

# Insect Pests in Corn

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### Insect pests of corn

- Pests from crop emergence to post-harvest
- A good integrated pest management plan begins before you plant
- Varietal selection
  - Genetics specifically adapted to your area
  - What type of insect control is needed
  - Follow refuge requirements!
- Risk reduction
  - Crop rotation
  - Tillage
  - Seed treatments
  - Timely harvest









## Stink bugs in corn

- Brown stink bug
  - Euschistus servus
- Brown marmorated stink bug
  - Halyomorpha halys
- Southern green stink bug
  - Nezara viridula
- Green stink bug
  - Chinavia halaris (Say)

- Overwinter as adults in protected areas
- Early hosts include winter weeds & wheat
- Mild winters encourage survival





### Stink bugs



Brown stink bug

Brown marmorated stink bug

Green & Southern green stink bugs



### Stink bugs



Brown stink bug

Brown marmorated stink bug

Green & Southern green stink bugs

## Scouting for stink bugs

- Scout early and often
  - V1 to R2
- They're sneaky! Will hide or drop off plant as you're scouting
- Look at plants 1-2 rows over
- Check several areas of the field
- Typically worse at the edge of the field









## Stink bug damage







## Stink bug damage

- Vegetative stunting, plant may develop multiple stems
- Pre-tassel damaged ears crook away from plant stem; aborted kernels
- Reproductive smaller kernels, potential for infection

Stage	Threshold
V1 – V6	1 stink bug / 10 plants
V14 – VT	1 stink bug / 8 plants
R1 – R2	1 stink bug / 4 plants





## Treating for stink bugs

- Successful control:
  - 1. Coverage
  - 2. Timing
- Pyrethroids
  - Ex. Warrior II, Declare, Mustang Maxx, Brigade, Delta Gold, etc.
- Brown stink bugs are harder to kill
  - If these make up the majority of what you are finding, go with the highest rate of Bifenthrin (ex. Hero, Brigade 2EC)





## Caterpillar pests of corn

- Prior to whorl stage:
  - Armyworms
    - Especially after a cool, wet spring
- In whorl stage:
  - Fall armyworm
  - Corn earworm
  - Southwestern corn borer

Risk increases with late planting





### CEW vs FAW



Fall armyworm





Fall armyworm

Corn earworm

### Caterpillar management and Bt

- All transgenic insect control traits are protein toxins from a naturally occurring soil bacterium, *Bacillus thuringiensis*
- Several different Bt toxins have been isolated and are active against different pests
- Two categories:
  - Above ground control (corn borers)
  - Below ground control (corn rootworm)

There is variation in the susceptibility to Bt toxins!



### **The Handy Bt Trait Table**

### for U.S. Corn Production

Updated February 2020

The newest version of the table is posted at https://www.texasinsects.org/bt-corn-trait-table.html Editor: Chris DiFonzo, Michigan State University, difonzo@msu.edu Web host: Pat Porter, Texas A&M University

The Handy Bt Trait Table provides a helpful list of trait names (below) and details of trait packages (over) to make it easier to understand company seed guides, sales materials, and bag tags.

At the end of 2018, European corn borer (ECB) damage to Cry1F Bt corn was reported in Nova Scotia, Canada. ECB populations were collected and bio-assayed. The results, published in fall 2019, confirm the first case of practical, field-evolved resistance by corn borer to any Bt trait. In their paper, entomologists from the University of Guelph highlight "*preventable causal factors*" contributing to ECB resistance in Nova Scotia. A key factor was the continued planting of single-trait Cry1F hybrids. To sell seed with reduced 5% or 10% refuge in the bag, seed companies were supposed to phase out single-trait hybrids and replace them with pyramided multiple-Bt hybrids to slow the development of resistance. This transition apparently did not happen in some places.

Unfortunately, single-trait hybrids are just part of the story. As insects become resistant to individual Cry proteins, *pyramided hybrids effectively become single-trait hybrids*. For example, because ECB is resistant to Cry1F in Nova Scotia, Cry1Ab + Cry1F hybrids are functionally single-trait for Cry1Ab in that province. Entomologists recommend that such pyramids not be used in that region to reduce the chance of ECB resistance to Cry1Ab. Similarly, because western bean cutworm developed resistance to Cry1F, Vip 3A is the only effective toxin to control it. All Vip hybrids, regardless of the number of other Bts in plant, are single-trait for this key pest. Finally, in the southern US, corn earworm (AKA cotton bollworm) is overcoming multiple Bt toxins and Vip3A increasingly functions alone in pyramided corn and cotton. Although you can't control how traits are packaged or marketed, it is important to realize which hybrids you plant are not really pyramids, to scout fields for unusual pest pressure, and to report problems promptly so that resistance can be dealt with quickly, as in Nova Scotia.

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Trade name for trait	Event	Protein(s) expressed	Primary Insect Targets + Herbicide tolerance								
Agrisure CB/LL	Bt11	Cry1Ab + PAT	corn borer + glufosinate								
Agrisure Duracade	5307	eCry3.1Ab	rootworm								
Agrisure GT	GA21	EPSPS	glyphosate								
Agrisure RW	MIR604	mCry3A	rootworm								
Agrisure Viptera	MIR162	Vip3Aa20	broad caterpillar control, except for corn borer								
Enlist	DAS40278	aad-1	2,4-D & 'FOPs'								
Herculex I (HXI) or CB	TC1507	Cry1Fa2 + PAT	corn borer + glufosinate								

#### Field corn 'events' (transformations of one or more genes) and their Trade Names

Trait packages in		Marketed for contro					ont	rol	of:		Resistance confirmed	Herbicide				
alphabetical order	Bt protein(s) in	в	С	E	F		S	s	Т	w		to the combination of		trait	Ľ	Non-Bt
(acronym that may be used)	the trait package	С	E	C	Α	S	С	w	Α	В	С	Bts in package	G	L		Refuge %
(		w	W	В	W	В	В	В	W	С	R	(check local situation)	R	L	E	(cornbelt)
AcreMax (AM)	Cry1Ab Cry1F	х	х	х	х	х	х	х				CEW FAW WBC	х	х		5% in bag
AcreMax CRW (AMRW)	Cry34/35Ab1										х	NCR WCR	х	х		10% in bag
AcreMax1 (AM1)	Cry1F Cry34/35Ab1	x		x	x	x	x	x			x	ECB FAW SWB WBC NCR WCR	x	x		10% in bag 20% ECB
AcreMax Leptra (AML)	Cry1Ab Cry1F Vip3A	х	х	х	х	х	х	х	х	x			х	х		5% in bag
AcreMax TRIsect (AMT)	Cry1Ab Cry1F	х	х	х	х	х	х	х			х	CEW FAW WBC	х	х		10% in bag
	mCry3A											WCR			_	
AcreMax Xtra (AMX)	Cry1Ab Cry1F	x	х	x	x	x	x	x			х	CEW FAW WBC	х	х		10% in bag
	Cry34/35Ab1											NCR WCR				
AcreMax Xtreme (AMXT)	Cry1Ab Cry1F	x	х	x	х	x	x	x			х	CEW FAW WBC	x	х		5% in bag
	mCry3A Cry34/35Ab1									L_		WCR		L	<u> </u>	
Agrisure 3010 (BR)	Cry1Ab		х	х			х	х				CEW	x	х		20%
Agrisure 3000GT & 3011A	Cry1Ab mCry3A		х	х			x	х			х	CEW WCR	х	х		20%
Agrisure Viptera 3110 (VR)	Cry1Ab Vip3A	х	х	х	х	х	х	х	х	x			х	х		20%
Agrisure Viptera 3111 (A4)	Cry1Ab Vip3A mCry3A	х	х	х	х	х	х	х	х	x	х	WCR	х	х		20%
Agrisure 3120 E-Z Refuge (BZ)	Cry1Ab Cry1F	х	х	х	х	х	х	х				CEW FAW WBC	х	See		5% in bag
Agrisure 3122 E-Z Refuge	Cry1Ab Cry1F	х	х	х	х	х	х	х			х	CEW FAW WBC	х	ba		5% in bag
	mCry3A Cry34/35Ab1											WCR		1		
Agrisure Viptera 3220 E-Z (VZ)	Cry1Ab Cry1F Vip3A	х	х	х	х	х	х	х	х	x			х	60		5% in bag
Agrisure Viptera 3330 E-Z	Cry1Ab Vip3A	x	х	х	х	х	х	х	х	x			х	8		5% in bag
	Cry1A.105/Cry2Ab2													-		
Agrisure Duracade 5122 E-Z (D1)	Cry1Ab Cry1F	х	х	х	х	х	х	х			х	CEW FAW WBC	х	õ		5% in bag
	mCry3A eCry3.1Ab											WCR		8		
Agrisure Duracade 5222 E-Z (D2)	Cry1Ab Cry1F Vip3A	х	х	х	х	х	х	х	х	x	х	WCR	х	н		5% in bag
	mCry3A eCry3.1Ab													R.		
Herculex I (HXI)	Cry1F	х		х	х	х	х	х				ECB FAW SWB WBC	х	х		20%
Herculex RW (HXRW)	Cry34/35Ab1										х	NCR WCR	х	х		20%
Herculex XTRA (HXX)	Cry1F Cry34/35Ab1	х		х	х	х	х	х			х	ECB FAW SWB WBC	х	х		20%
		I 1										NCR WCR				

### The Handy Bt Trait Table for U.S. Corn Production, updated February 2020

## Bt terminology

- <u>Event</u> the successful insertion of genes into a crop plant
- <u>Stacked traits</u> toxins that are active against different pest groups combined into one hybrid
- <u>Pyramid traits</u> toxins that are active against the same pest group are combined into one hybrid
- <u>Resistance</u> a genetic shift in a population of insects that makes it less susceptible to a toxin
- <u>Refuge strategy</u> some acreage (the refuge) is planted to non-Bt corn. Insects coming out of these crops are susceptible to Bt, mate with insects that came from Bt → keep overall population susceptible



### Insect resistance management, IRM

- Following an IRM plan is the best way to ensure Bt traits last
- Seed companies present IRM plans to the Environmental Protection Agency (EPA) as they register Bt traits
- Non-Bt refuge
  - 1 gene = 50%
  - 2 gene = 20%
  - Can be planted within, adjacent, or separate (within ½ mile)
- Compliance
  - Seed companies are responsible for reporting compliance to EPA each year
  - This is crucial for extending the life of current traits



### EPA looking to make changes

- New regulations to extend the life of current Bt traits in corn and cotton
- Will change some IRM strategies and also add additional ones

Why do we need to make changes?

- Current IRM is from 20+ years ago
- Documented resistance
- Vip3A only Bt toxin with no resistance to corn earworm
- Threat of additional resistance



### Proposed changes

- Addresses risk factors
  - Single-trait Bt corn
  - Only a few highly effective Bt traits
  - Lack of refuge compliance
- Changes to definition of resistance
  - Field failures are now considered a case of practical resistance
  - These fields will immediately begin a resistance mitigation program
  - Unexpected injury (UXI) will be communicated widely



Some of these changes will substantially impact **corn and cotton** production in the south.

### What does this actually mean?

- Refuge in a bag can be planted in southern states but with a 20% block refuge
- Phase out all single toxin Bt corn hybrids within 3 years and all pyramid hybrids without Vip3A in 5 years

What is left?

• Corn: pyramid hybrid with Vip3A or non-Bt variety





### What does this actually mean?

- AcreMax Leptra
- Agrisure Viptera 3110
- Agrisure Viptera 3111
- Agrisure Viptera 3220 E-Z
- Agrisure Viptera 3330 E-Z
- Agrisure Duracade 5222 E-Z
- Leptra
- Trecepta



## EPA wants to hear from you!

- Seeking feedback on the proposal before it is finalized
- 60-day public comment period is currently open through Nov 6
- Specifically
  - Phase down of traits
  - Refuge compliance monitoring







- Reduce risk at every step
- Help to preserve the current Bt technologies as long as possible
- Share comments with the EPA!

https://beta.regulations.gov/document/EPA-HQ-OPP-2019-0682-0001



### Questions?

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