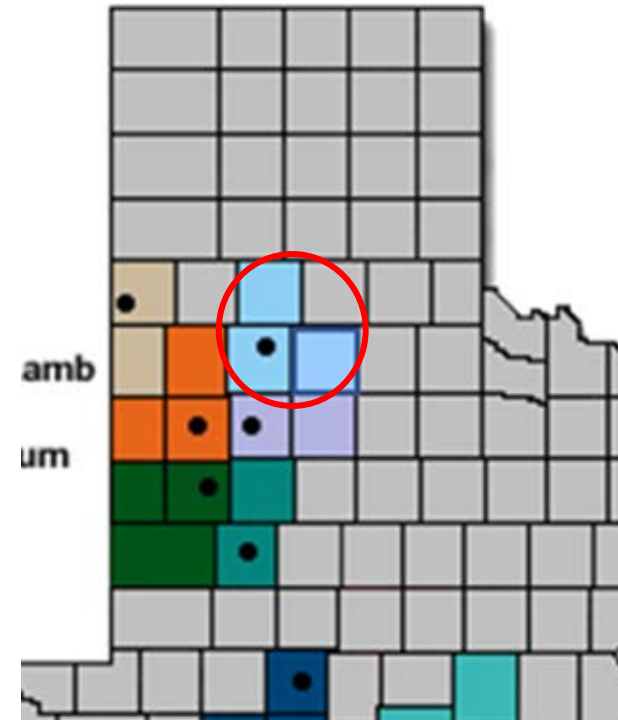
- Pyrethroid Resistance Studies from 4 locations on High Plains
 - Multiple sample dates
- Alternate Chemistry Treatment Efficacy

3. Cotton Bollworm Resistance Update – Pyrethroid Resistance Studies; Hale, Swisher, & Floyd

Percent likely expected survival

Percent with likely dominant resistant trait

- Floyd 7/12/18
 - 28.6% survival
 - 19.1% dominant resistant trait
- Swisher 7/12/18
 - 40% survival
 - 20% dominant resistant trait
- Hale 8/5/18
 - 42.9% survival
 - 7.1% dominant resistant trait
- Floyd 8/5/18
 - 18.2% survival
 - 18.2% dominant resistant trait

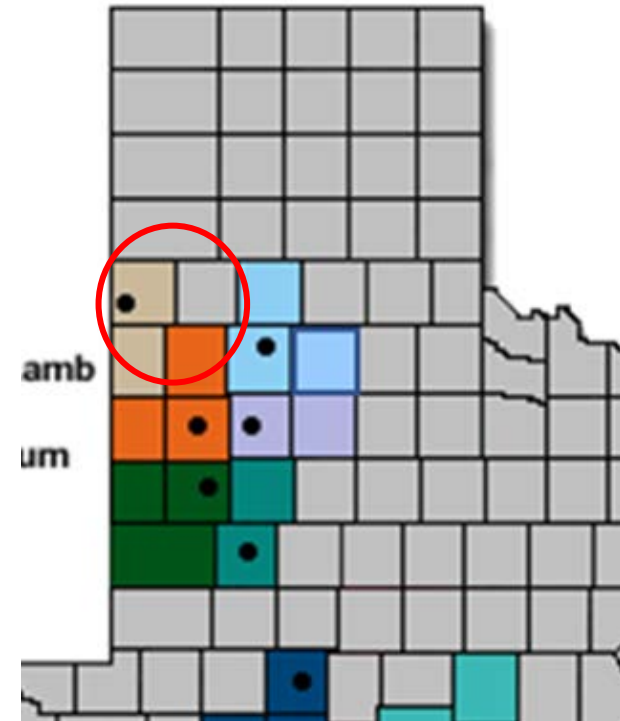


3. Cotton Bollworm Resistance Update – Pyrethroid Resistance Studies; Palmer, Bailey, & Castro

Percent likely expected survival

Percent with likely dominant resistant trait

- 8/3/18
 - 44.4% survival
 - 22.2% dominant resistant trait
- 8/31/18
 - 33.3% survival
 - 11.1% dominant resistant trait

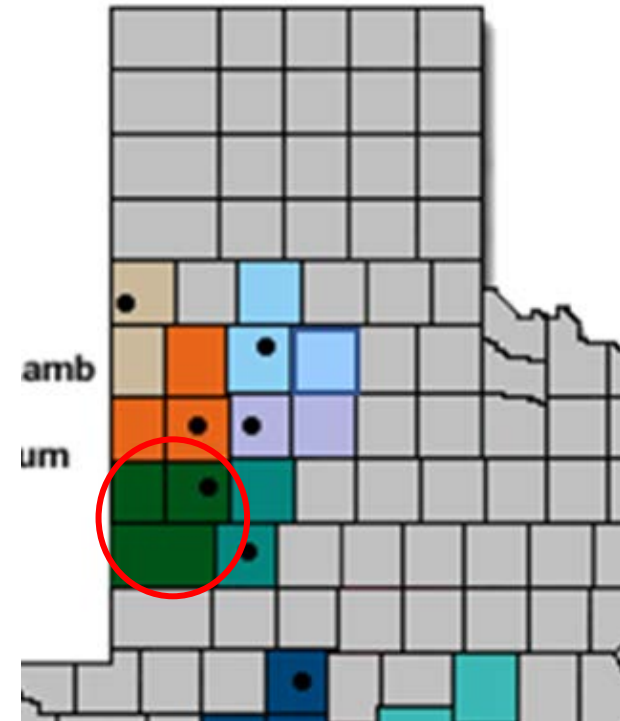


3. Cotton Bollworm Resistance Update – Pyrethroid Resistance Studies; Terry, Yoakum, & Gains

Percent likely expected survival

Percent with likely dominant resistant trait

- 6/21/18
 - 37.5% survival
 - 0% dominant resistant trait
- 6/27/18
 - 15.4% survival
 - 7.7% dominant resistant trait

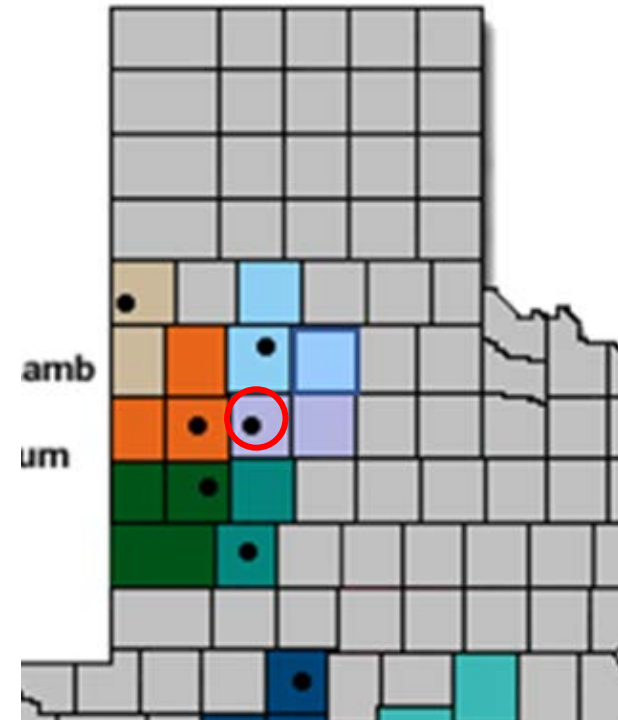


3. Cotton Bollworm Resistance Update – Pyrethroid Resistance Studies; Lubbock

Percent likely expected survival

Percent with likely dominant resistant trait

- 6/14/18
 - 18.2% survival
 - 0% dominant resistant trait
- 6/23/18
 - 23.1% survival
 - 15.4% dominant resistant trait
- 7/31/18
 - 16.7% survival
 - 0% dominant resistant trait
- 8/21/18
 - 33.3% survival
 - 11.1% dominant resistant trait



3. Cotton Bollworm Resistance Update - Pyrethroids

- Pyrethroids have been the standard for economical broad spectrum pest control for many pests in many crops for many years. Particularly for bollworms in cotton.
- Bollworm resistance to pyrethroids has been shown and proven across the cotton belt.
 - Light bollworm pressure on the Texas High Plains in recent seasons had left some doubt locally
 - Seasonal bollworm overwintering and migration patterns guarantee that some level of resistance would migrate onto the Texas High Plains
- These 2018 prove that the pyrethroid resistance issue is a problem for West Texas also.
- To maintain economic control of bollworms, alternate chemistry is needed and sole reliance upon pyrethroids is no longer feasible.
- The newer bollworm control options all come with a higher price and are not as 'user friendly.'
- What do we use?



3. Bollworm Product Efficacy – Visual of a 2018 Plains Pest Management Trial in Corn

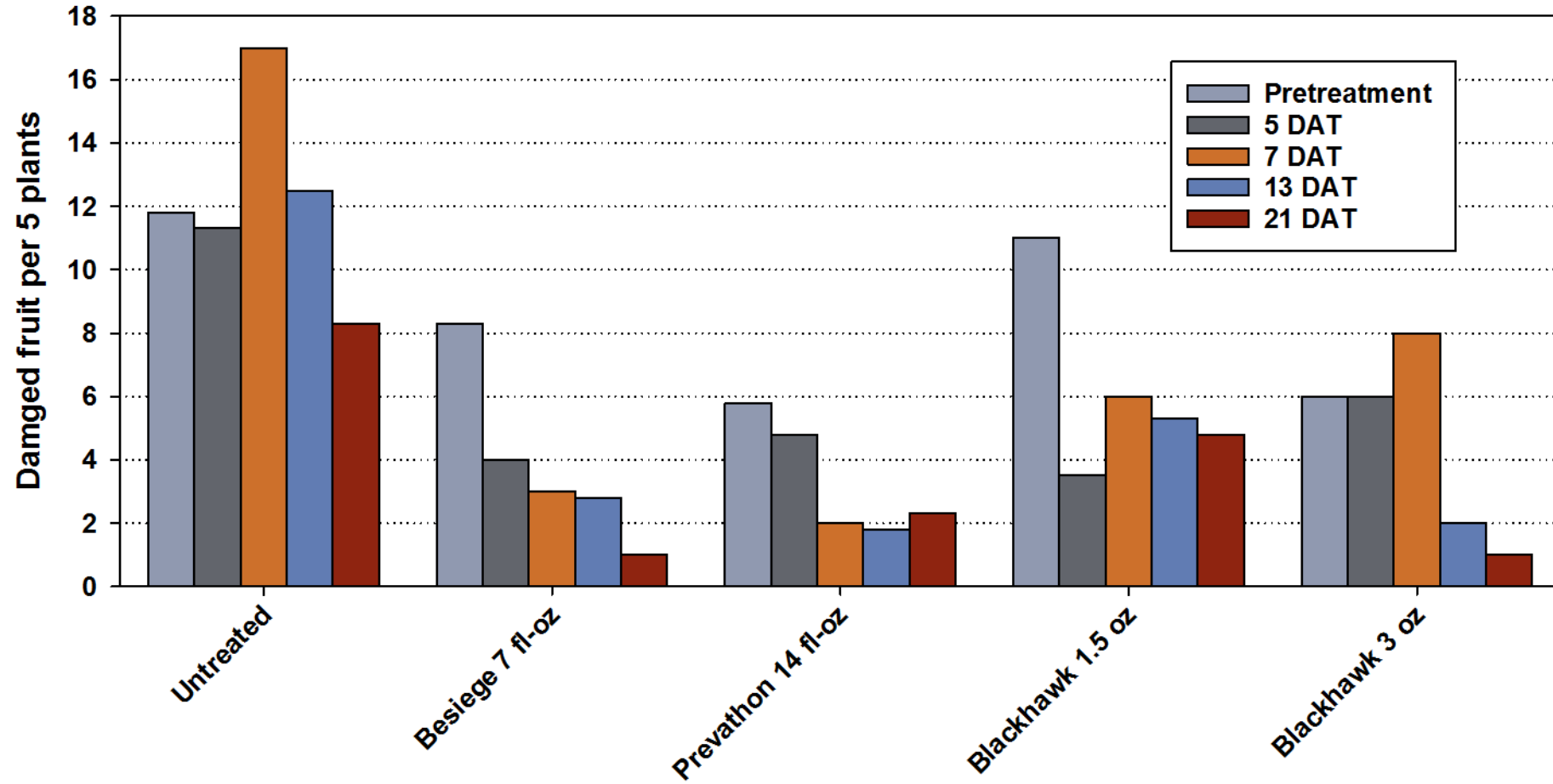




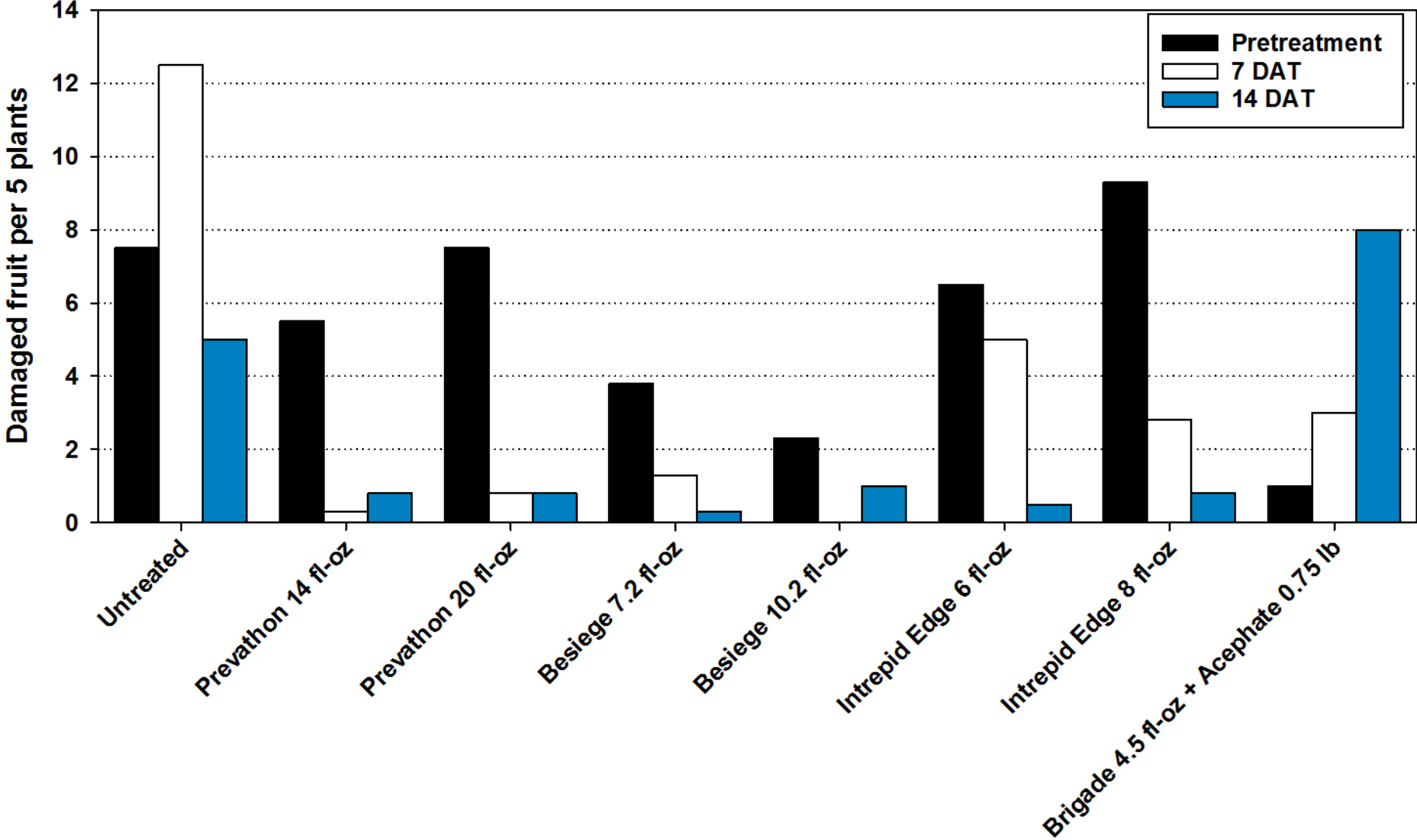
Privation Performance

David Kerns & Kate Harrell
Department of Entomology
Texas A&M University
College Station, TX

College Station, TX - 2018



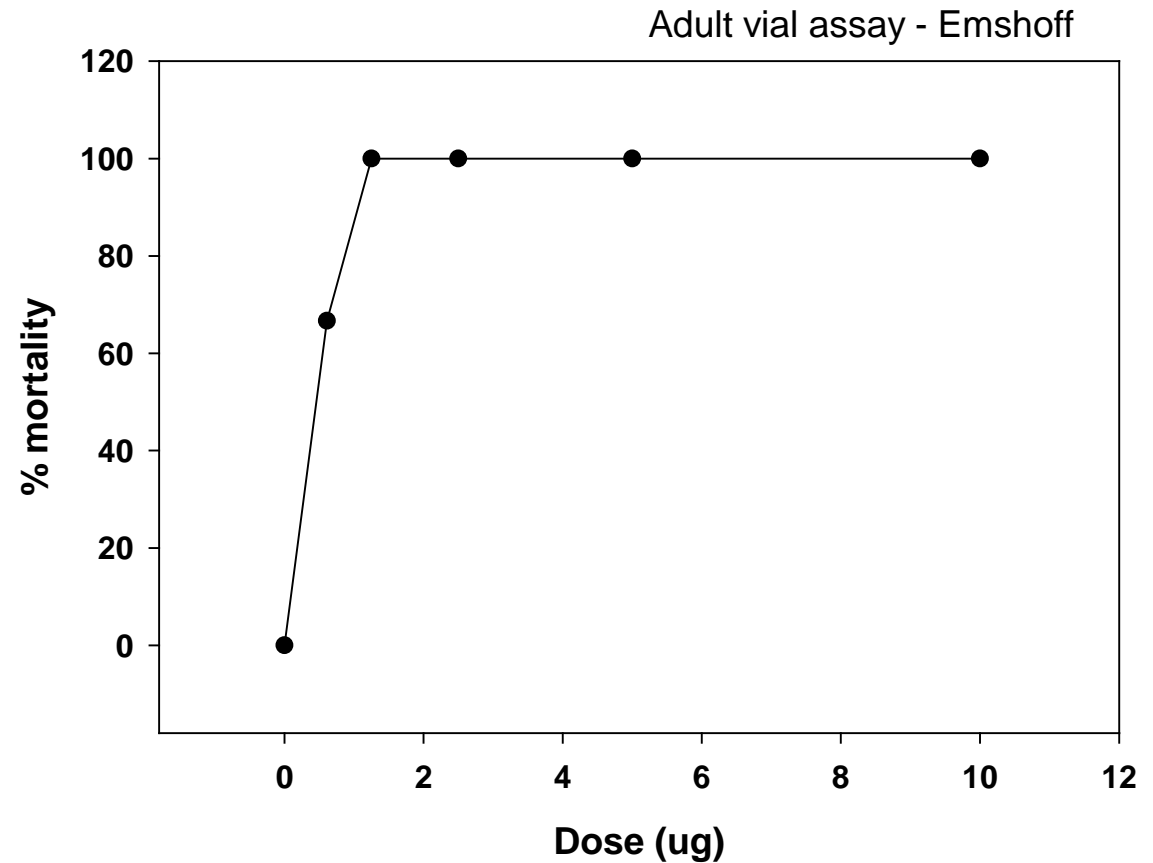
College Station, TX - 2018



Adult moth vial assay

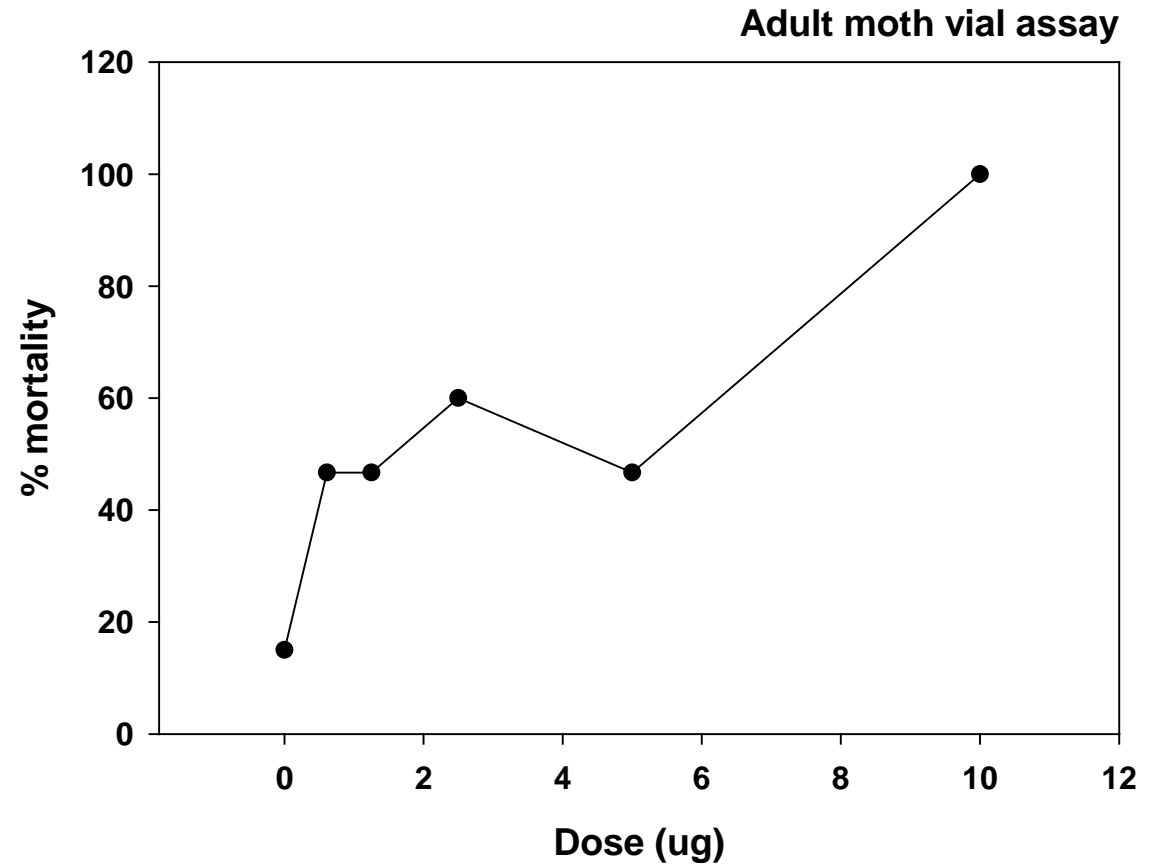
Kate Harrell

- Used fresh pheromone trapped male moths
- 3 moths per dose
- Concentrations tested were 0, 0.612, 1.25, 2.5, 5, and 10 μg per vial
- Mortality rated at 24 hr
- Dead = moths unable to fly



Adult moth vial assay College Station

- Used fresh pheromone trapped male moths
- 20 moths per dose
- Concentrations tested were 0, 0.612, 1.25, 2.5, 5, and 10 μg per vial
- Mortality rated at 24 hr
- Dead = moths unable to fly





Thank you!

Blayne Reed, EA-IPM Hale, Swisher, & Floyd

WTACI Annual Conference

September 11, 2018