

Bollworm Resistance Issues

**Louisiana Agricultural Technology and Management
Conference
February 12-14, 2020
Sebe Brown**





Louisiana Bt Performance





Kernel x Bt Technology



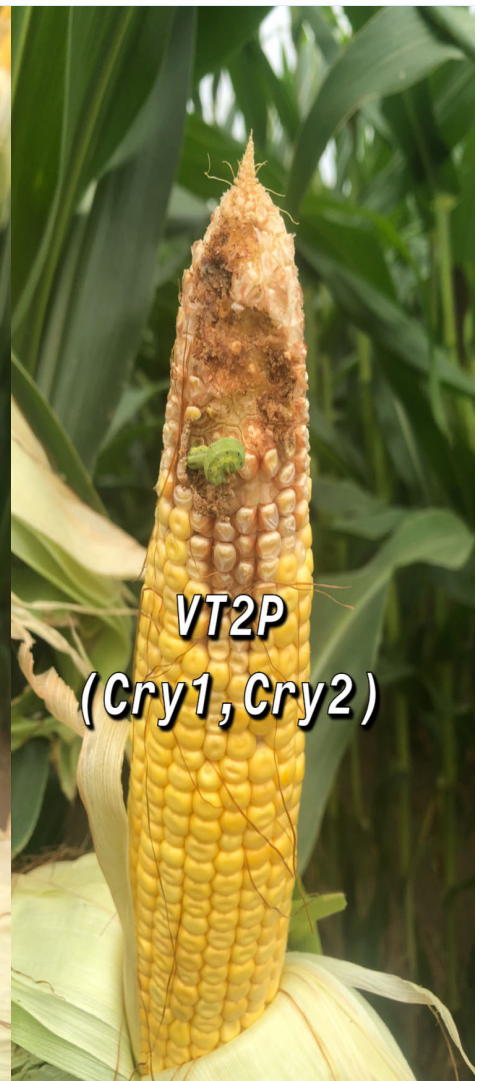
Intrasect
(Cry1Ab, Cry1F)



Trecepta
(Cry1, Cry2,
Vip3A)



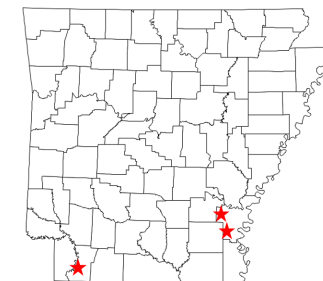
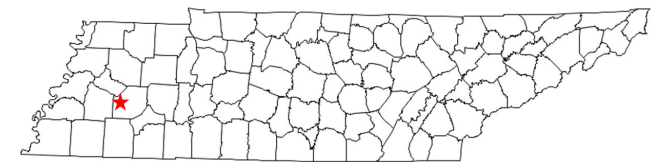
RR2 (Non-Bt)



VT2P
(Cry1, Cry2)

MID-SOUTH 2019 - CRYI Ac

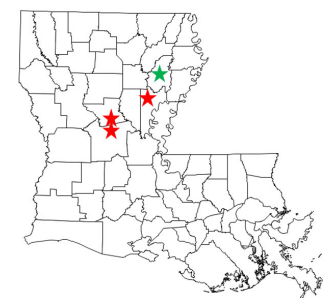
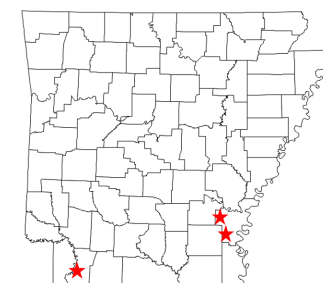
Insect strain	N ^a	LC ₅₀ (95% CL) ($\mu\text{g}/\text{cm}^2$) ^b	Slope \pm SE	X ²	df	Resistance ratio ^c
CBW-BZ-SS-TAMU	640	0.11 (0.07, 0.16)	1.10 \pm 0.11	60.8	34	1.0
CBW-TX-SS-TAMU	640	0.09 (0.07, 0.12)	1.53 \pm 0.13	39.0	34	0.8
CBW-AR-LE-VT2P	512	>100.0	/	/	/	> 909.1
CBW-AR-TR-VT2P	512	>100.0	/	/	/	> 909.1
→ CBW-LA-AA-BG2	512	>100.0	/	/	/	> 909.1
→ CBW-LA-AA-VT2P	512	8.97 (5.90, 14.29)	0.93 \pm 0.10	39.8	26	81.5
→ CBW-LA-WB-VT2P	512	15.64 (9.11, 30.75)	0.76 \pm 0.10	47.9	26	142.2
CBW-TN-JN-VT2P	512	>100.0	/	/	/	> 909.1
CBW-BZ-SS-USDA	640	0.18 (0.15, 0.22)	1.97 \pm 0.16	146.3 7	33	1.0
CBW-PK-AR-NBt corn	512	27.71 (15.42, 63.60)	0.75 \pm 0.09	72.28	26	153.9
→ CBW-HB-LA-CC	512	12.30 (7.39, 24.14)	0.71 \pm 0.08	81.73	26	68.3



D. Kerns

MID-SOUTH 2019 – CRY2Ab2

Insect strain	N ^a	LC ₅₀ (95% CL) ($\mu\text{g}/\text{cm}^2$) ^b	Slope \pm SE	X ²	df	Resistance ratio ^c
CBW-BZ-SS-TAMU	960	0.20 (0.17, 0.24)	1.61 \pm 0.09	30.7	26	1.0
CBW-TX-SS-TAMU	448	0.69 (0.51, 0.95)	1.89 \pm 0.22	32.2	22	3.4
CBW-AR-LE-VT2P	512	4.42 (3.18, 6.35)	1.39 \pm 0.15	24.2	26	7.0
CBW-AR-TR-VT2P	512	8.06 (5.60, 12.56)	0.99 \pm 0.10	33.4	26	12.8
→ CBW-LA-AA-BG2	512	>20.0	/	/	/	> 31.7
→ CBW-LA-AA-VT2P	512	15.12 (8.80, 34.39)	1.03 \pm 0.15	32.5	26	24.0
→ CBW-LA-WB-VT2P	512	1.62 (1.24, 2.12)	1.27 \pm 0.10	27.1	26	2.6
CBW-TN-JN-VT2P	512	>20.0	/	/	/	> 31.7
CBW-BZ-SS-USDA	640	0.98 (0.75, 1.33)	1.11 \pm 0.08	193.3 7	33	1.0
CBW-PK-AR-NBt corn	512	3.16 (1.30, 12.89)	0.37 \pm 0.06	33.57	26	3.23
→ CBW-HB-LA-CC	512	> 10.0	/	/	/	> 10.2



MID-SOUTH 2019 – VIP3Aa39

Insect strain	N ^a	LC ₅₀ (95% CL) ($\mu\text{g}/\text{cm}^2$) ^b	Slope \pm SE	X ²	df	Resistance ratio ^c (BZ-SS)	Resistance ratio ^c (TX-SS)
CBW-BZ-SS-TAMU	448	0.69 (0.56, 0.87)	3.66 \pm 0.53	8.5	22	1.0	0.24
CBW-TX-SS-TAMU	448	0.17 (0.14, 0.21)	2.84 \pm 0.29	10.5	22	-2.3	1.0
CBW-AR-LE-VT2P	448	0.39 (0.33, 0.47)	2.77 \pm 0.27	18.6	22	-1.8	2.3
CBW-AR-TR-VT2P	448	0.15 (0.13, 0.19)	2.53 \pm 0.25	6.9	22	-0.2	0.9
→ CBW-LA-AA-BG2	448	0.24 (0.20, 0.29)	2.50 \pm 0.24	16.8	22	-2.9	1.4
→ CBW-LA-AA-VT2P	448	0.23 (0.18, 0.28)	2.16 \pm 0.19	24.3	22	-3.0	1.4
→ CBW-LA-WB-VT2P	448	0.14 (0.12, 0.17)	2.48 \pm 0.25	11.8	22	-4.9	-1.2
CBW-TN-JN-VT2P	448	0.32 (0.24, 0.44)	2.50 \pm 0.33	38.8	22	-2.2	1.9
CBW-BZ-SS-USDA	640	0.39 (0.31, 0.49)	1.49 \pm 0.10	217	33	1.0	--
CBW-PK-AR-NBt corn	512	0.21 (0.17, 0.26)	2.15 \pm 0.19	132.4	26	-1.9	--



BT RESISTANCE SURVEY SUMMARY

Percentage of populations expressing RR exceeding 10X

2016 ¹		2017		2018		2019	
CryIAc	40%	CryIAc	100%	CryIAc	93.75%	CryIAc	95.65%
Cry2Ab2	80%	Cry2Ab2	76.92%	Cry2Ab2	73.33%	Cry2Ab2	73.33%
CryIF	ND	CryIF ⁴	28.5-100%	CryIF	100%	CryIF	100%
Vip3A	0%	Vip3A	0%	Vip3A	0%	Vip3A	0%

¹Small sample size from the Mid-South; Bad CryIF toxin

²RRs were >5.4 or >10.9, depending on highest concentration tested. Data suggests “true” RRs likely all exceeded 10X for all populations

***H. zea*-F₂ FAMILIES SURVIVING THE DIAGNOSTIC CONCENTRATION OF VIP3Aa5 I (3 μg/cm²)**

				7-day survival	
Location	Collection date	Method to establish the F ₂ families	Number of F ₂ families screened	Number of surviving families*	Number of 3 rd and 4 th instar larvae
Texas	April-August, 2018 and 2019	Light trap/ Cross with SS♀	126	1	7
Louisiana	June, 2019	Cross with SS♀	21	1	21
Mississippi	July, 2019	Cross with SS♀	15	0	0
Tennessee	July, 2019	Cross with SS♀	6	0	0
			Total	2 (1.2%)	28

*5 survivors with at least 1 larva ≥ 3rd instar

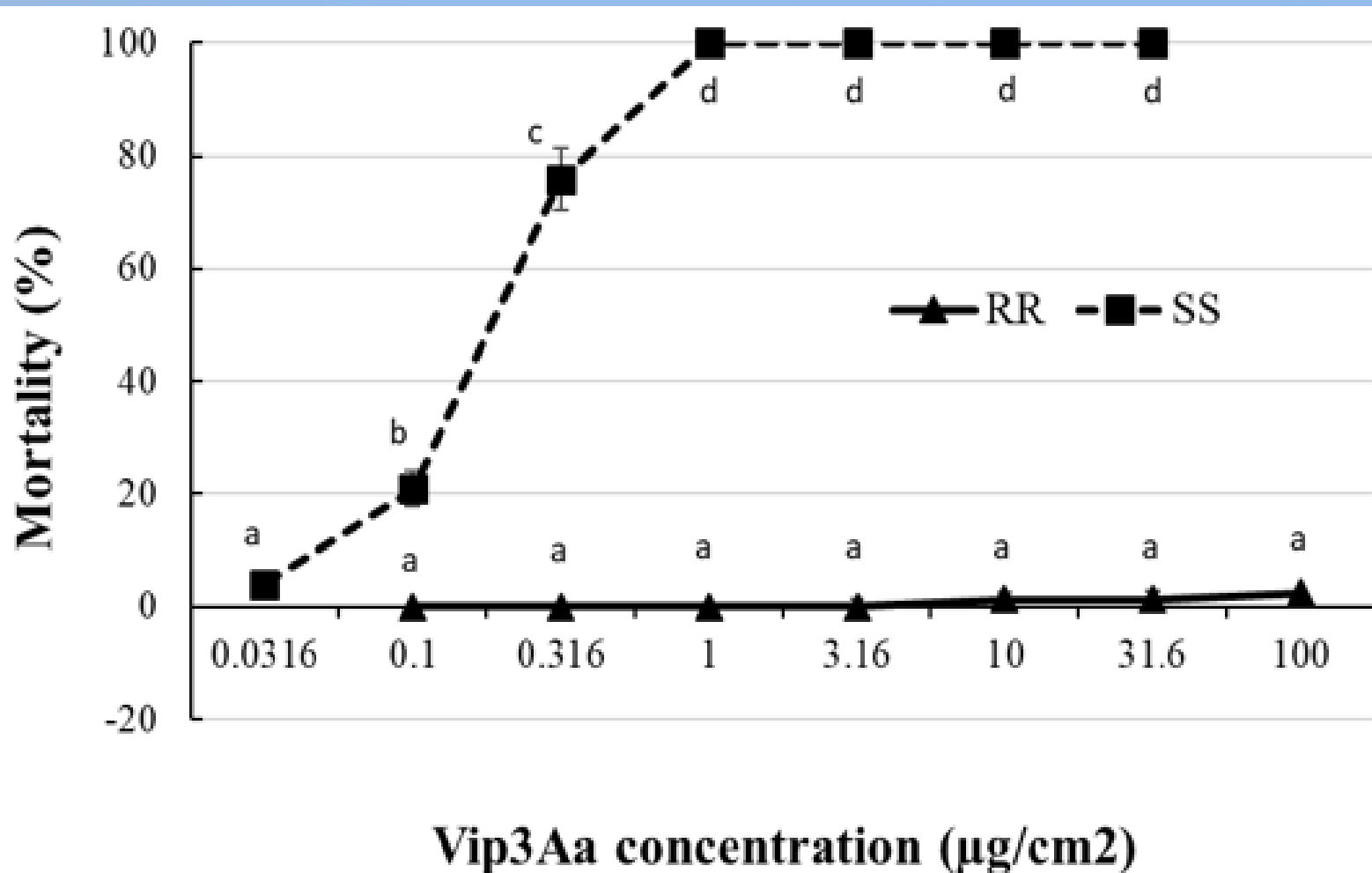
**VIP resistance gene is not rare but not common
Allele frequency (0.6%) = 0.6% moths carry this gene
600 moths 3.6 moths carry the allele**

MEDIAN LETHAL CONCENTRATION (LC₅₀) OF DIFFERENT POPULATIONS OF *H. zea* AGAINST VIP3Aa39 PROTEIN

Family	Vip3Aa39 concentration (μg/cm ²)	LC ₅₀ (μg/cm ²)	Resistance ratio
BZ-SS	-	0.17	1.0
TX-LT-70	100	≥100	≥588.24*
LA-M1	31.6	≥31.6	≥185.88*

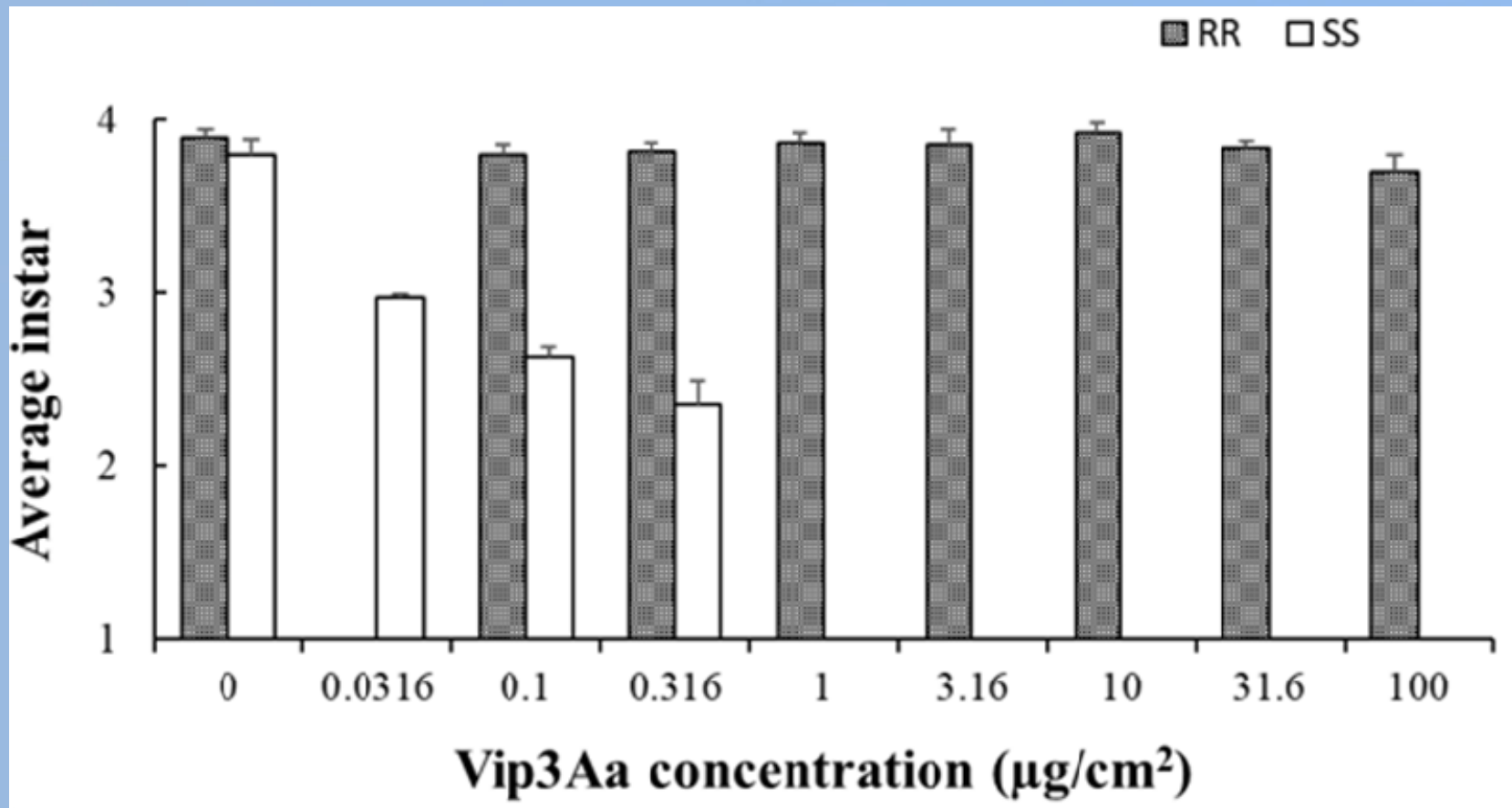


RR vs SS Vip Survivable





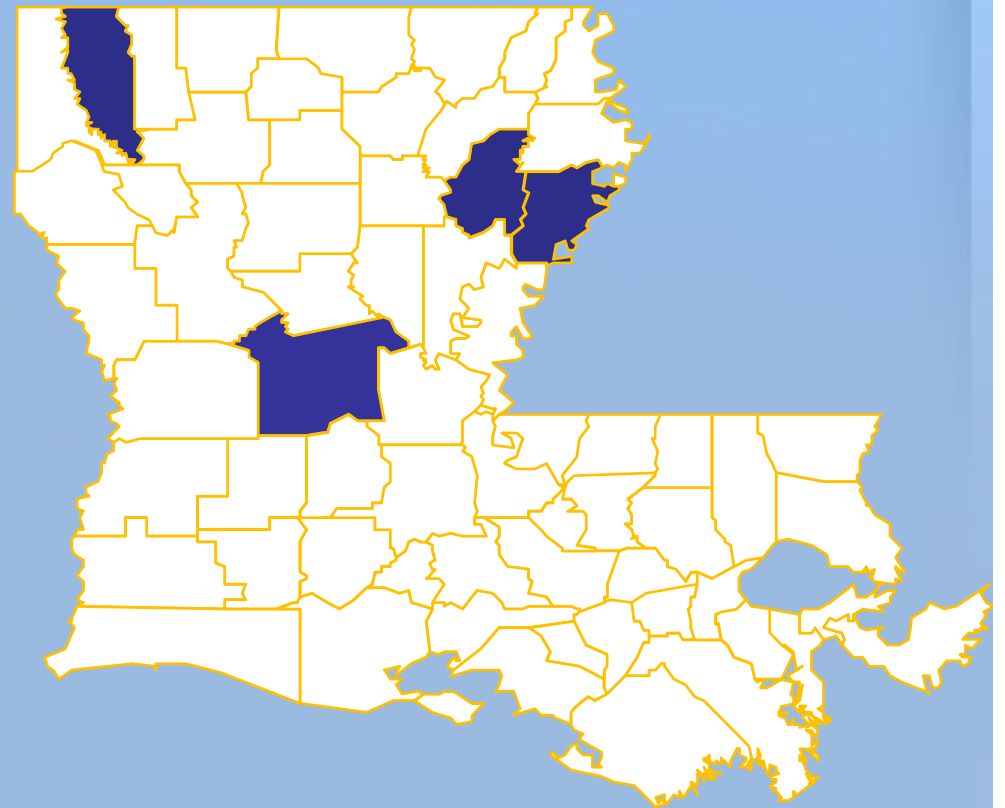
Fitness Costs of Vip Resistance





Bt Sentinel Plot Locations

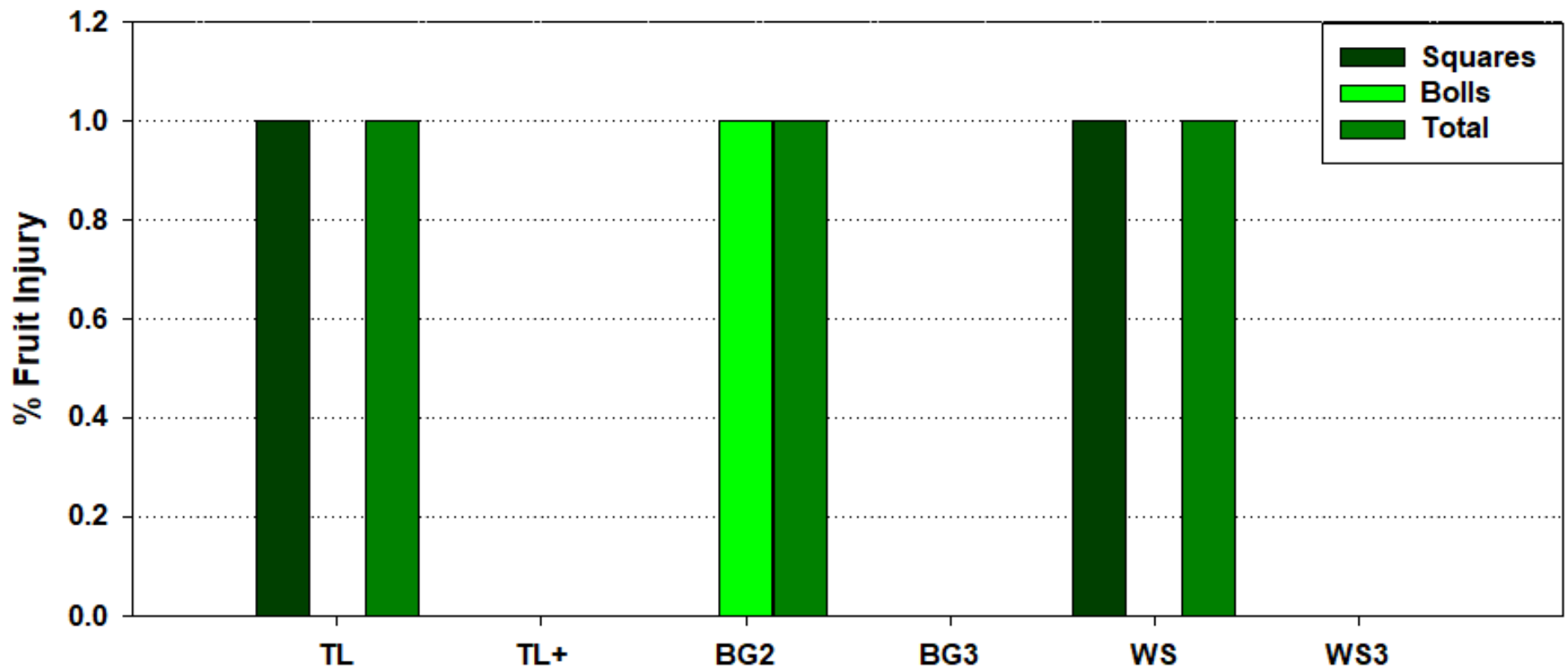
- Red River Station
- Macon Ridge Station
- Northeast Station
- Rapides Parish: Pete DeKeyzer Farm





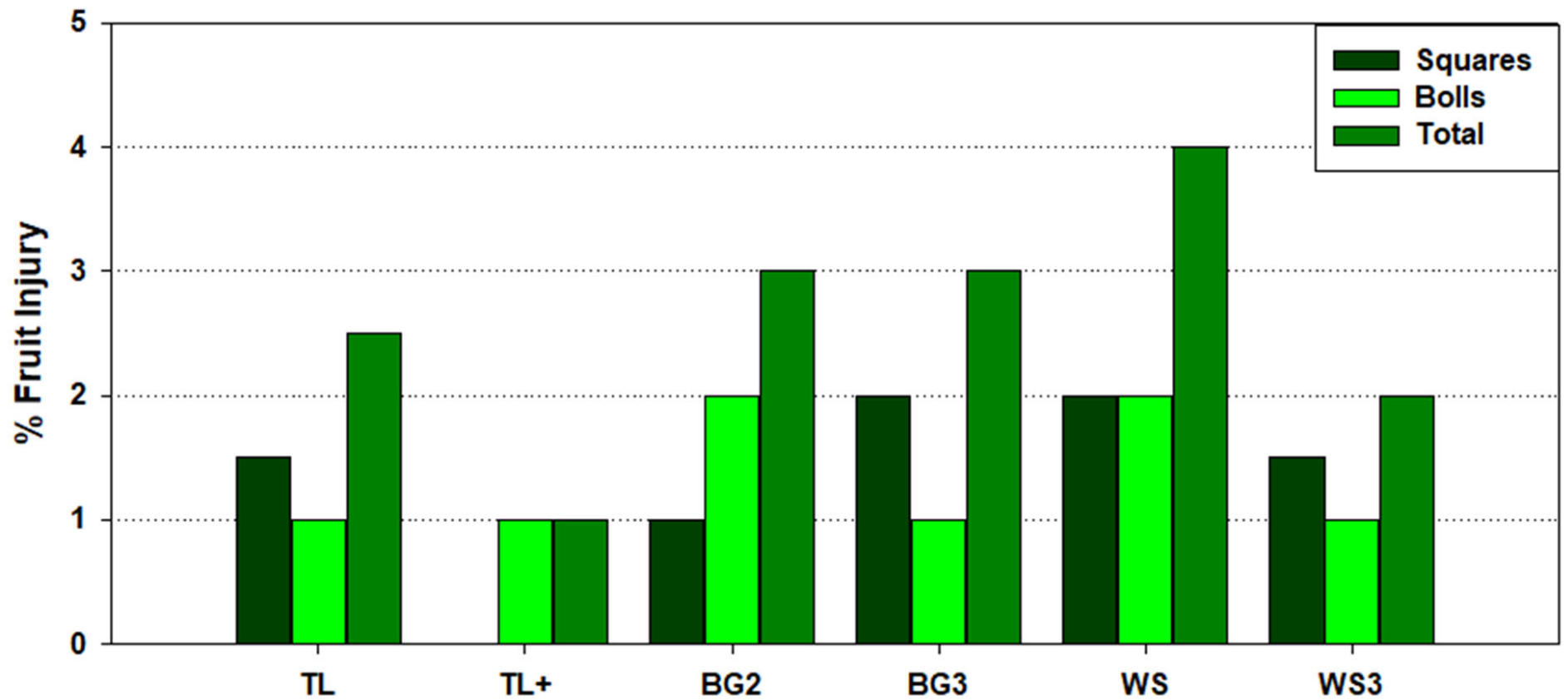


2019: MRRS





2019: DLRS



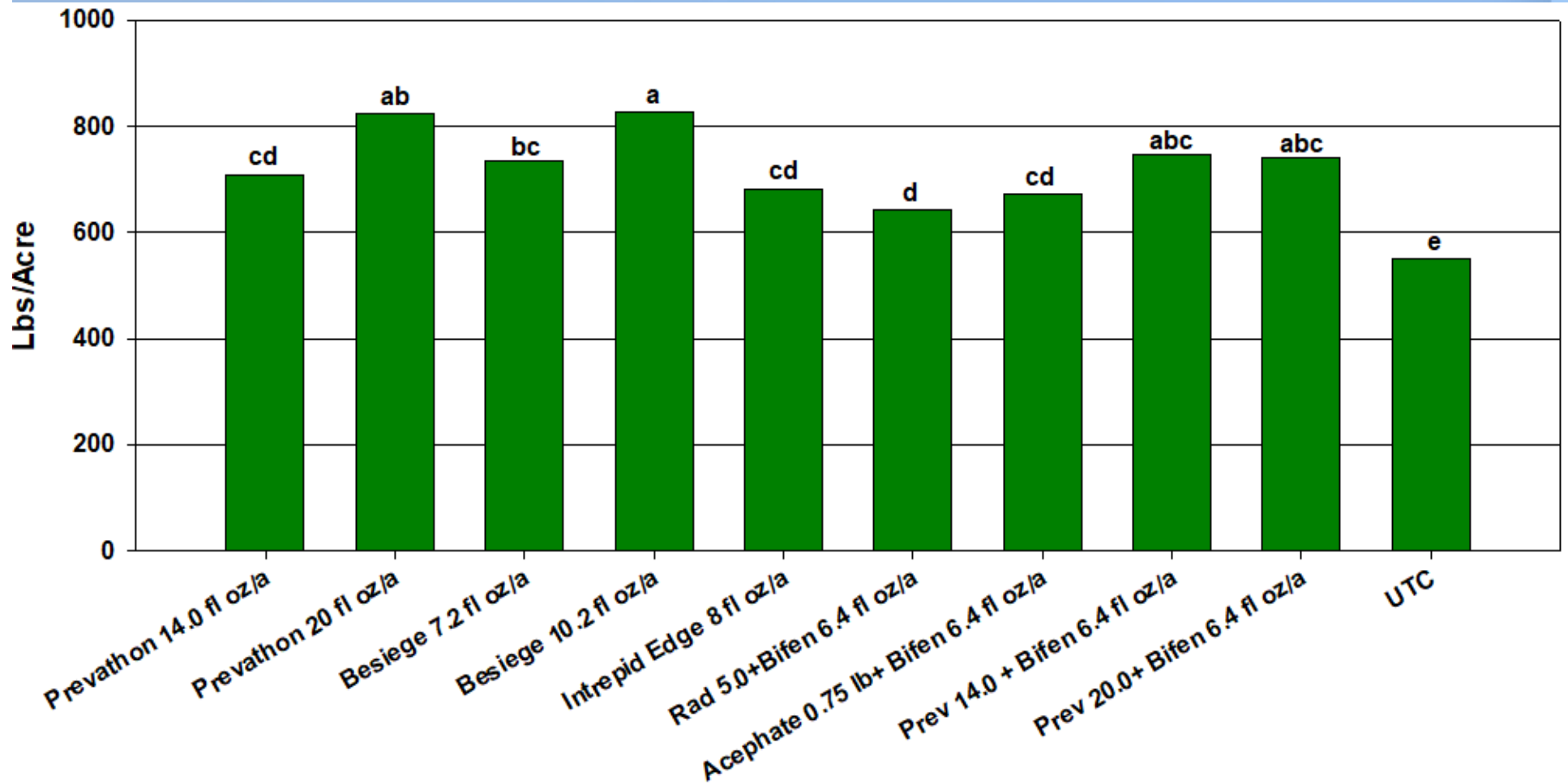


Besiege Control Failure

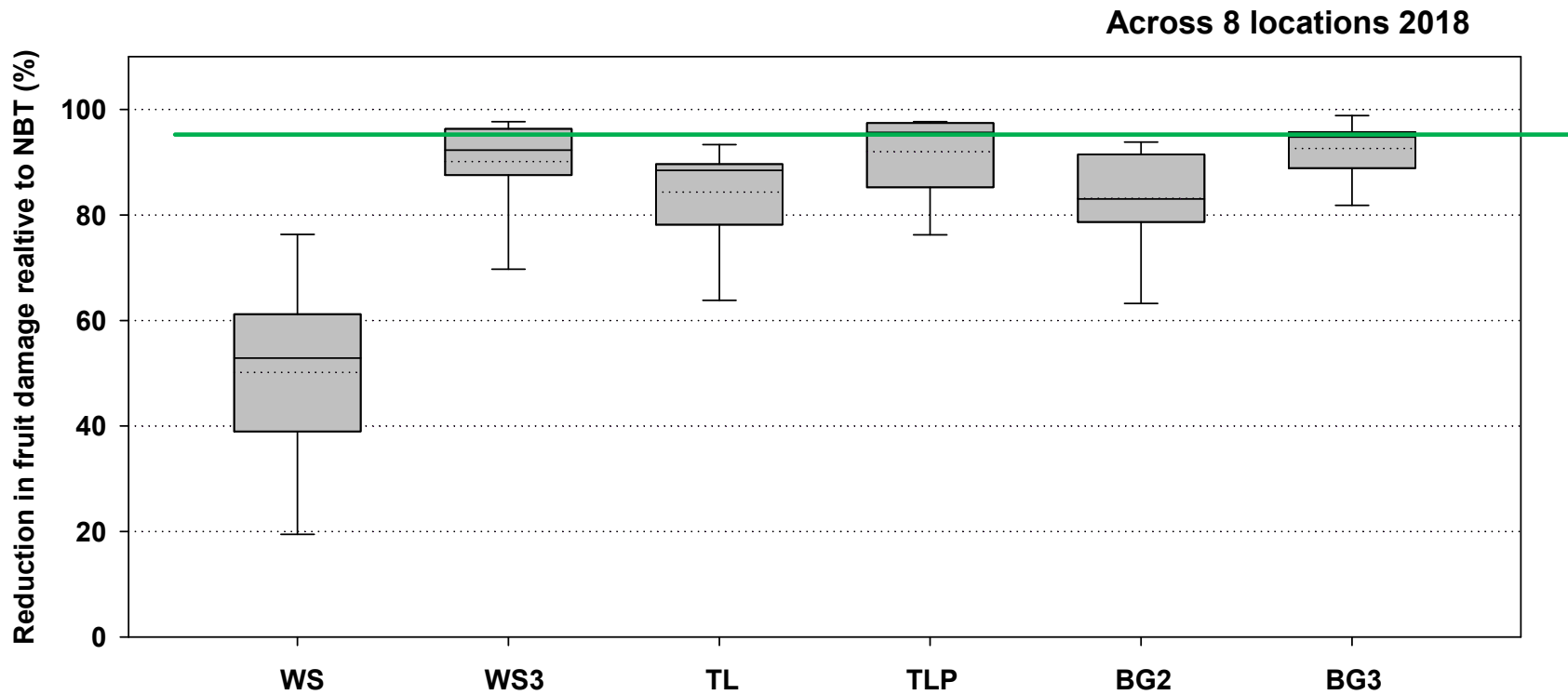




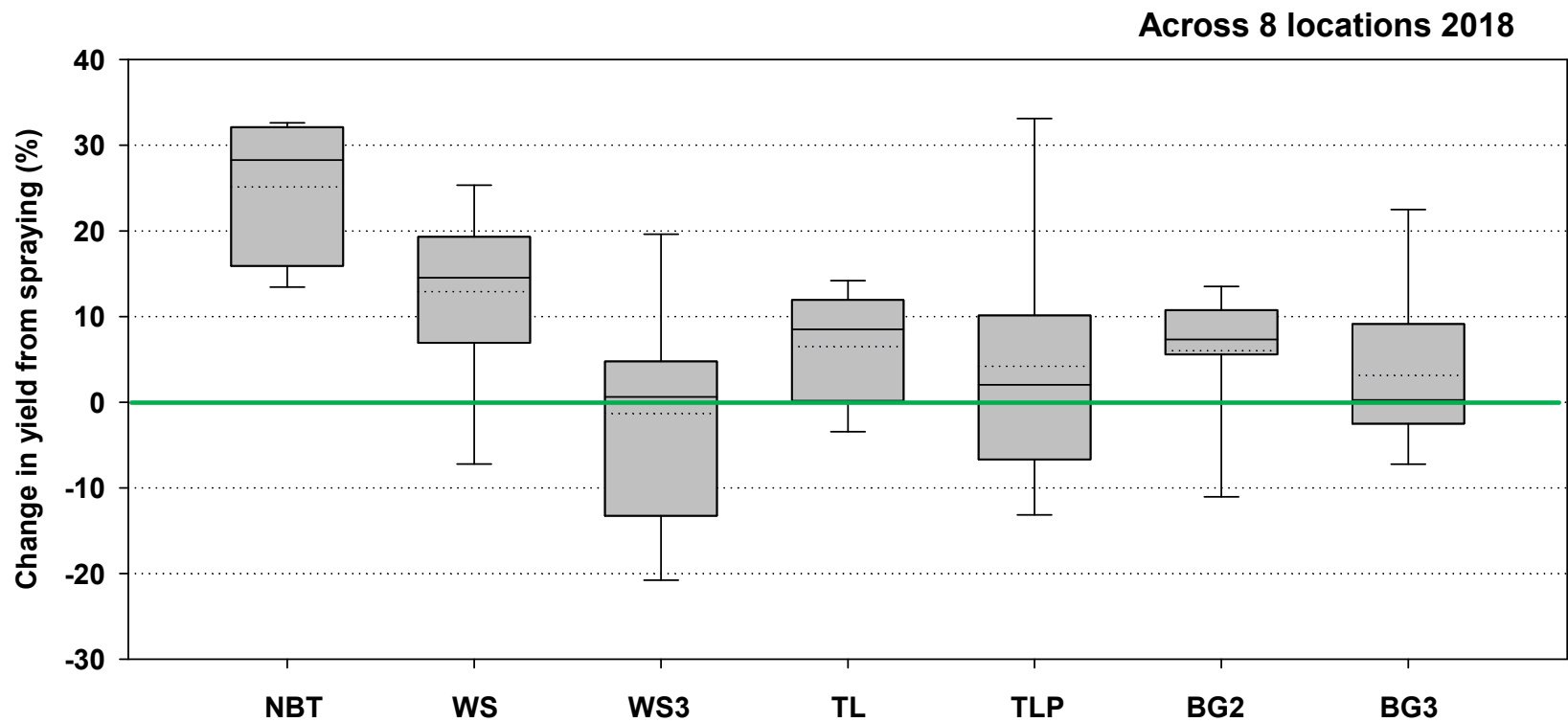
Bollworm Overspray: 2019



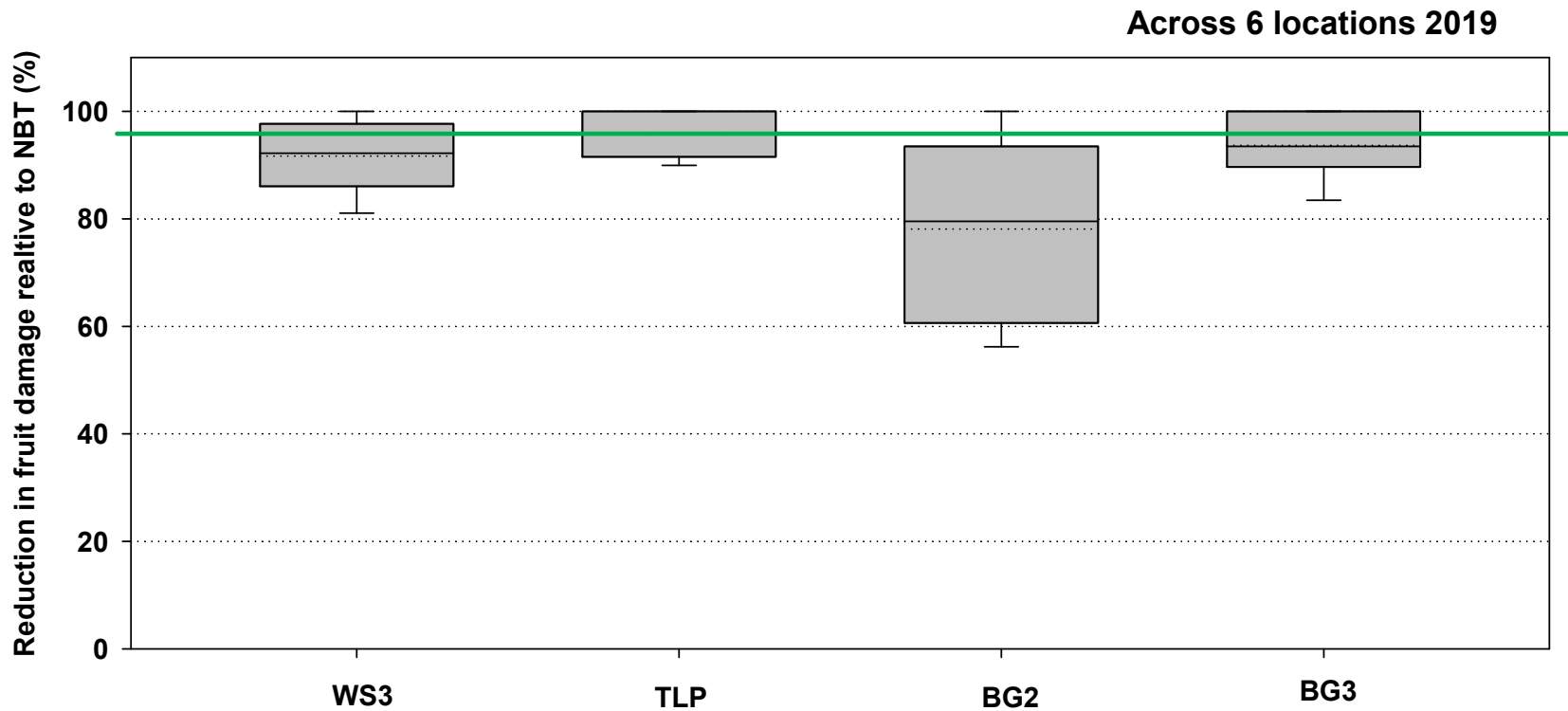
SEASONAL FRUIT DAMAGE – ALL LOCATIONS 2018



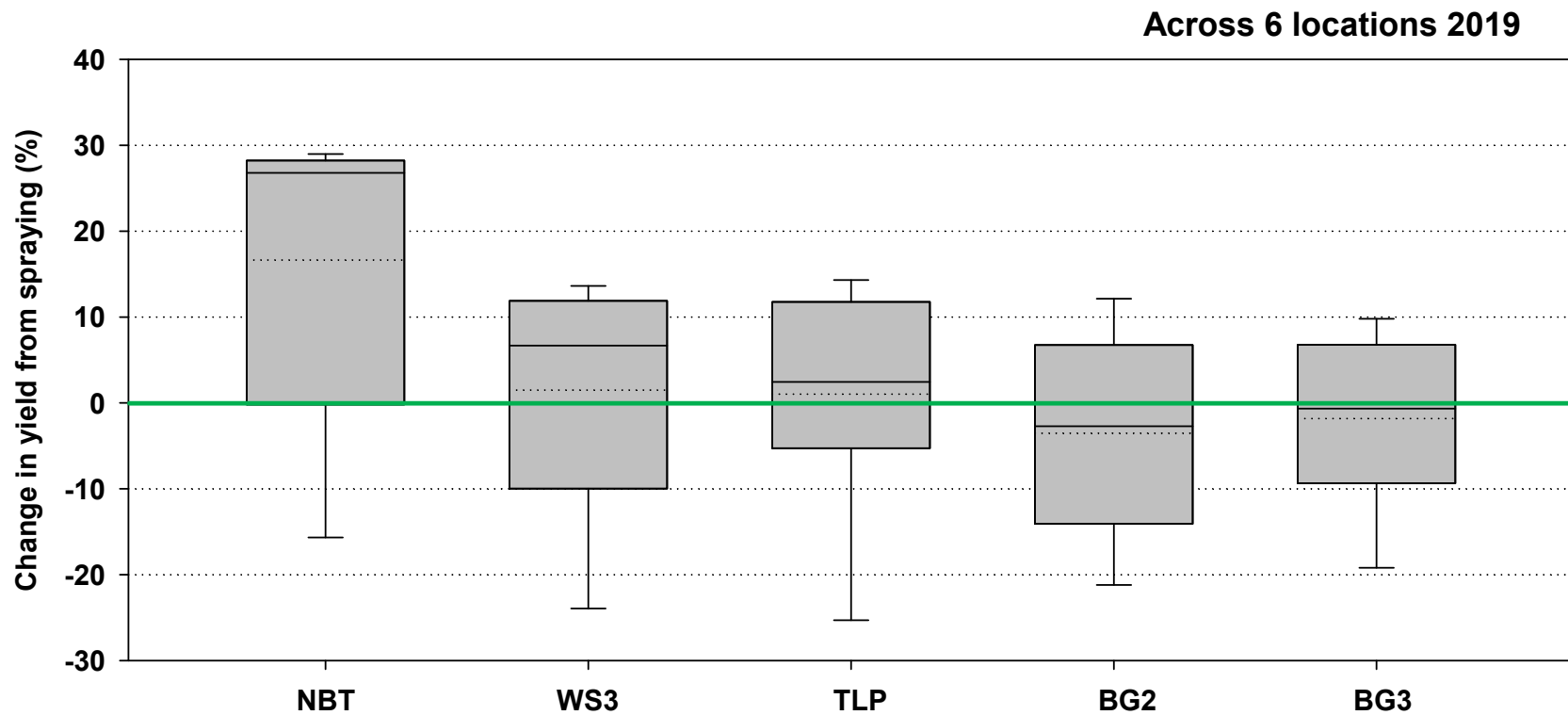
BENEFIT FROM PREVATHON TREATMENT – ALL LOCATIONS 2018



SEASONAL FRUIT DAMAGE – ALL LOCATIONS 2019



BENEFIT FROM PREVATHON TREATMENT – ALL LOCATIONS 2019





Notes on Resistance in LA

- Delta experiences least amount of Bt failures
- Macon Ridge failures have and probably will occur
- Northwest failures have and probably will occur more than the Delta but less than the Ridge
- Central failures WILL occur with 2nd generation and will probably occur with 3rd (not resistance but expression)



Going Forward

- 2nd generation Bt (BG2, TL)
 - Egg threshold (20% eggs)
- 3rd generation (BG3, TL+, WS3)
 - 6% fruit injury (with presence of live worms*)
- High rates vs low rates of diamides
- Timing is more important than rate with eggs

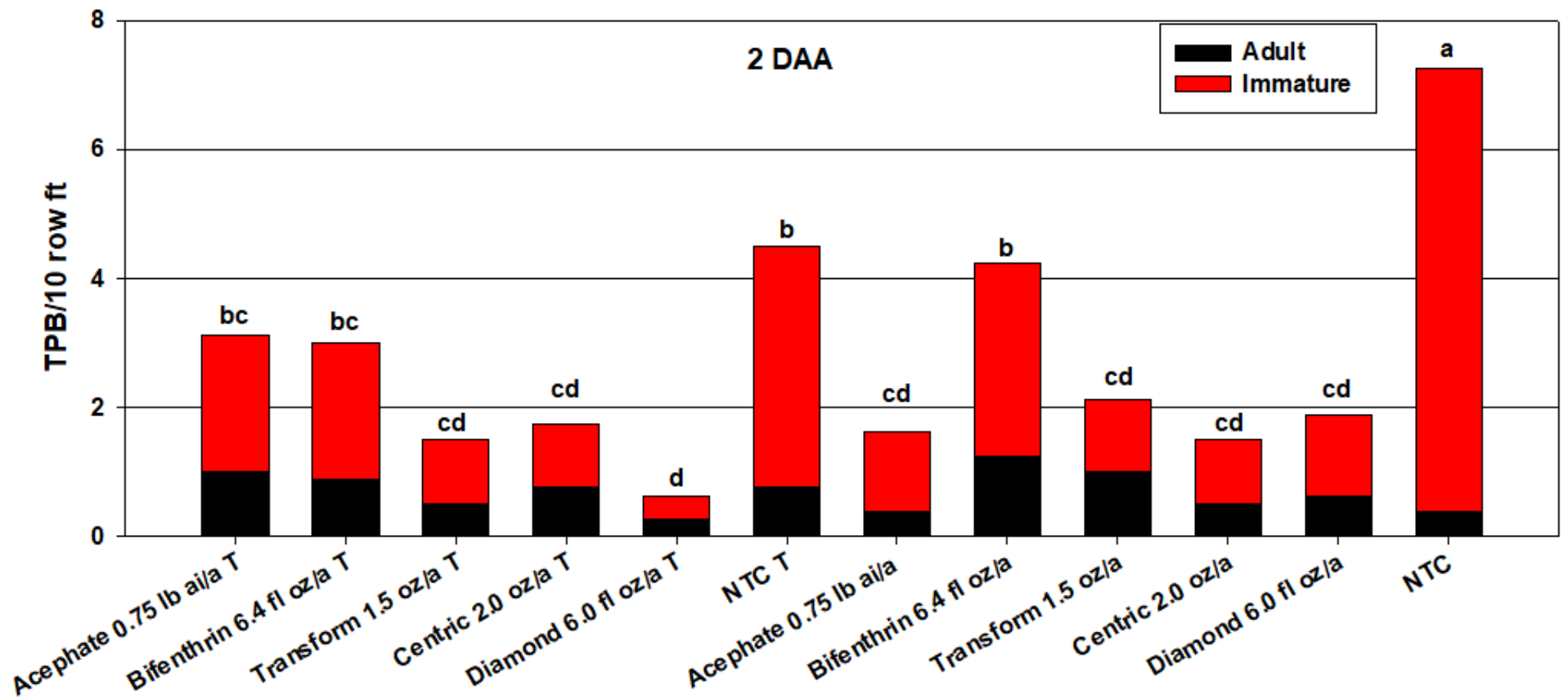


REMIND Text Message

Commodity	Group text number	Group Text Name
Rice	81010	@larice
Corn	81010	@lacorn
Grain Sorghum	81010	@lasorghum
Soybeans	81010	@lasoybean
Wheat	81010	@lawheat
Cotton	81010	@lacotton
Sweet Potato	81010	@laspotato
Sugarcane	81010	@lasugar

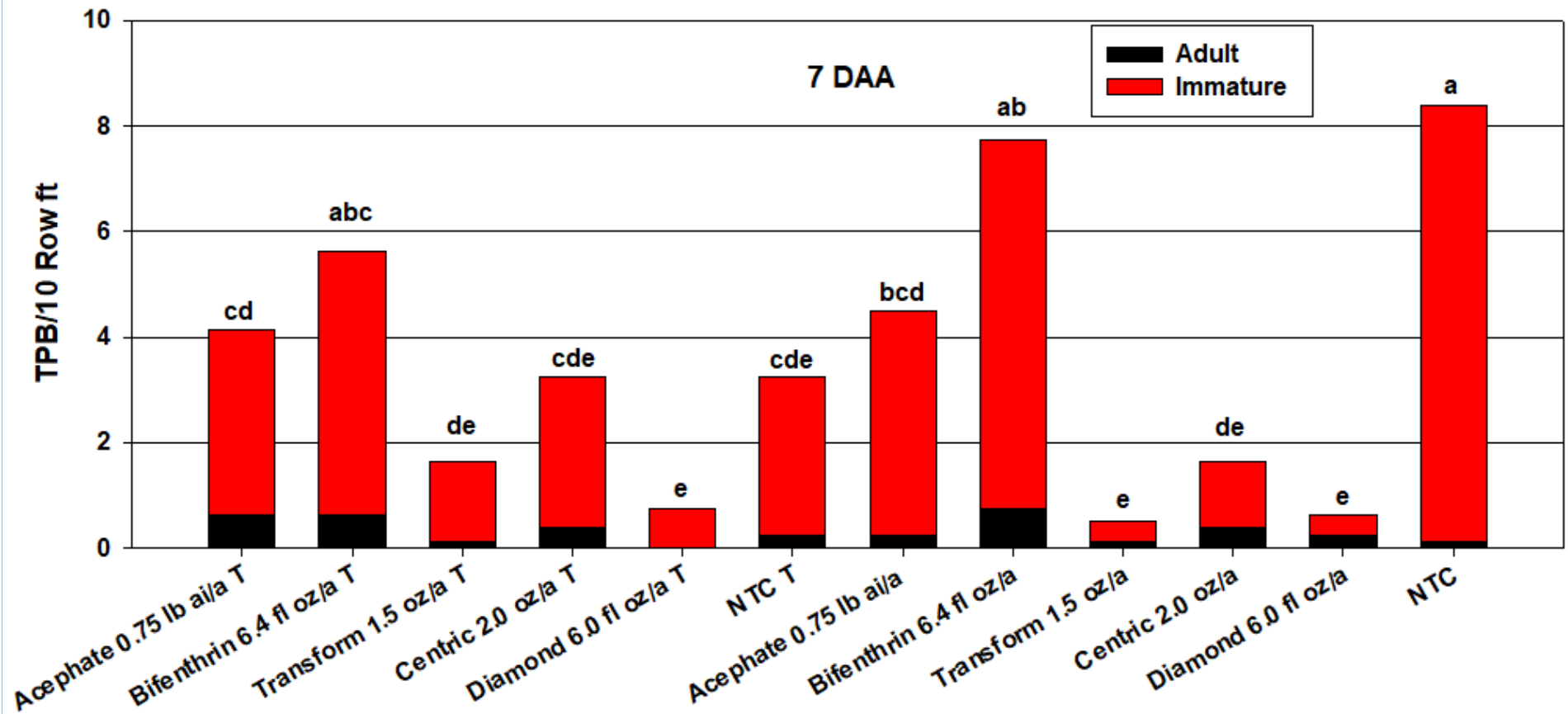


Lygus Trait Cotton





Lygus Trait Cotton





Thank You



Cell: 318-498-1283