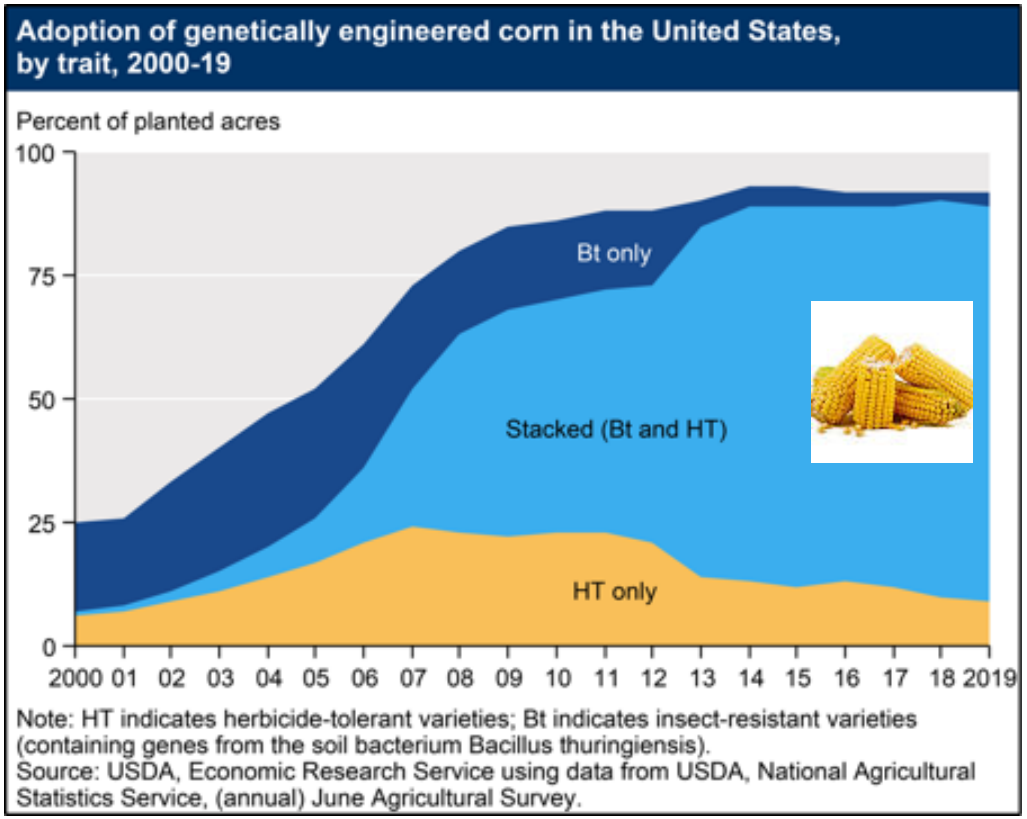
Bt Corn, Resistance Update

Current status and trends: Corn insect pest management

- Vast majority of corn (ca. 85%) is Bt corn
- Few single-trait varieties (i.e. usually several stacked traits)
- = consistent selection pressure during years when corn planted
- BUT no resistance reports in Indiana



The Handy Bt Trait Table for U.S. Corn Production, updated November 2018

Trait packages in alphabetical order (acronym)	Bt protein(s) in the trait package	Marketed for control of: BCW	CEW	ECB	FAW	SCB	SWCB	TAW	WBC	CRW	Insects resistant to the combination of Bt proteins in the trait package	Herbicide trait: GT RR2	Herbicide trait: LL	Non-Bt Refuge % (cornbelt)
AcreMax (AM)	Cry1Ab Cry1F			x	x	x	x				FAW WBC	x	x	5% in bag
AcreMax CRW (AMRW)	Cry34/35Ab1									x	CRW	x	x	10% in bag
AcreMax1 (AM1)	Cry1F Cry34/35Ab1	x		x	x	x	x			x	FAW SWCB WBC CRW	x	x	10% in bag 20% ECB
AcreMax Leptra (AML)	Cry1Ab Cry1F Vip3A	x	x	x	x	x	x	x	x			x	x	5% in bag
AcreMax TRIsect (AMT)	Cry1Ab Cry1F mCry3A	x		x	x	x	x			x	FAW WBC CRW	x	x	10% in bag
AcreMax Xtra (AMX)	Cry1Ab Cry1F Cry34/35Ab1	x		x	x	x	x			x	FAW WBC CRW	x	x	10% in bag
AcreMax Xtreme (AMXT)	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x			x	FAW WBC CRW	x	x	5% in bag
Agrisure 3010 and 3010A	Cry1Ab			x			x	x				x	x	20%
Agrisure 3000GT and 3011A	Cry1Ab mCry3A			x			x	x		x	CRW	x	x	20%
Agrisure Viptera 3110	Cry1Ab Vip3A	x	x	x	x	x	x	x	x			x	x	20%
Agrisure Viptera 3111	Cry1Ab Vip3A mCry3A	x	x	x	x	x	x	x	x	x	CRW	x	x	20%
Agrisure 3120 E-Z Refuge	Cry1Ab Cry1F	x		x	x	x	x				FAW WBC	x	See bag tag for code	5% in bag
Agrisure 3122 EZ Refuge	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x			x	FAW WBC CRW	x		5% in bag
Agrisure Viptera 3220 E-Z Refuge	Cry1Ab Cry1F Vip3A	x	x	x	x	x	x	x	x			x		5% in bag
Agrisure Viptera 3330 E-Z Refuge	Cry1Ab Vip3A Cry1A.105 + Cry2Ab2	x	x	x	x	x	x	x	x			x	E20 NO E21 YES	5% in bag
Agrisure Duracade 5122 E-Z Refuge	Cry1Ab Cry1F mCry3A eCry3.1Ab	x		x	x	x	x			x	FAW WBC CRW	x		5% in bag
Agrisure Duracade 5222 E-Z Refuge	Cry1Ab Cry1F Vip3A mCry3A eCry3.1Ab	x	x	x	x	x	x	x	x	x	CRW	x		5% in bag
Herculex I (HXI)	Cry1F	x		x	x	x	x				FAW SWCB WBC	x	x	20%
Herculex RW (HXRW)	Cry34/35Ab1									x	CRW	x	x	20%
Herculex XTRA (HXX)	Cry1F Cry34/35Ab1	x		x	x	x	x			x	FAW SWCB WBC CRW	x	x	20%
Intrasect (YHR)	Cry1Ab Cry1F	x		x	x	x	x				FAW WBC	x	x	5%
Intrasect TRIsect (CYHR)	Cry1Ab Cry1F mCry3A	x		x	x	x	x			x	FAW WBC CRW	x	x	20%
Intrasect Xtra (YXR)	Cry1Ab Cry1F Cry34/35Ab1	x		x	x	x	x			x	FAW WBC CRW	x	x	20%
Intrasect Xtreme (CYXR)	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x			x	FAW WBC CRW	x	x	5%
Leptra (VYHR)	Cry1Ab Cry1F Vip3A	x	x	x	x	x	x	x	x			x	x	5%
Powercore [a] Powercore Refuge Advanced [b]	Cry1A.105 Cry2Ab2 Cry1F	x	x	x	x	x	x				CEW WBC	x	x	[a] 5% [b] 5% in bag
QROME (Q)	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x			x	FAW WBC CRW	x	x	5% in bag
SmartStax [a] Smartstax Refuge Advanced [b] SmartStax RIB Complete [b]	Cry1A.105 Cry2Ab2 Cry1F Cry34/35Ab1 Cry35Bb1	x	x	x	x	x	x			x	CEW WBC CRW	x	x	[a] 5% [b] 5% in bag
Trecepta [a] Trecepta RIB Complete [b]	Cry1A.105 Cry2Ab2 Vip3A	x	x	x	x	x	x	x	x			x		[a] 5% [b] 5% in bag
TRIsect (CHR)	Cry1F mCry3A	x		x	x	x	x			x	FAW SWCB WBC CRW	x	x	20%
VT Double PRO [a] VT Double PRO RIB Complete [b]	Cry1A.105 Cry2Ab2		x	x	x	x	x	x			CEW	x		[a] 5% [b] 5% in bag
VT Triple PRO [c] VT Triple PRO RIB Complete [d]	Cry1A.105 Cry2Ab2 Cry35Bb1		x	x	x	x	x	x		x	CEW CRW	x		[c] 20% [d] 10% in bag
Yieldgard Corn Borer (YGCB)	Cry1Ab			x			x	x				x		20%
Yieldgard Rootworm (YGRW)	Cry35Bb1									x	CRW	x		20%
Yieldgard VT Triple	Cry1Ab Cry35Bb1			x			x	x		x	CRW	x		20%

The Handy Bt Trait Table

for U.S. Corn Production

The latest version of this document is always posted at https://www.texasinsects.org/bt-corn-trait-table.html

For questions & corrections: Chris DiFonzo, Michigan State Univ., difonzo@msu.edu

Contributor: Pat Porter, Texas A&M University (southern version of the table)

Updated November 2018

Field resistance to vast majority of current Bt toxins

Vip3A = currently the only active in-plant toxin with no field resistance reported

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Corn earworm control, ca. 2008

Genuity VT Double Pro (Cry1A.105 + Cry2Ab2)

YieldGard CB (Cry1b)

Non-Bt

5 August 2008, Blackville, SC

J Econ Entomol. 2019 Aug 3;112(4):1845-1857. doi: 10.1093/jee/toz062.

Susceptibility of Corn Earworm (Lepidoptera: Noctuidae) to Cry1A.105 and Cry2Ab2 in North and South Carolina.

Bilbo TR[1], Reay-Jones FPF[1], Reisig DD[2], Greene JK[3].

Author information

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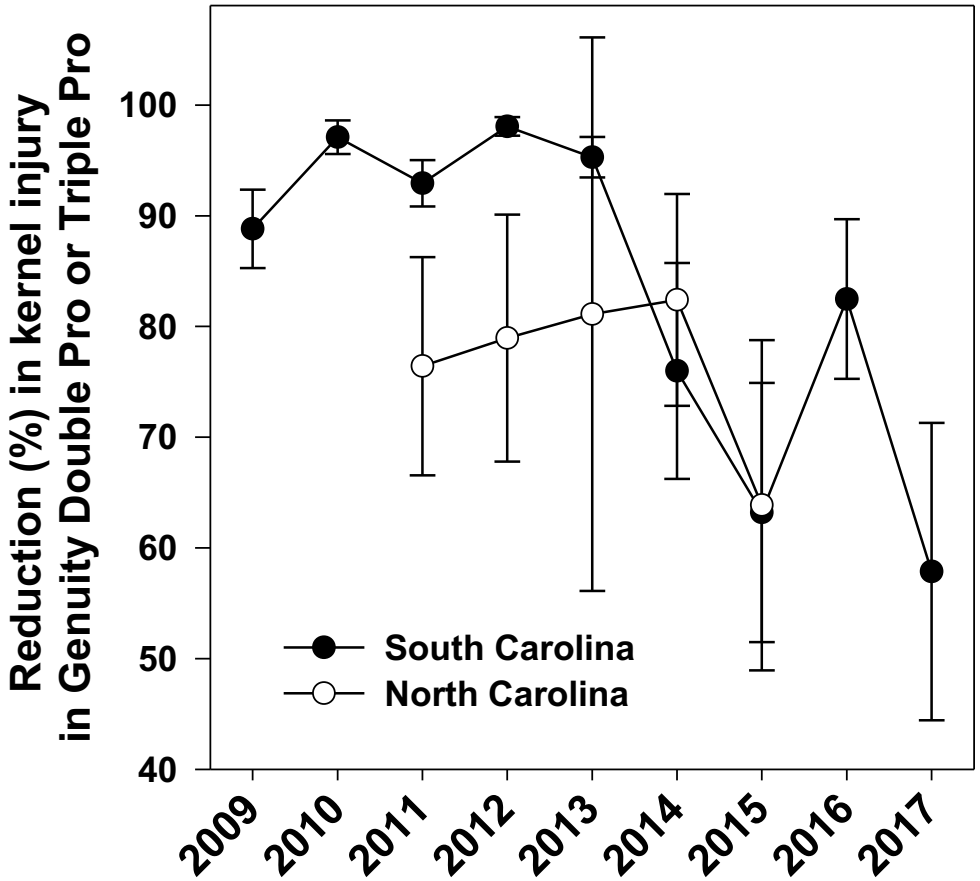
Abstract

The corn earworm, Helicoverpa zea (Boddie), is managed in corn and cotton in the United States primarily using transgenic cultivars that produce insecticidal proteins from the bacterium Bacillus thuringiensis (Bt). However, increasing reports of resistance to one or more Bt proteins threaten the continued efficacy of Bt traits. To better understand the development of resistance of H. zea to Bt corn and cotton in the southeastern United States, we monitored for resistance to Cry1A.105 and Cry2Ab2 among 22 field populations of H. zea collected in non-Bt and Bt corn expressing Cry1A.105 + Cry2Ab2 during 2017 and 2018. Colonies were established in the laboratory and progeny were screened in diet-overlay bioassays to purified Cry1A.105 and Cry2Ab2 proteins. Compared with two susceptible laboratory colonies, all 14 field colonies tested with Cry1A.105 were highly resistant, with resistance ratios (RRs) ranging from 13.5 to >4,000. For Cry2Ab2, 19 colonies were tested and RRs ranged from 0.26 to 33.7. Field populations were significantly more susceptible to Cry2Ab2 than Cry1A.105. We documented variability in F0 and F1 pupal weight and developmental rates of natural populations of H. zea, but observed no significant correlation with susceptibility to either Cry1A.105 or Cry2Ab2. Our results expand on the recent reports of H. zea resistance to Cry1A and Cry2A proteins and will aid in the design and deployment of future pyramided crops in the United States.

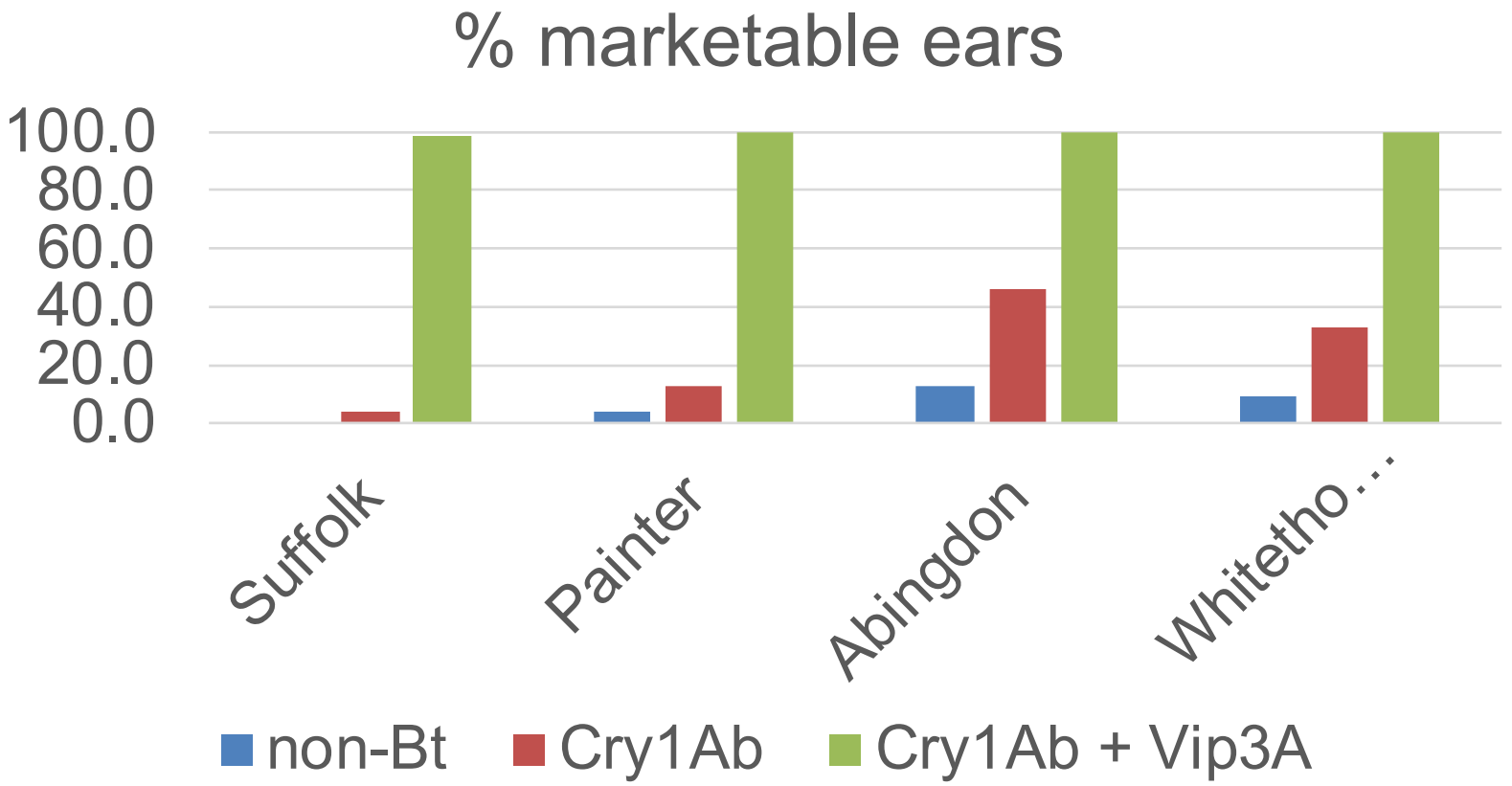
Corn earworm control, ca. 2017

Percent control of kernel injury in VT2P (Cry1A.105 + Cry2Ab2) compared to non-Bt near isoline



Francis Reay-Jones and Dominic Reisig

Corn earworm: one trait left standing in southern states (VA data shown)



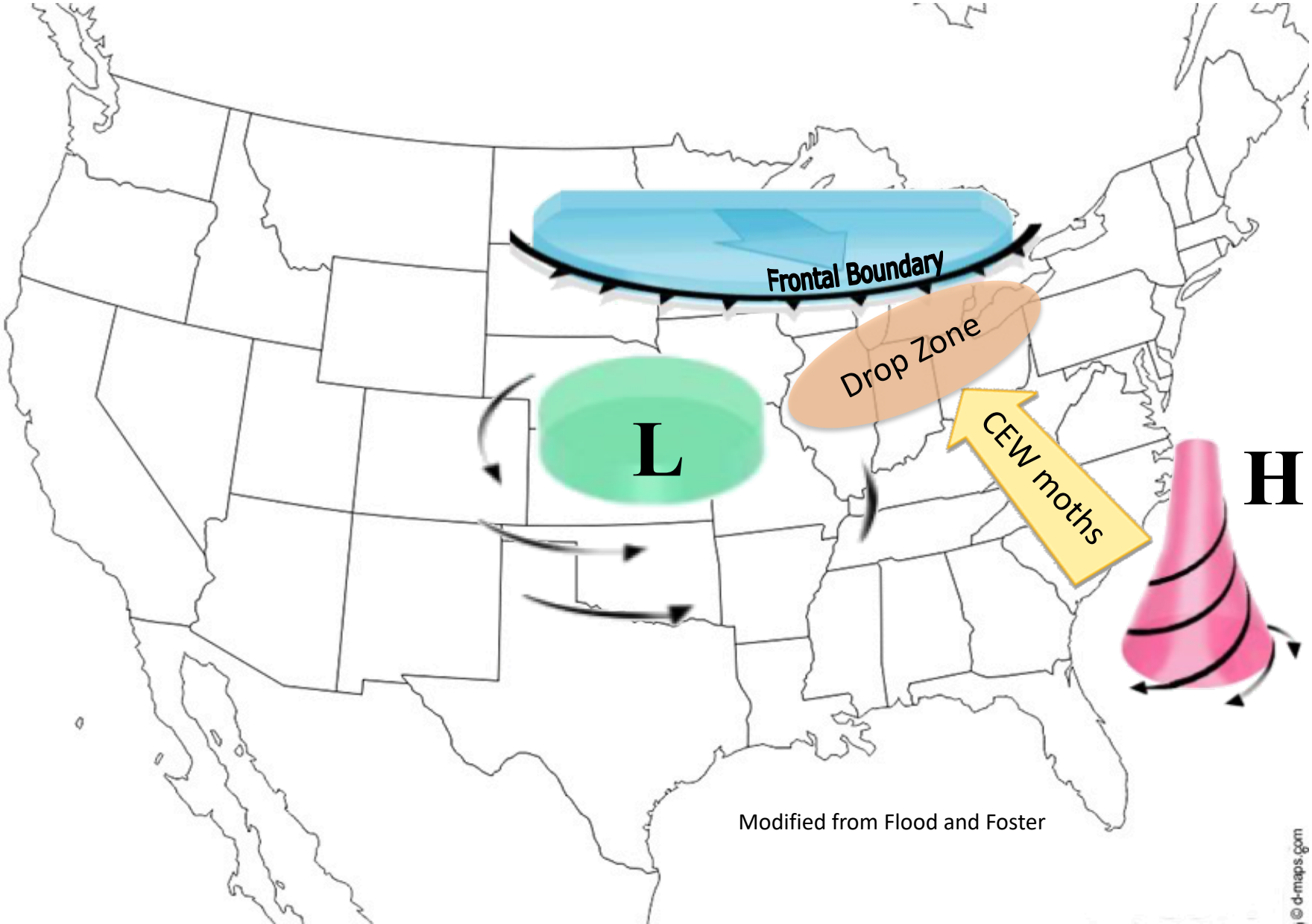
Corn earworm resistance to final trait will probably arise in the South

Survival of corn earworm on a Leptra hybrid (Cry1Ab + Cry1F + Vip3A)

Number of pupae / 200 ears

Year	South Carolina	North Carolina
2013	0	0
2014	0	0
2015	0	1
2016	0	5
2017	3	2

Trials in Florence, SC, and Plymouth, NC


Frontal Boundary
Drop Zone
L
CEW moths
H
Modified from Flood and Foster
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