

# Bt Resistance: Impacts and Updates



# Summary of Bt Resistance Surveys

David Kerns and Fei Yang – Texas A&M

<i>Bt</i> protein	Texas and Mid-South Percentage of populations with RR > 10X					
	2016 <i>n</i> =5	2017 <i>n</i> =14	2018 <i>n</i> =13	2019 <i>n</i> =13	2020 <i>n</i> =5	2021 <i>n</i> =12
<b>Cry1Ac</b>	40%*	100%	94%	96%	100%	92%
<b>Cry2Ab2</b>	80%	77%	73%	73%	100%	92%
<b>Cry1F</b>	ND	100%	100%	100%	ND	ND
<b>Vip3Aa</b>	0%	0%	0%*	0%*	0%	0%

# Resistance inheritance tests and F2 screen allele frequencies

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<i>Bt</i> protein	Inheritance characterization			Allele frequency
	Sex linkage	Genes	Dominance	
<b>Cry1Ac</b>	Autosomal	Polygenic	Incompletely recessive/completely dominant	(0.53-0.59)
<b>Cry2Ab2</b>	Autosomal	Polygenic	Incompletely dominant/dominant	(0.17-0.19)
<b>Cry1F</b>	ND	ND	ND	ND
<b>Vip3Aa</b>	Autosomal	Monogenic	Completely recessive	0.004-0.017

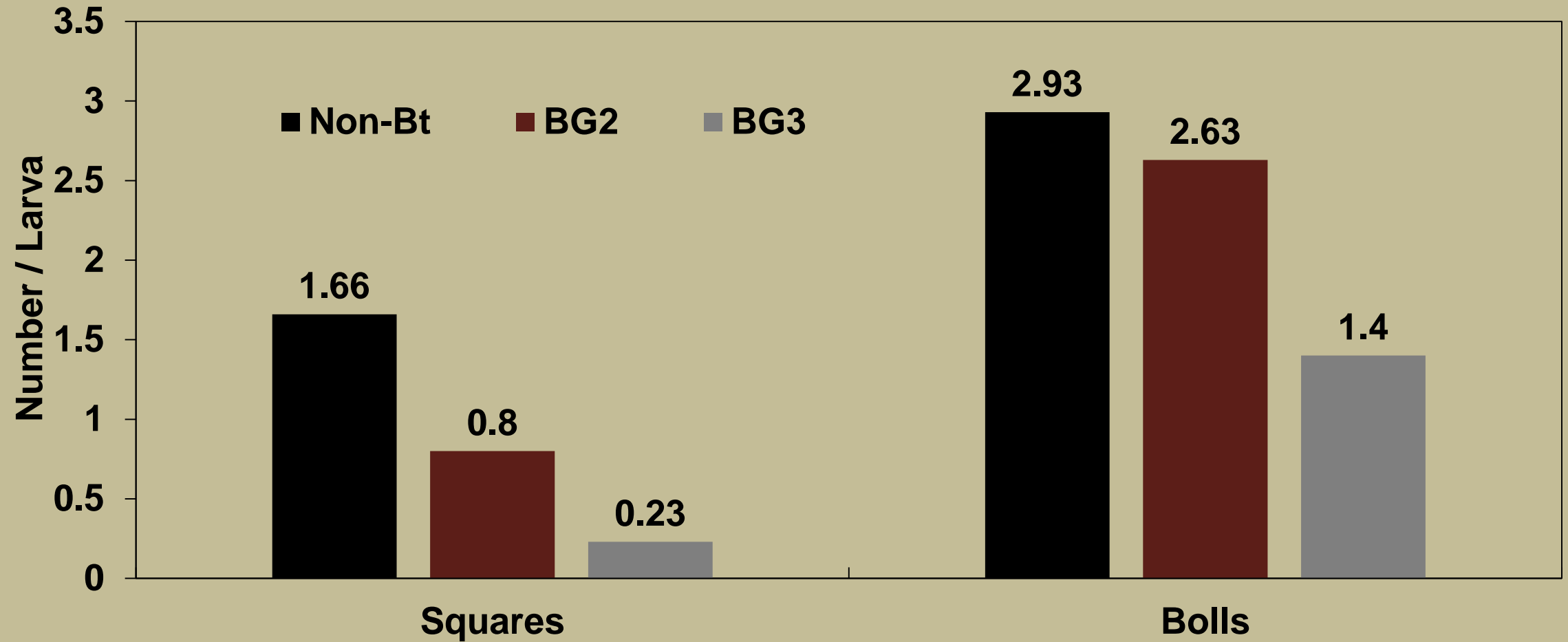
Very high

High

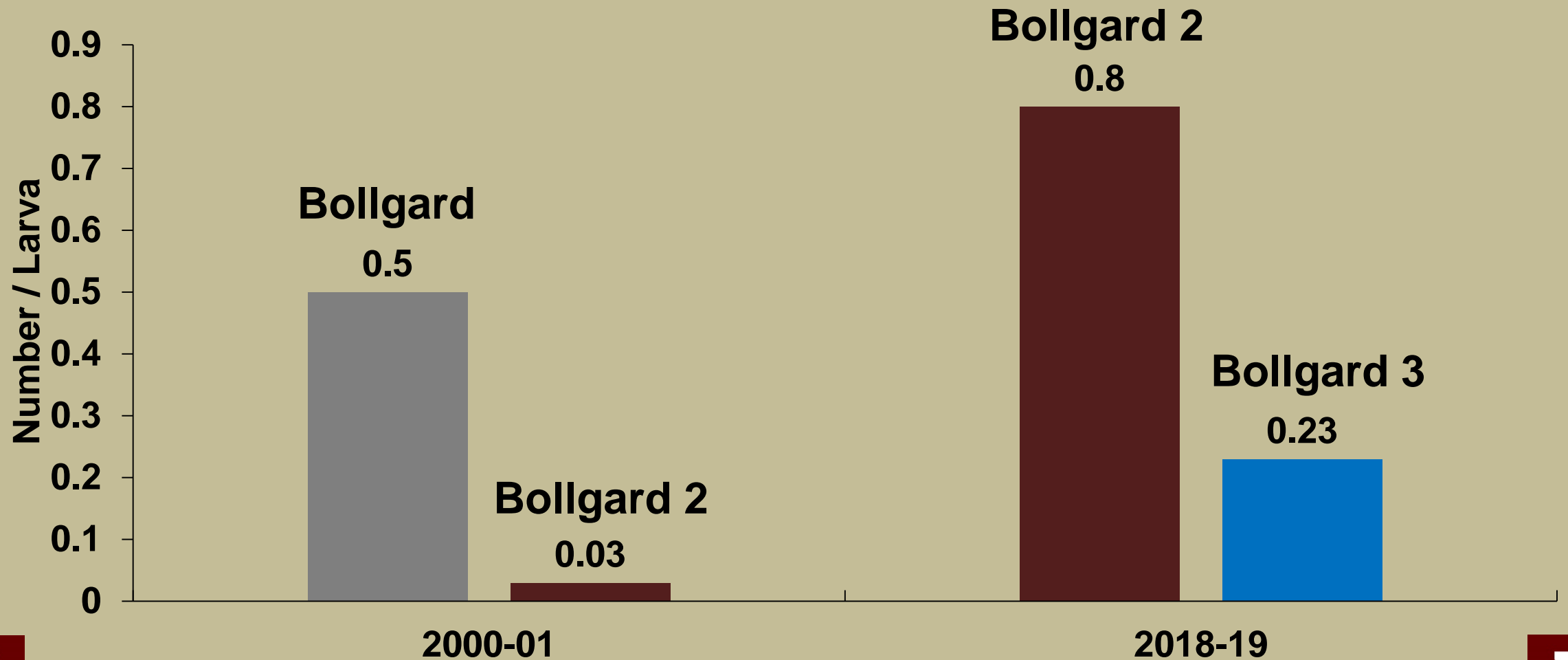
Low but not rare

# Bollworm Damage in Cotton

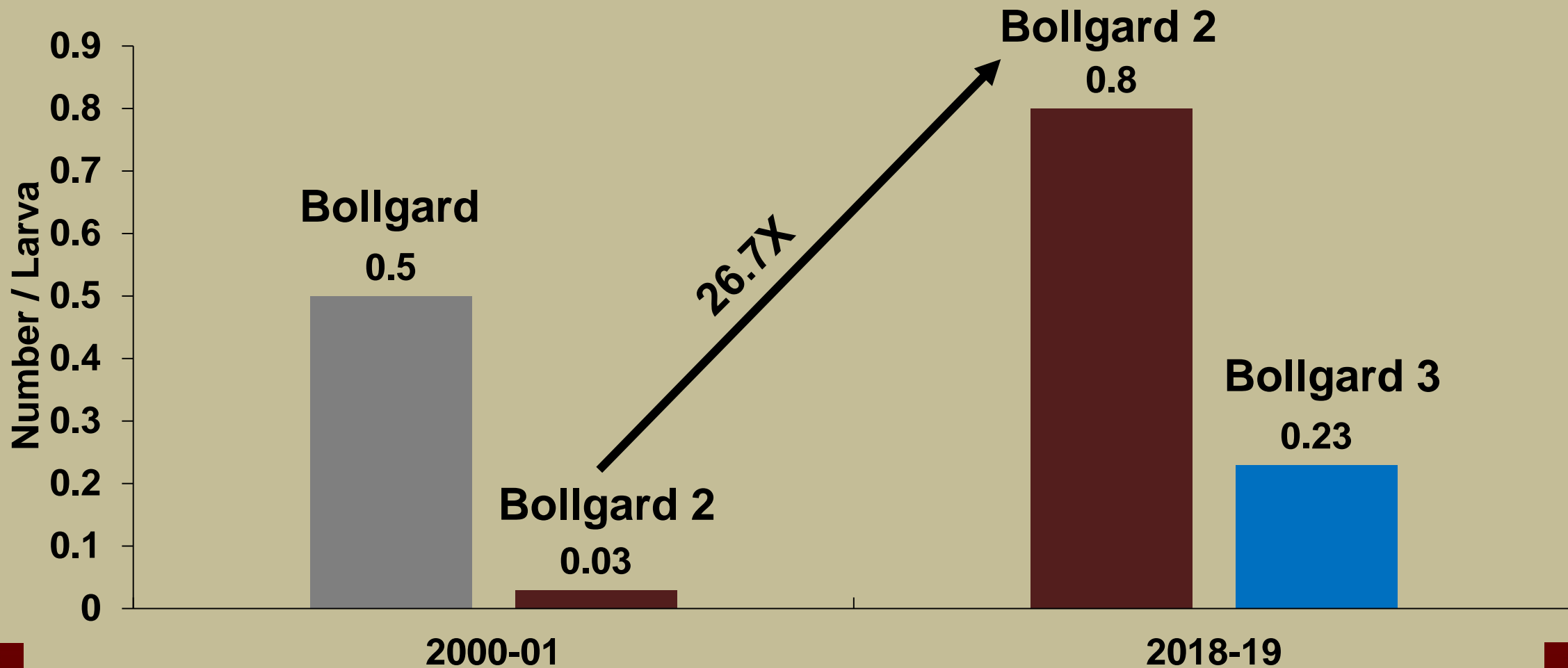
Mr. Russ Godbold, M.S. Student



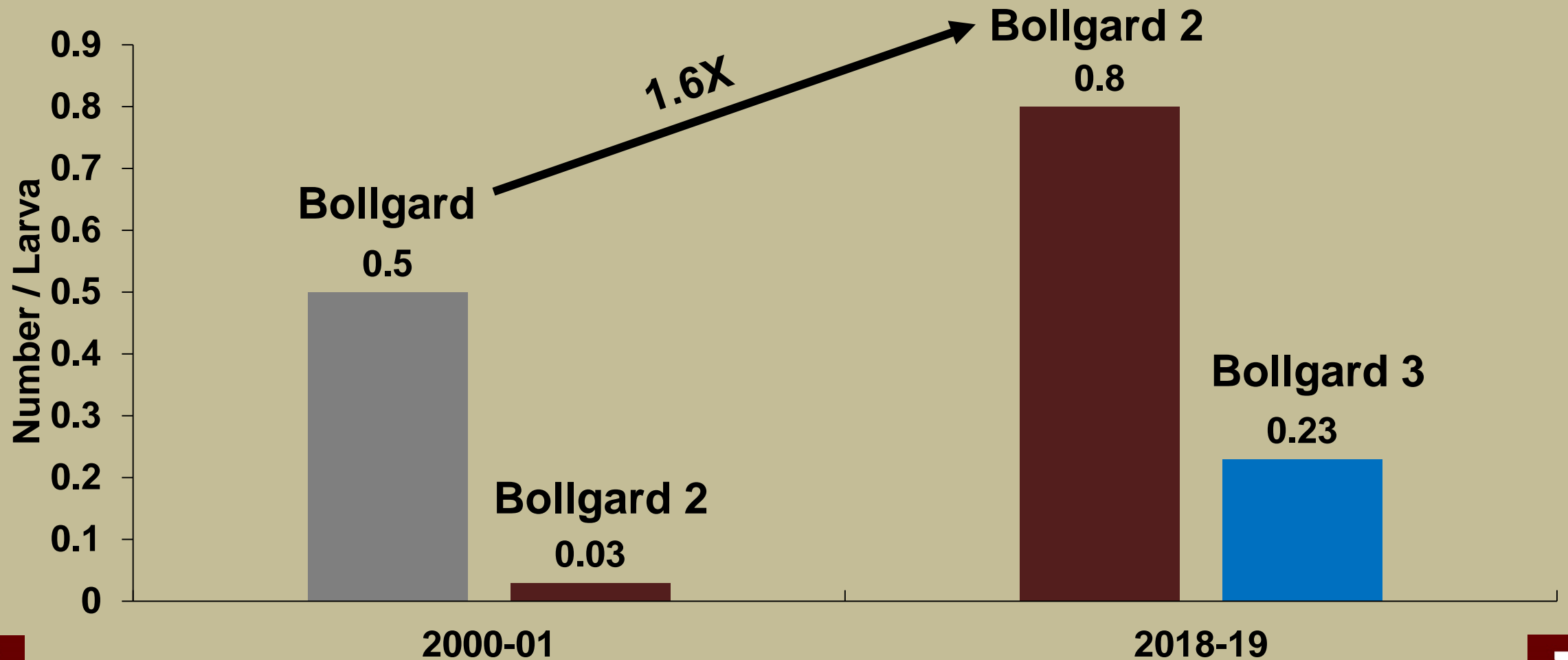
# Bollworm Damage to Squares in Cotton



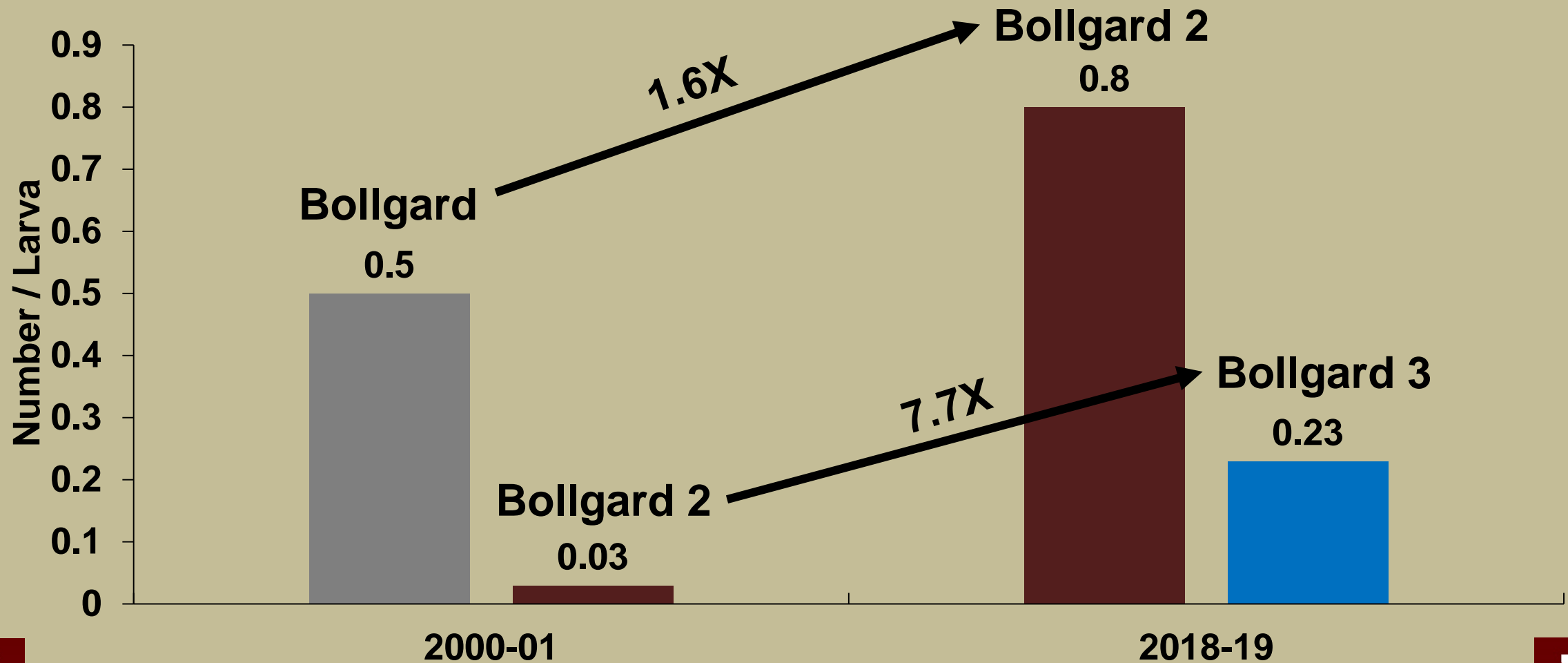
# Bollworm Damage to Squares in Cotton



# Bollworm Damage to Squares in Cotton

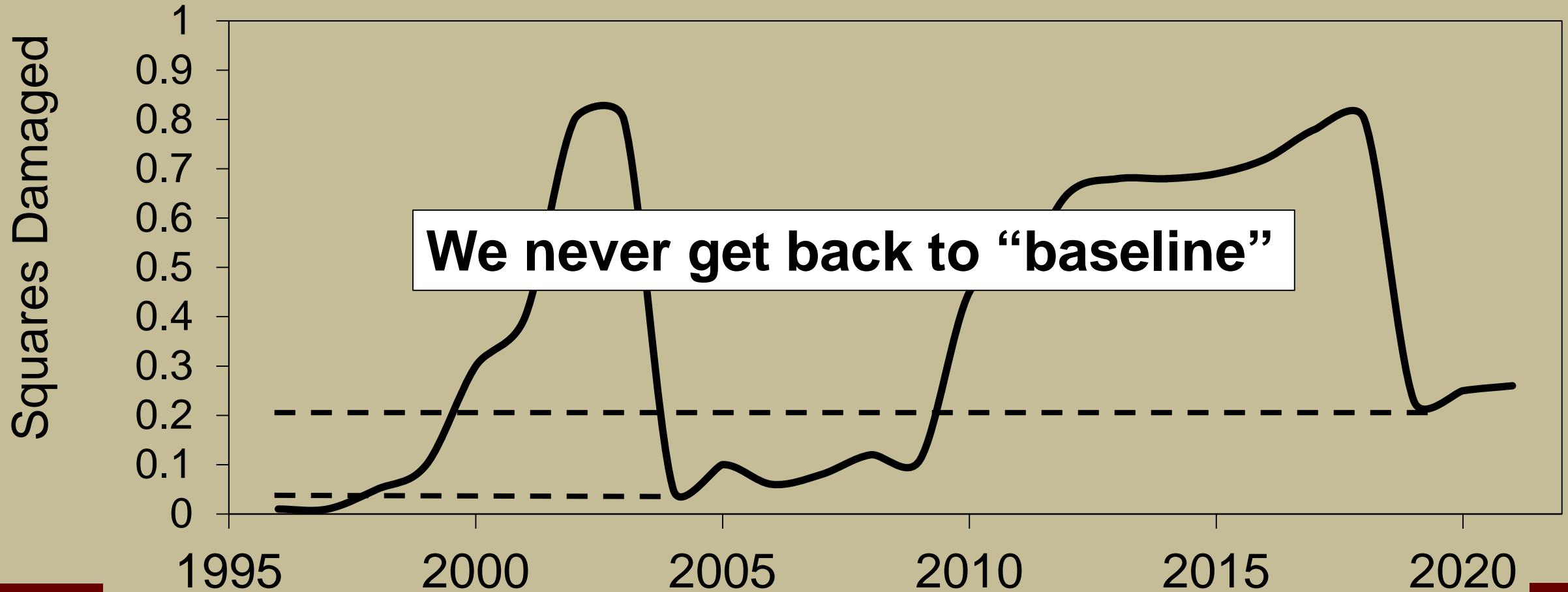


# Bollworm Damage to Squares in Cotton



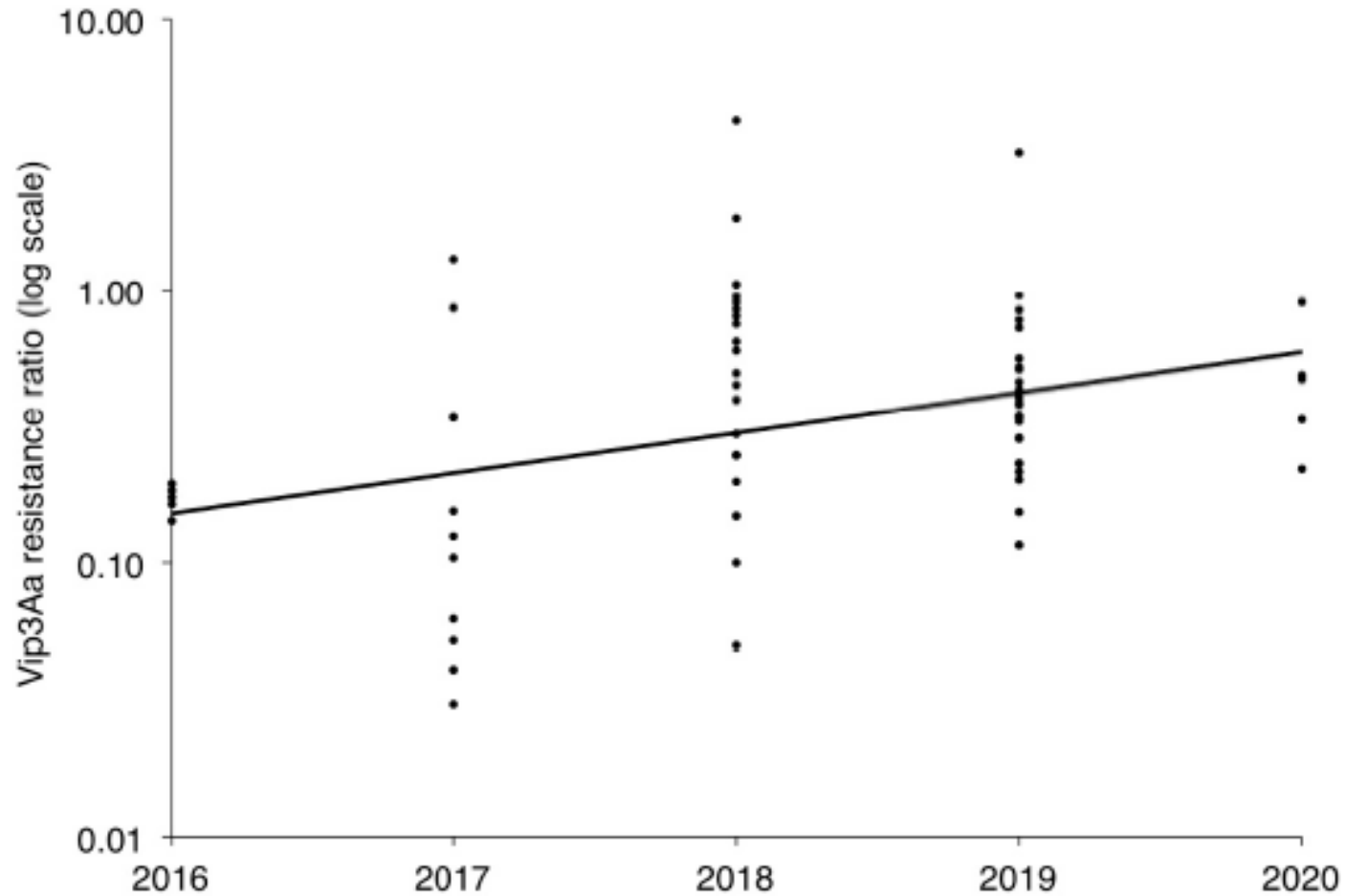


# Evolution of Bollworm Resistance to Bt Traits (Mostly Theoretical – Kinda!)

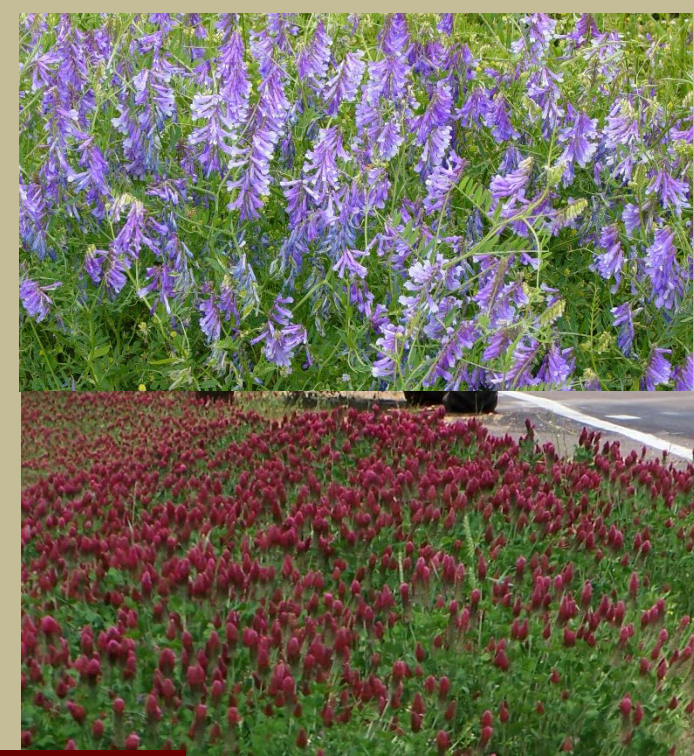


# Resistance Ratio Trend for Vip3a

David Kerns and Fei Yang – Texas A&M



**Figure 2.** Increase from 2016 to 2020 in the Vip3Aa resistance ratio relative to the BZ lab strain for 71 field-derived strains of *Helicoverpa zea*. Linear regression:  $\log(y) = 0.14X - 282$ ;  $R^2 = 0.12$ ;  $df = 69$ ;  $p = 0.003$ .



**Wild Hosts**

**Corn**

**Soybeans, Cotton  
Grain Sorghum, Peanut**



**April**

**May**

**June**

**July**

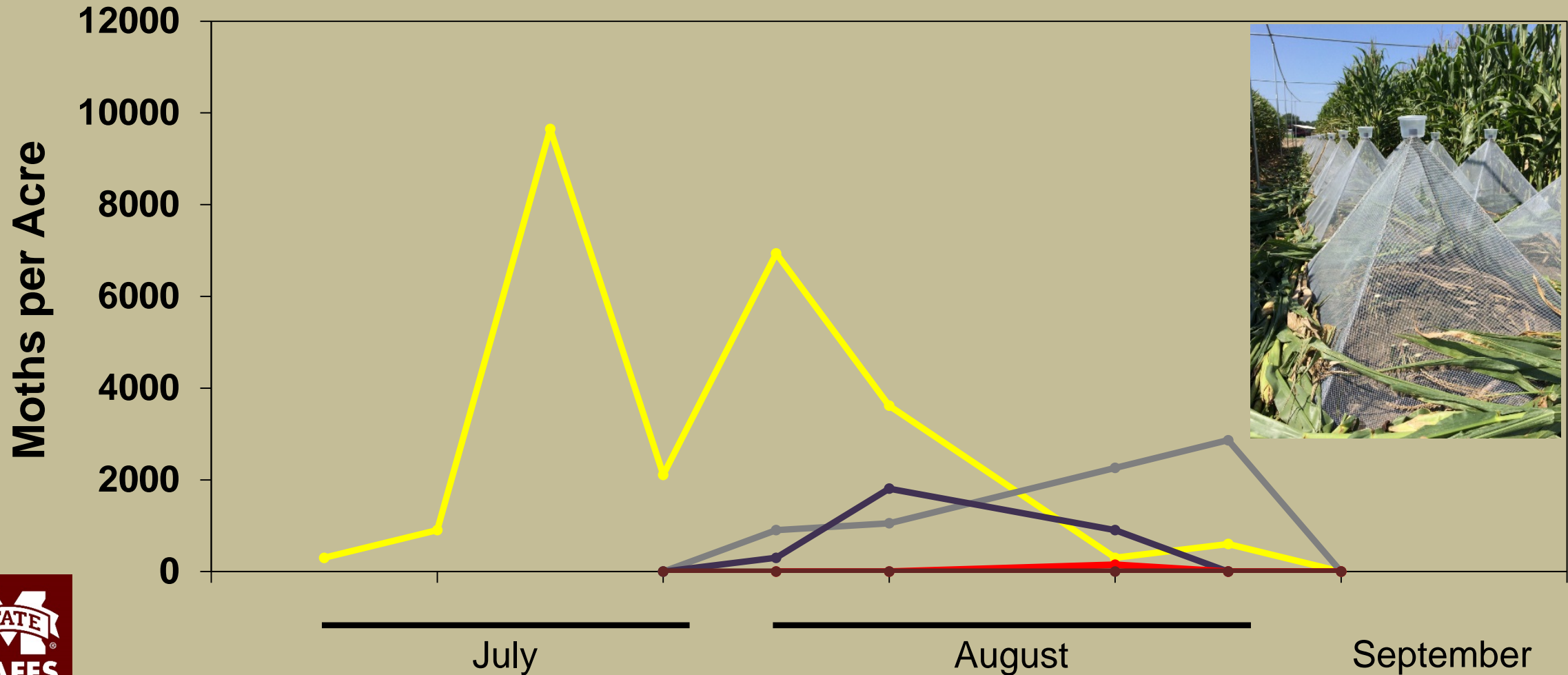
**August**

**September**



# Temporal Emergence of Bollworm

Corn Peanut Grain Sorghum Cotton Soybean



# Resistance is Driven by Selection in Corn



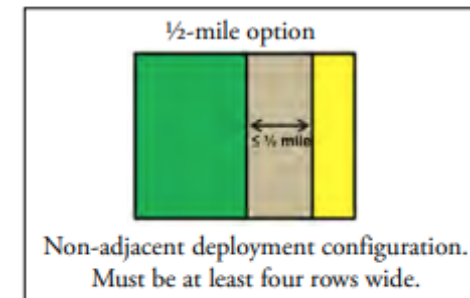
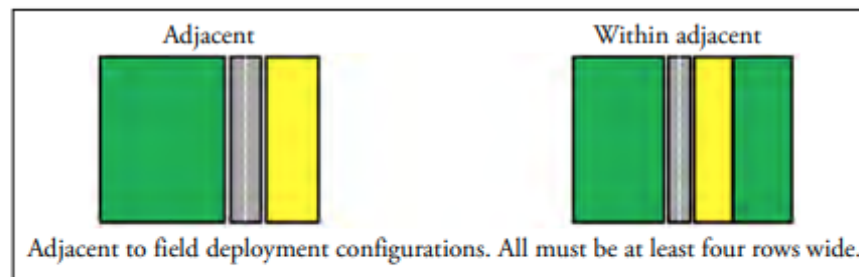
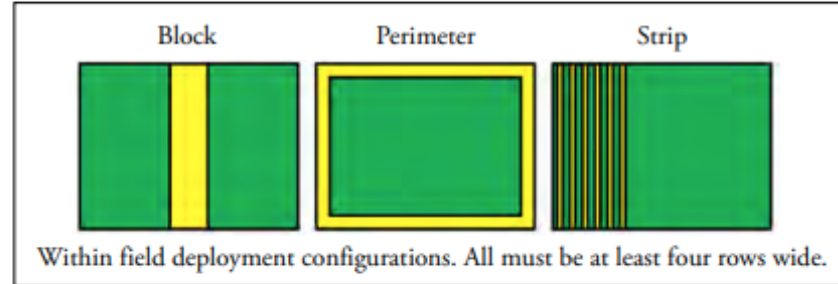


# Consequences for Corn EPA Focus

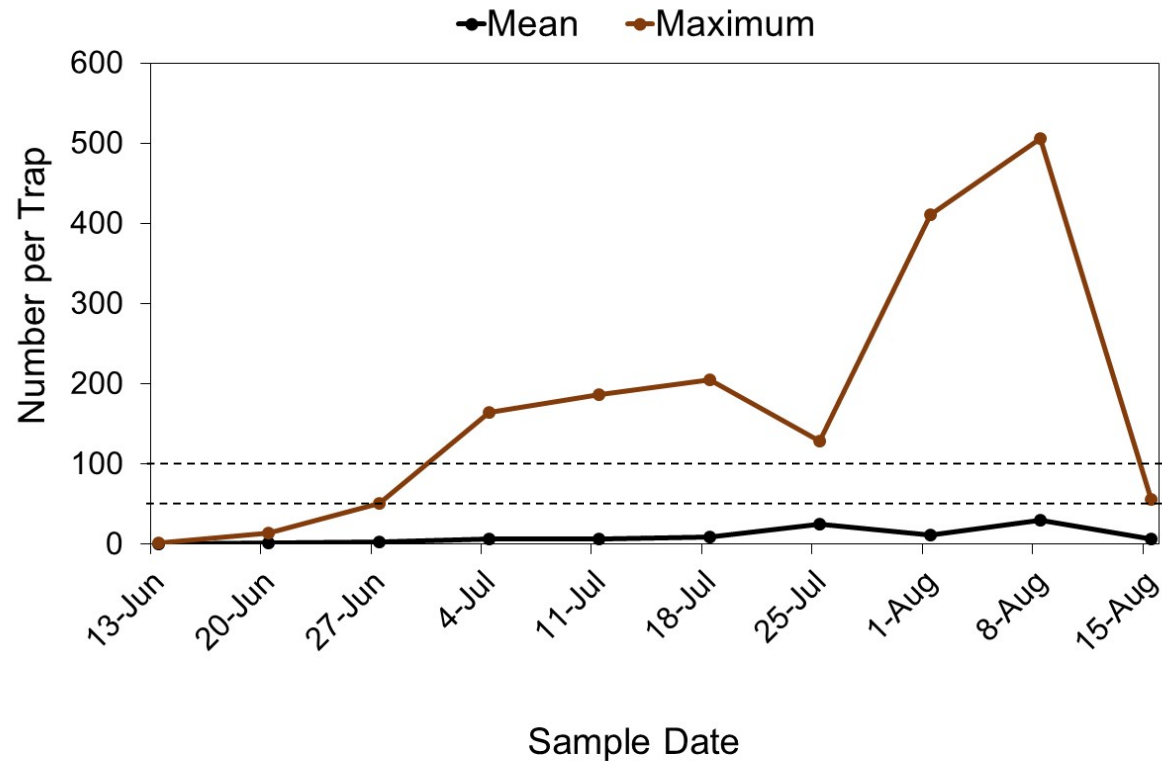
## Refuge Deployment Options

When both rootworm and caterpillar traits are present in a hybrid, growers are required to follow refuge requirements and deployment strategies that satisfy the criteria for both. For example, if a field is planted to a hybrid that has a single caterpillar trait (requires 50% refuge up to ½-mile away) and a single rootworm trait (requires 20% refuge within field or adjacent to the field), the total refuge for that field has to be 50%. There are several ways that this can be accomplished. The entire 50% refuge can be planted within the field or adjacent to the field. Another possibility is that 20% of the refuge may be planted within the field or adjacent to the field and the remaining 30% within ½-mile of the field. Examples of refuge deployment options are illustrated here.

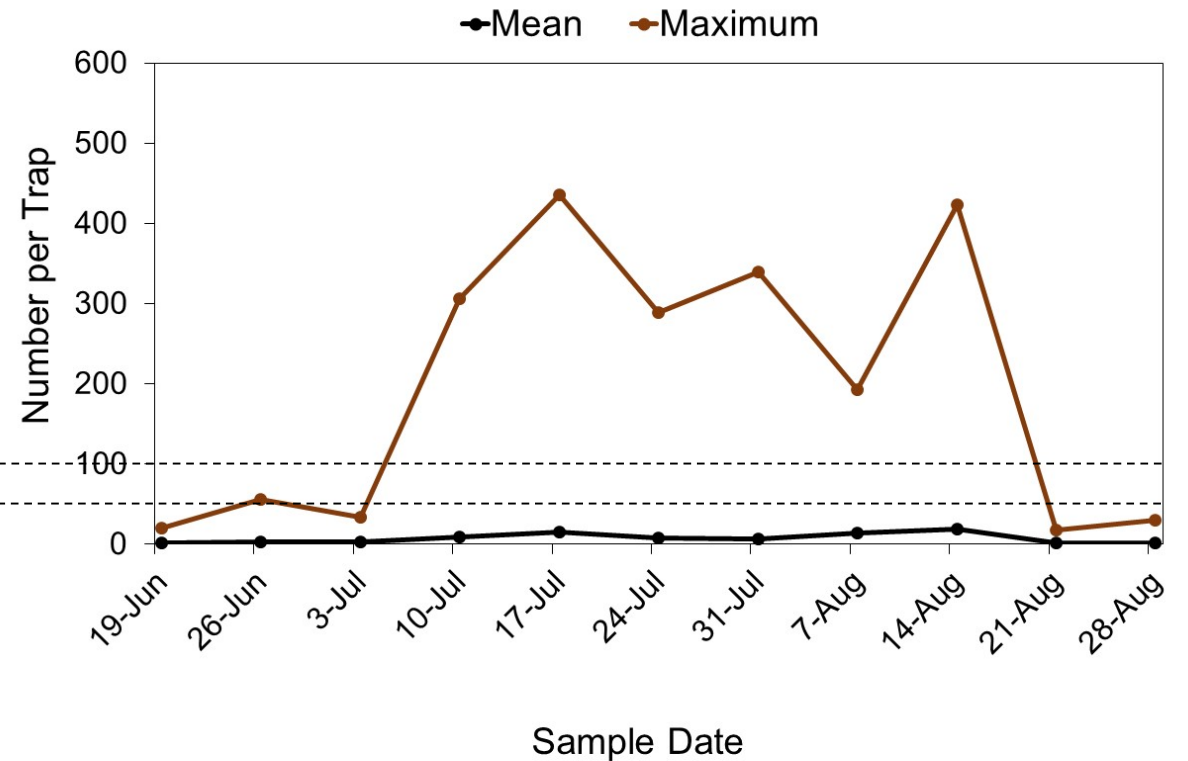
Blended refuge corn products (i.e., non-Bt seed mixed with Bt) may be encountered. This refuge strategy was developed for the Midwest. If these products are planted, a separate structured refuge is still required.



## Southwestern Corn Borer Trapping Mississippi - 2020

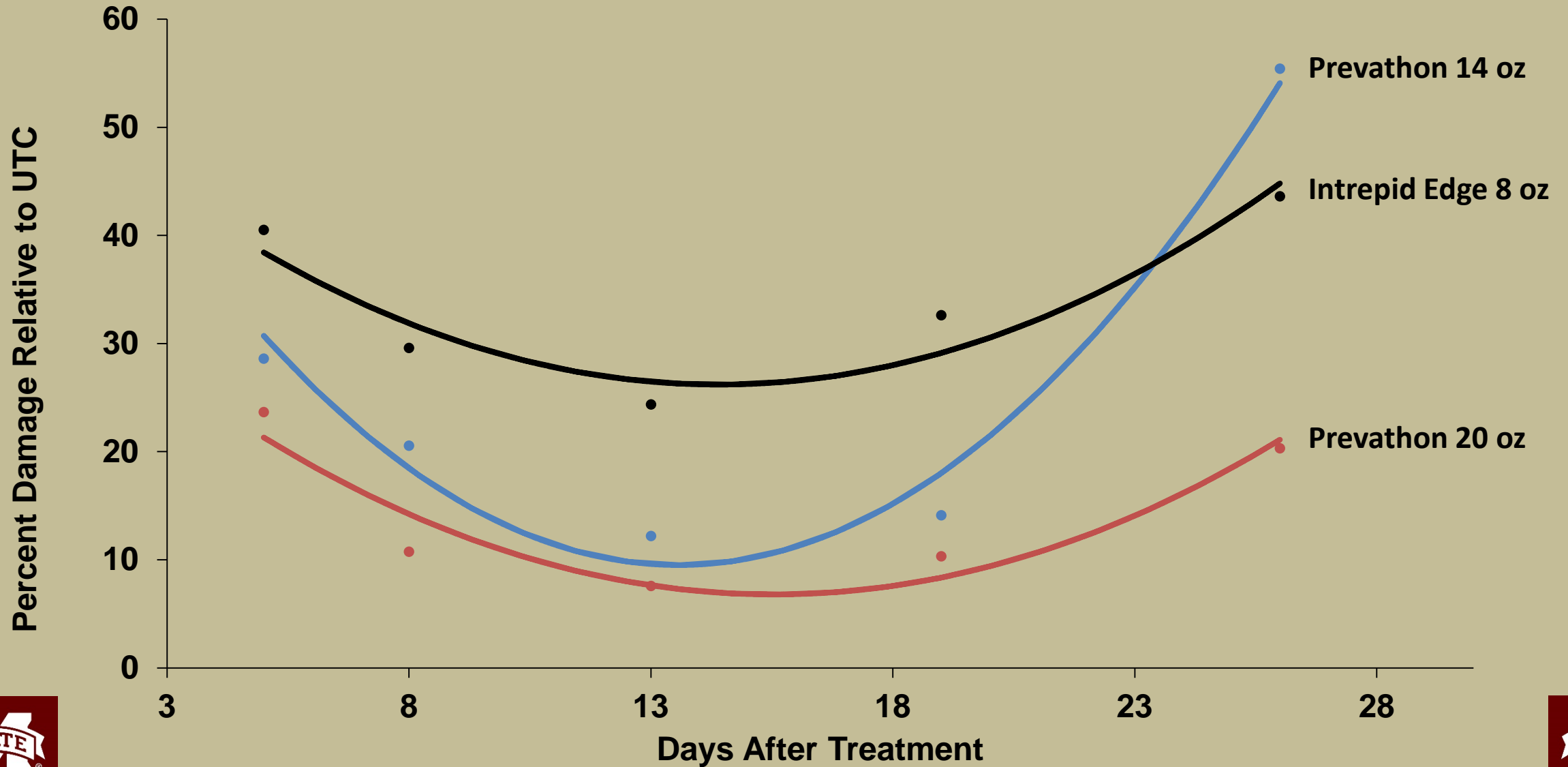


## Southwestern Corn Borer Trapping Mississippi – 2021



# Percent Fruit Damage Over Time

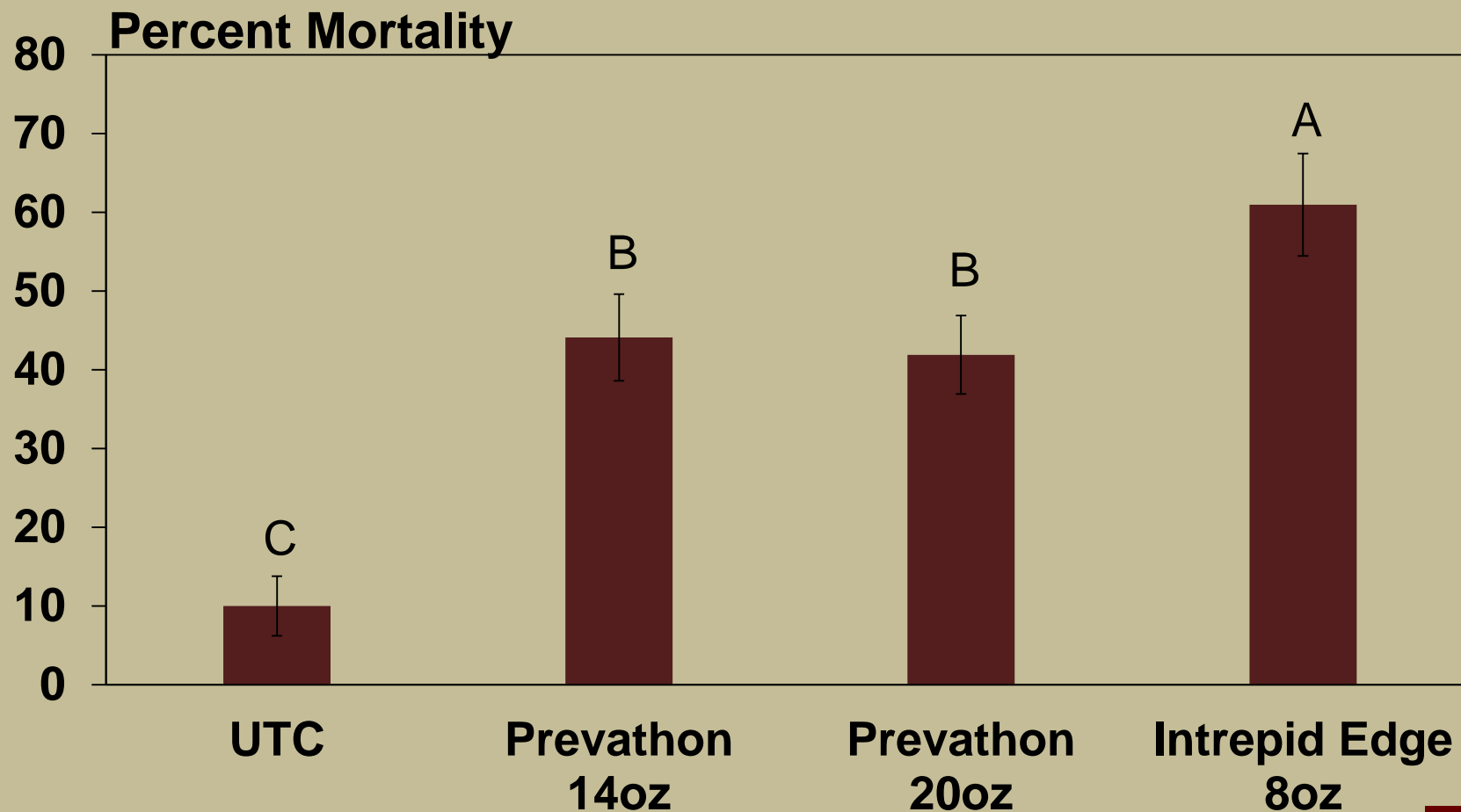
4 Trials - Gus Lorenz





# Bollworms Under Bloomtags

## Mr. Russ Godbold







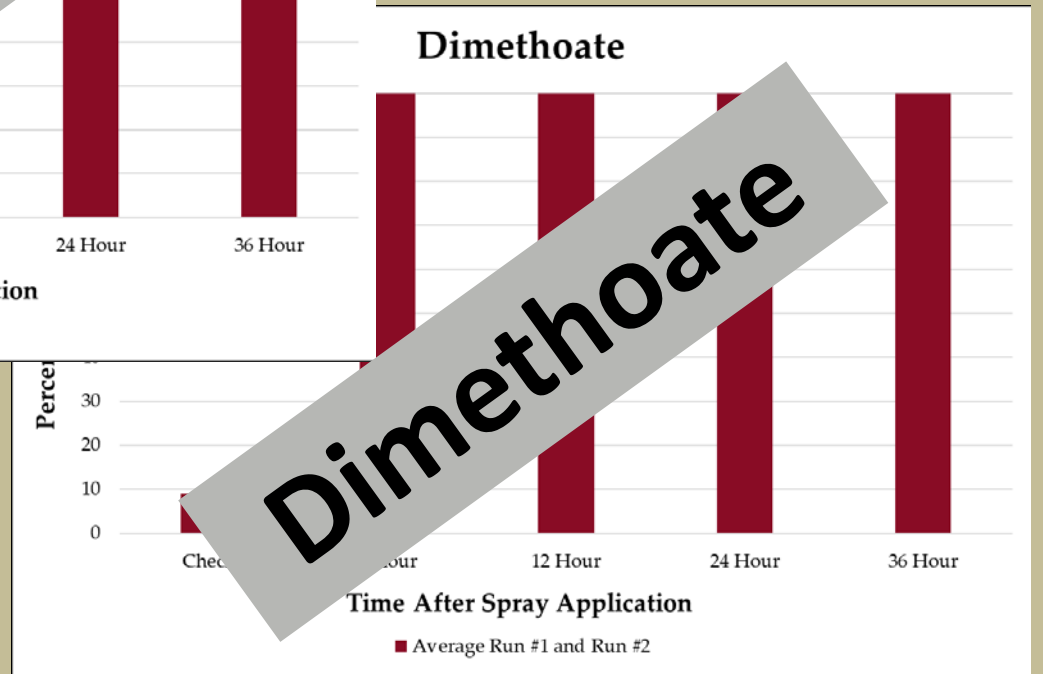
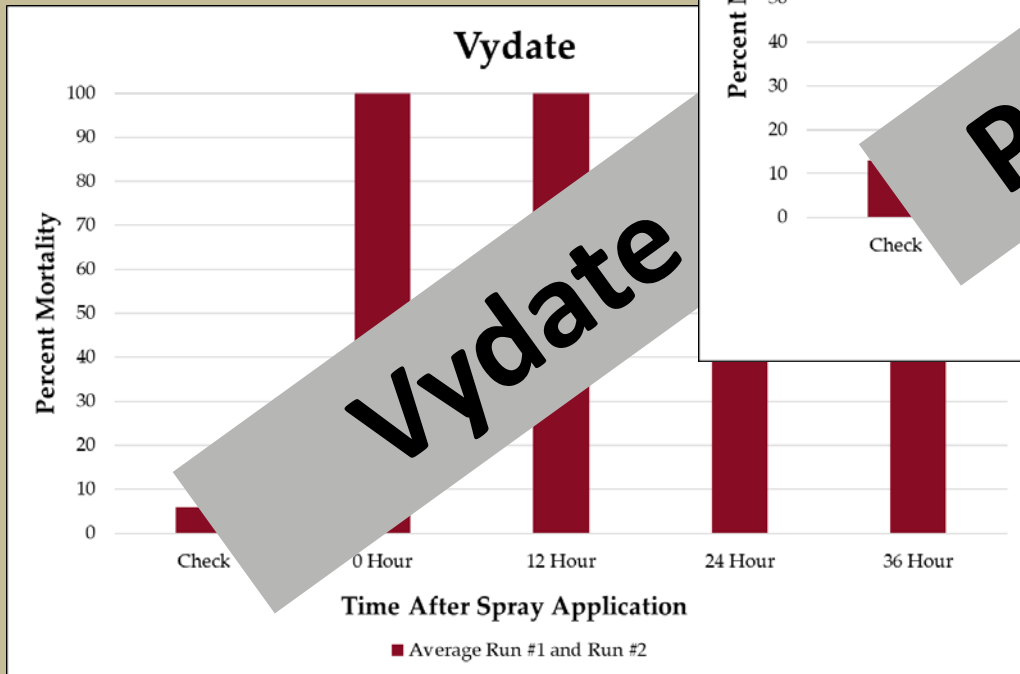
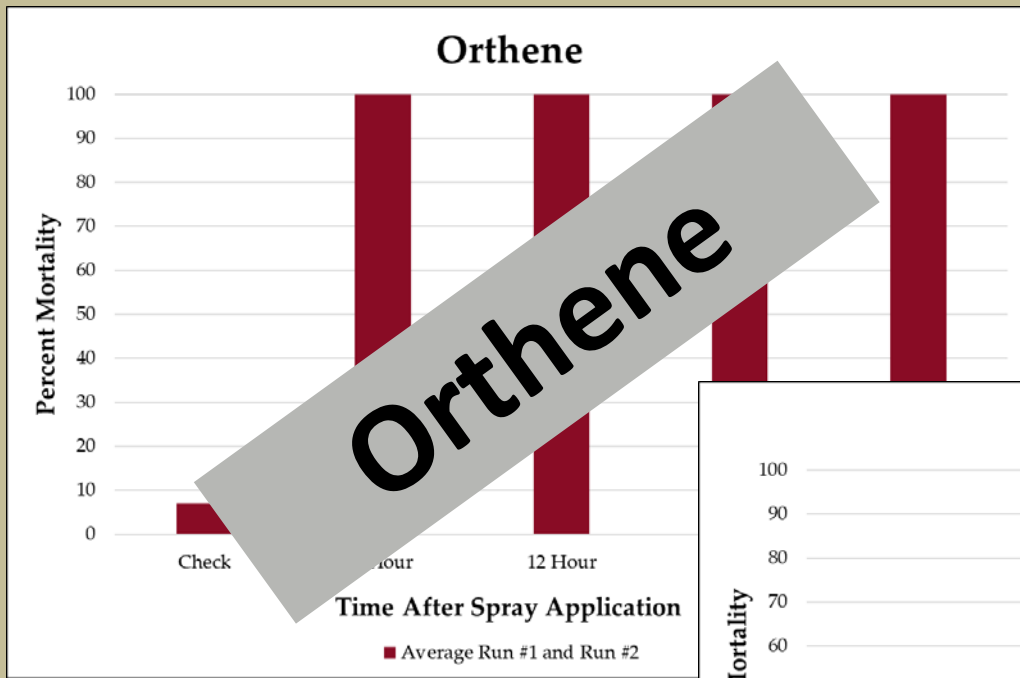




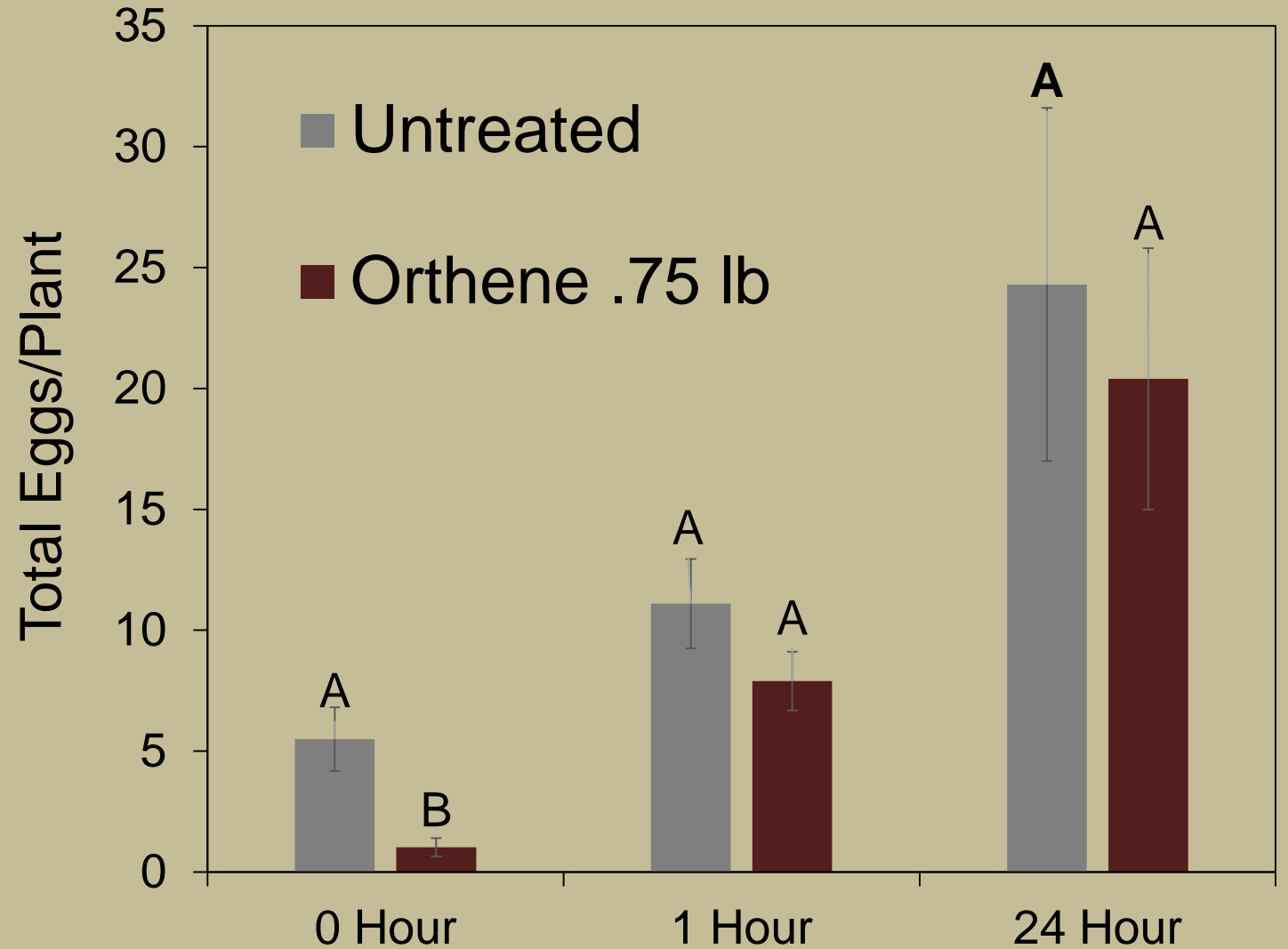
# **Bollworm Moth Control to Prevent Economic Yield Damage in Mississippi Cotton**

**Brett Farmer**

M.S. Student



# Total Eggs Per Plant



# 2018 Cotton Variety Yields

- Best 2-Gene minus Best 3-Gene  
= **109 lbs**
- $0.70 \times 109 = \mathbf{\$76.30}$
- 2 Apps ~ **\$40-50**

DP 1646 B2XF	1223*
NG 3729 B2XF	1131
DG 3526 B2XF	1119
ST 5471GLTP	1114
DP 1845 B3XF	1109
PHY 430 W3FE	1107
PHY 320 W3FE	1090
DP 1835 B3XF	1085
PHY 480 W3FE	1034
ST 5122GLT	1023

# 2020 Cotton Variety Yields

- Best 2-Gene minus  
Best 3-Gene  
= **-54 lbs**

- 2 Apps ~ **\$40-50**

PHY 443 W3FE	1188
DP 2038 B3XF	1139
PHY 400 W3FE	1136
DP 2012 B3XF	1134
DP 1646 B2XF	1118
PHY 390 W3FE	1110
ST 4990 B3XF	1105
NG 4936	1058
DG 3520 B2XF	1040
NG 4098 B3XF	998



**TOP**

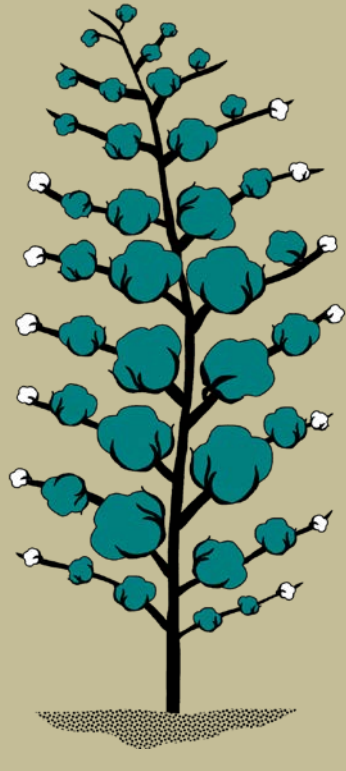
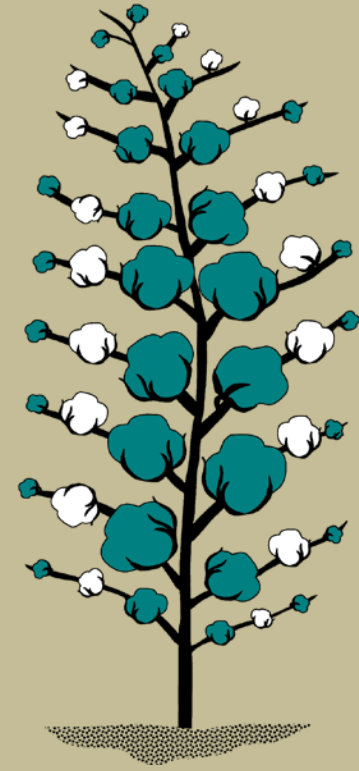
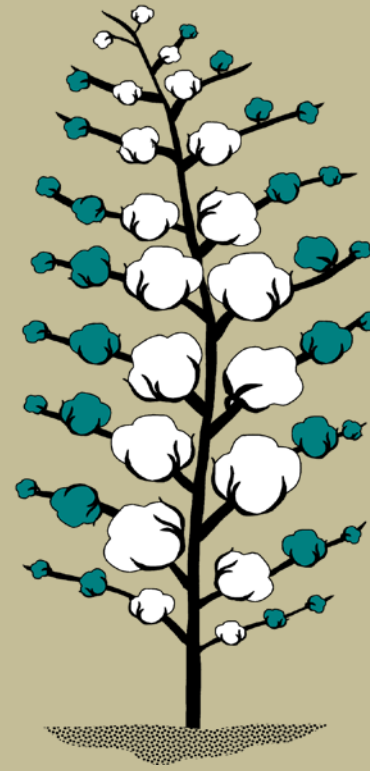
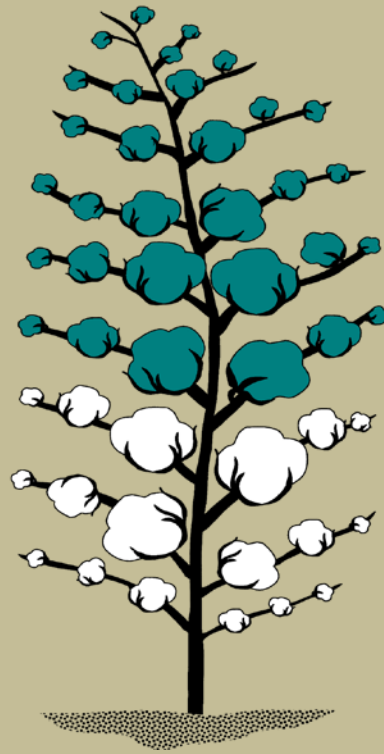
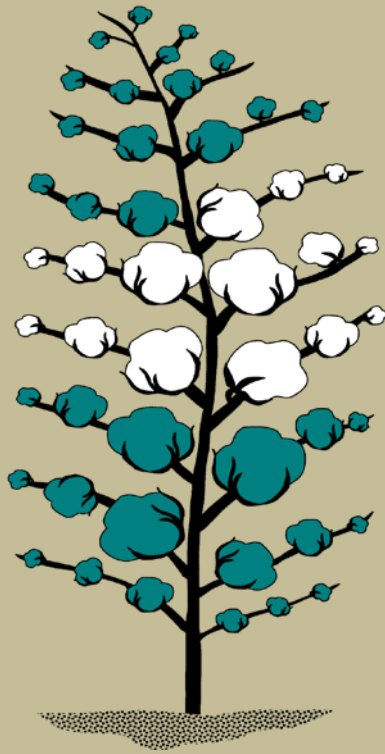
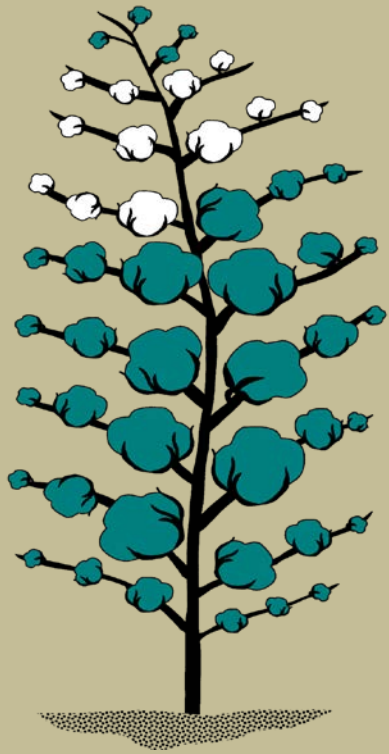
**MIDDLE**

**BOTTOM**

**ONE**

**TWO**

**THREE**



**8.6**

**6.9**

**7.8**

**6.9**

**7.8**

**7.5**

**bolls**

**bolls**

**bolls**

**bolls**

**bolls**

**bolls**









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