Integrated Mycotoxin Management

Michigan Agribusiness Association 2020 Winter Conference

January 15, 2020

Katlin Fusilier and Manni Singh

MSU Department of Plant, Soil, and Microbial Sciences

Fungal Ear Rots

- Many of the issues with grain quality are the result of fungal activity
- Grain that is infected with ear rot is often unfit for food or feed
- Ear rots can produce mycotoxins (secondary metabolites) which can cause health problems in both humans and animals

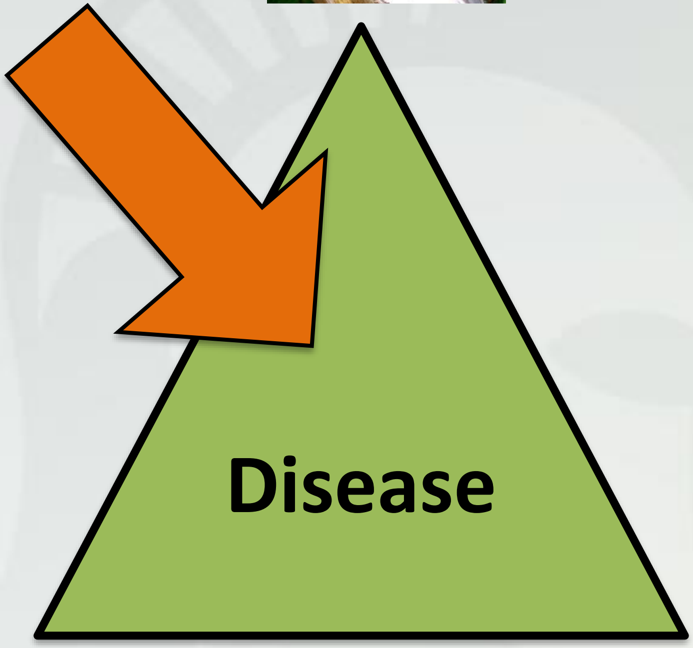
Ear Rots

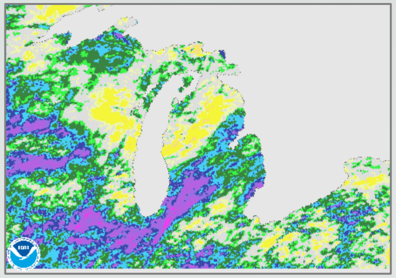
Other Factors

-Ex. Ear feeding insects

Host

-Hybrid susceptibility
-Hybrid characteristics
-Crop growth stage (silking)

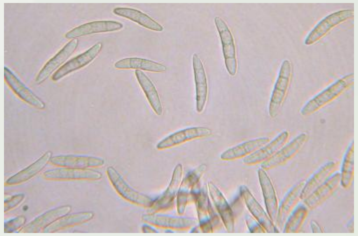




Environment

-Weather conditions
-Field management

Pathogen



Contamination by Ear Rots and Mycotoxins

- Between 2012 and 2015 Michigan had an estimated yield loss of approximately 26 million bushels due to ear rots
- During this same time, an estimated 44,000 bushels were contaminated by mycotoxins in the state of Michigan
- Since 2015, outbreaks of mycotoxin contamination have occurred in the state of Michigan (2016 and 2018)
- Managing mycotoxin levels is important from a health and safety prospective along with an economic prospective

Ear Rots in the U.S.

- Aspergillus Ear Rot (*Aspergillus flavus*)
- Fusarium Ear Rot (*Fusarium verticillioides*)
- Gibberella Ear Rot (*Fusarium graminearum*)
- Diplodia Ear Rot (*Stenocarpella maydis and S. macrospora*)
- Cladosporium Ear Rot (*Cladosporium spp*.)
- Nigrospora Ear Rot (*Nigrospora oryzae*)
- Penicillium Ear Rot (*Penicillium spp*.)
- Trichoderma Ear Rot (*Trichoderma spp*.)

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Aspergillus ear rot (*Aspergillus flavus*)

- Olive-green ear rot
- Mycotoxin Produced
  - Aflatoxins

Fusarium ear rot (*Fusarium verticillioidies*)

- Diseased kernels are often isolated
- Affected kernels appear tan or brown
- Kernels often have a starburst pattern

- Mycotoxin Produced
  - Fumonisins

Gibberella ear rot (*Fusarium graminearum*)

- Pink to red ear rot
- Mycotoxins Produced
  - Deoxynivalenol (DON)
    - Also known as vomitoxin
    - Causes:
      - –Feed refusal
      - –Vomiting
  - Zearalenone

Vomitoxin (Deoxynivalenol/DON) Discount Schedules in Michigan

Albion Grain Division
Corn Premium & Discount Schedule*
*Subject to change without notice
Crop Year 2019-2020

The Andersons
Sheet Updated: 12/3/19

Vomitoxin Discount Effective: 3/18/2019
5.1 and greater subject to rejection

mac michigan agricultural commodities, inc.
Michigan Agricultural Commodities, Inc
3346 Main St * Marlette, MI * Phone: (800) 647-4628
7115 Maple Valley * Brown City, MI * Phone: (800) 851-1448
CORN DISCOUNT SCHEDULE
EFFECTIVE OCTOBER 21, 2019

VOMITOXIN	
00-3.0ppm	No discount
3.1-4.0	($0.05)
4.1-5.0	($0.15)
5.1-6.0	($0.25)
6.1-7.0	($0.35)
7.1-8.0	($0.45)
8.1	subject to rejection

ADM
YELLOW CORN
ADM Grain - GRAND LEDGE, MI
CORN DISCOUNT SCHEDULE V1 09/15/17

VOMITOXIN	PER BU
4.0 OR LESS	No Discount
4.1 TO 6.0	-0.06
6.1 TO 7.0	-0.10
7.1 TO 7.9	-0.14
8.0 OR MORE	-0.25

mac michigan agricultural commodities, inc.
MICHIGAN AGRICULTURAL COMMODITIES
CORN DISCOUNT SCHEDULE 01/15/19 JASPER/BLISSFIELED ELEVATORS

VOMITOXIN		
0.0	5.0	$0.00
5.1	8.0	$ 0.10
8.1	10.0	$ 0.35
10.1 REJECTED		

KALMBACH FEEDS OF MICHIGAN, FAMILY OWNED, EST. 1963

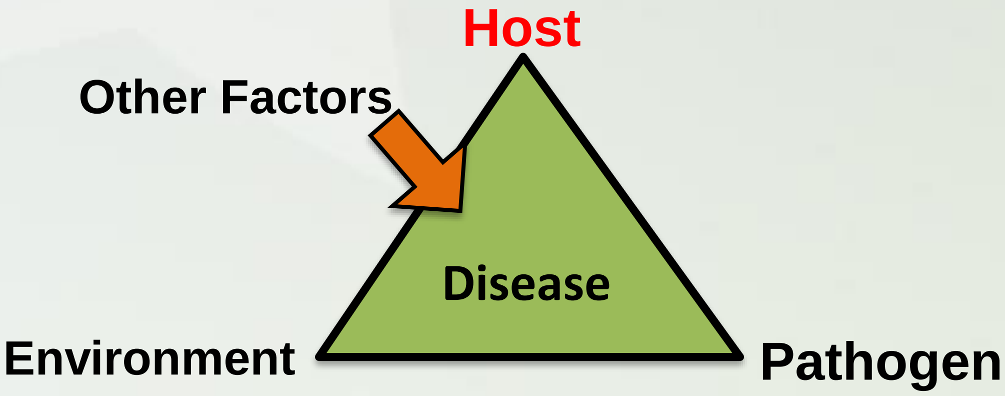
Vomitoxin	Discount
0.0 - 7.0 ppm	$.00
7.1 - 8.0 ppm	$.10
8.1 - 9.0 ppm	$.20
9.0 - 10.0 ppm	$.30
10 ppm +	$.40

>10 ppm subject to rejection

Ear Rot and Mycotoxin Management

- In-season
  - Once an ear is infected, fungal growth may continue during post-harvest stages
  - Goal: alter conditions so that they are unfavorable for fungi i.e. reducing infection rates
- Harvest and Drying
  - Reduce the amount of mycotoxin contamination in harvested corn
  - Prevent further mycotoxin development in stored grain
- Storage
  - Limit fungal growth in storage

Management of Mycotoxins in Corn Grain
Host



Hybrid Selection

Host

- Hybrid susceptibility/resistance
  - Silk resistance
  - Kernel resistance
- Hybrid morphology
  - Husk cover- tighter husk cover hold in more moisture
  - Ear erectness- erect ear holds more moisture

MICHIGAN STATE UNIVERSITY

Host

DU PONT PIONEER

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Home > Products > Corn Seed Guide

CORN SEED GUIDE

East Lansing, MI (48824)

Print (0 Selected) | Show Filters | Show Rows All

Choose Products	Product Name	CRM	Technology Segment	Hybrid Family	Market Segment	Grain Drydown	Stalk Strength	Root Strength	Stress Emergence	Staygreen	Drought Tol.	High Residue Suitability	Ear Flex	Test Wt.	Plant Ht.	Ear Ht.	Mid-Season Brittle Stalk	No. Leaf Blight	Anthrac. Stalk Rot	Gibberella Ear Rot
+	P7958AM	79	AM LL RR2	P7958	HAE HTF	4	6	7	5	6	7	NS	4	6	5	5	4	3		
+	P8034R *	80	RR2	P8234	HTF	7	8	8	4		7	NS		5	4	4	3	7		
+	P8234AM *	82	AM LL RR2	P8234	HTF	7	8	8	4		7	NS		5	4	4	4	7		
+	P8210	82		P8210	HAE	4	7	6	5	5	7	NS	6	4	4	5	6	5		5
+	P8387AM	83	AM LL RR2	P8387		4	5	5	4	5	7	NS	3	5	5	6	6	5		6
+	P8581R	85	RR2	P8581		7	8	7	5	5	7	S	7	5	7	7	5	5	4	7
+	P8639AM	86	AM LL RR2	P8639	HTF	6	4	4	5	4	8	NS	6	4	6	8	5	7		4
+	P8700AM *	87	AM LL RR2	P8700	HTF	5	4	7	5		8	NS		5	3	4	6	7		
+	P9188 *	91		P9188	HAE	4	6	8	4	4	7	NS	5	6	4	4	5	7		5

Host

Dekalb® Corn — DKC54-38RIB Brand Blend

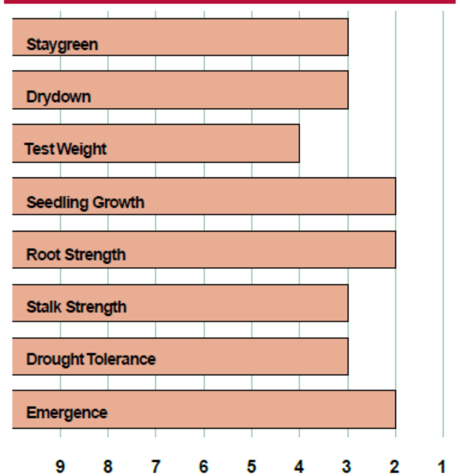
SMARTSTAX CORN — RIB COMPLETE

DKC54-38RIB blend provides excellent yield potential and Goss' Wilt tolerance. Very good greensnap tolerance combined with solid roots and stalks make this a very reliable addition to the 105 RM.

Product Brand Characteristics

Category	Characteristic	Value
MANAGEMENT	Value Added Trait	GENSSRIB
	Relative Maturity	104
	GDUs to Mid-pollination	1300
	GDUs to Black Layer	2600
	Average for Maturity	1312
PLANTING	Planting Rate	M-H
	Emergence	2
GROWTH	Seedling Growth	2
	Root Strength	2
	Stalk Strength	3
	Drought Tolerance	3
	Greensnap	3
	Plant Height	M
	Ear Placement	M
HARVEST	Staygreen	3
	Harvest Appearance	3
	Drydown	3
	Test Weight	4
DISEASES	Northern Corn Leaf Blight	3
	Southern Corn Leaf Blight	1
	Gray Leaf Spot	4
	Eye Spot	2
	Common Rust	3
	Southern Rust	4
	Anthracnose Leaf Blight	-
	Anthracnose Stalk Rot	4
	Stewart's Leaf Blight	3
	Goss's Wilt	3
	Corn Lethal Necrosis	2
	Southern Virus Complex	-
	Headsmut	
	Diplodia Ear Rot	P
	Growth Regulators Sensitivity	A

DKC54-38RIB Brand Blend — 104-DAY RM



Key Strengths

- Very good top-end yield potential
- Very good Goss' Wilt tolerance
- Solid roots and stalks
- Good greensnap tolerance

Plant Description

Leaf Color	Dark Green
Silk Color	Green - Yellow
Anther Color	Yellow
Kernel Row	18-20
Kernel Cap Color	Yellow
Cob Color	Red

Management Tips

- Position in areas with moderate or worse Goss' Wilt pressure
- Position as a product that performs well in the 100, 105 and 110 RM zones
- Good performance in areas with moderate or less drought stress

Dekalb® Corn — DKC55-20RIB Brand Blend

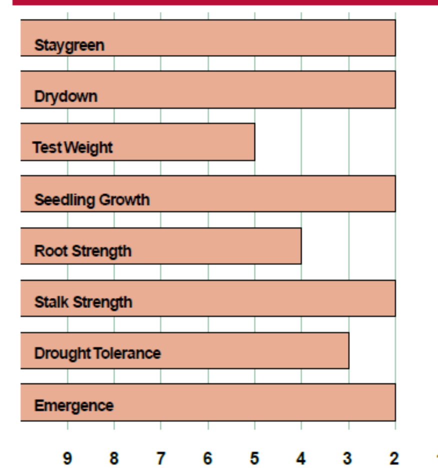
SMARTSTAX CORN — RIB COMPLETE

DKC55-20RIB Brand Blend is an exciting 105 RM product that will work east to west. It has very high yield potential combined with very good Goss' Wilt tolerance to make it an excellent choice for continuous corn. It carries very girthy ears with deep kernels and excellent late season appearance.

Product Brand Characteristics

Category	Characteristic	Value
MANAGEMENT	Value Added Trait	GENSSRIB
	Insect Resistance Management	Y
	Relative Maturity	105
	GDUs to Mid-pollination	1335
	GDUs to Black Layer	2600
	Average for Maturity	1319
PLANTING	Planting Rate	M-MH
	Emergence	2
GROWTH	Seedling Growth	2
	Root Strength	4
	Stalk Strength	2
	Drought Tolerance	3
	Greensnap	3
	Plant Height	M
	Ear Placement	M
HARVEST	Staygreen	2
	Harvest Appearance	3
	Drydown	2
	Test Weight	5
DISEASES	Northern Corn Leaf Blight	3
	Southern Corn Leaf Blight	3
	Gray Leaf Spot	5
	Eye Spot	3
	Common Rust	3
	Southern Rust	7
	Anthracnose Leaf Blight	3
	Anthracnose Stalk Rot	4
	Stewart's Leaf Blight	3
	Goss's Wilt	2
	Corn Lethal Necrosis	3
	Southern Virus Complex	-
	Headsmut	
	Diplodia Ear Rot	Avg
	Growth Regulators Sensitivity	C

NEW **DKC55-20RIB Brand Blend** — 105-DAY RM



Key Strengths

- High yield potential in many environments
- Very good Goss' Wilt tolerance
- Maintains performance under drought stress
- Very girthy ears with deep kernels
- Solid overall agronomic package with very nice late season appearance

Plant Description

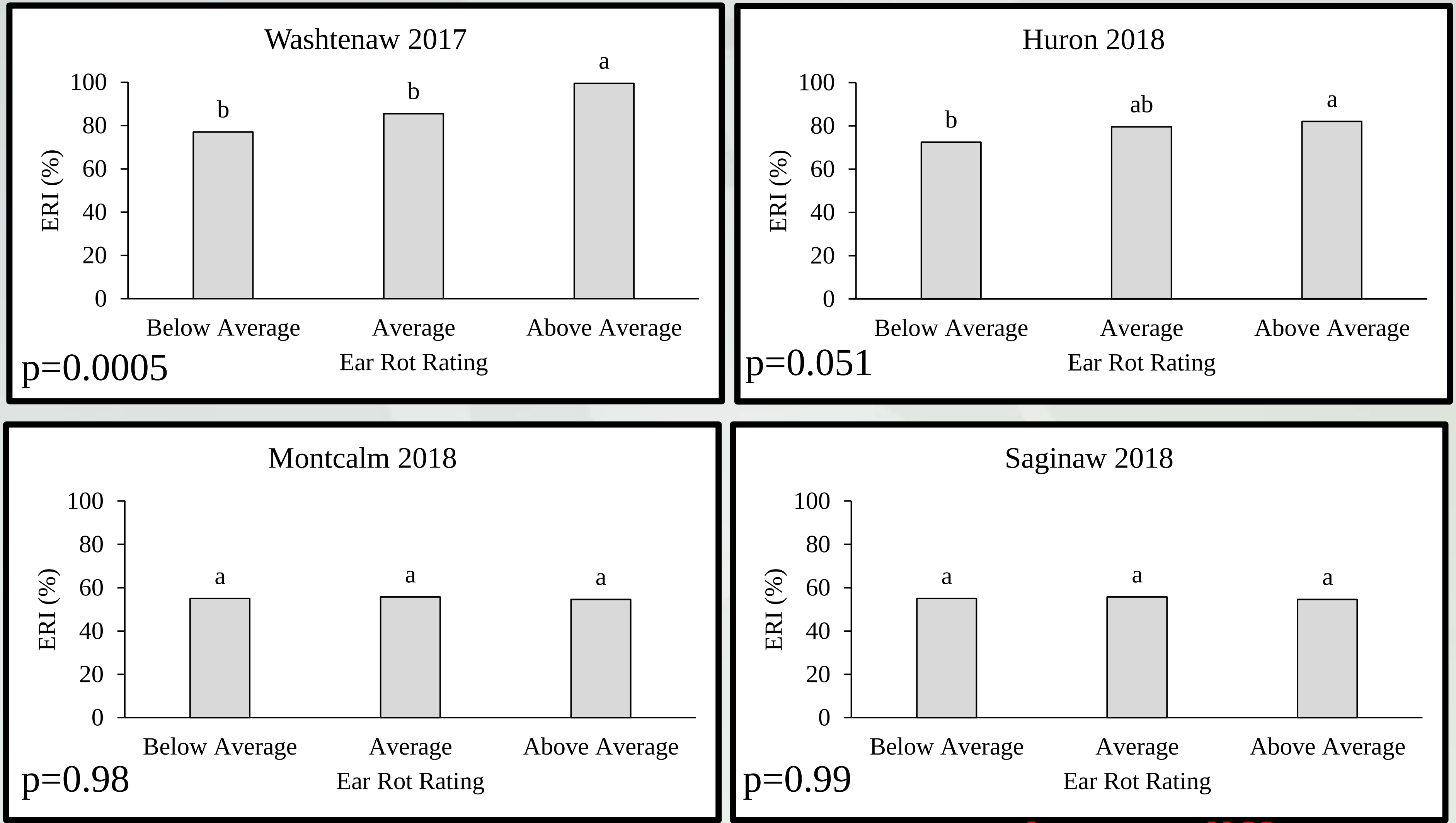
Leaf Color	Dark Green
Silk Color	Green - Yellow
Anther Color	Pink
Kernel Row	20-22
Kernel Cap Color	Yellow
Cob Color	Red

Management Tips

- Plant at medium to medium-high populations
- Performs well with northern movement but later flowering might be limiter
- Very good late season health and strong yield performance in the 11 RM indicate good southern movement

Host Plant Resistance- Ear Rot Incidence

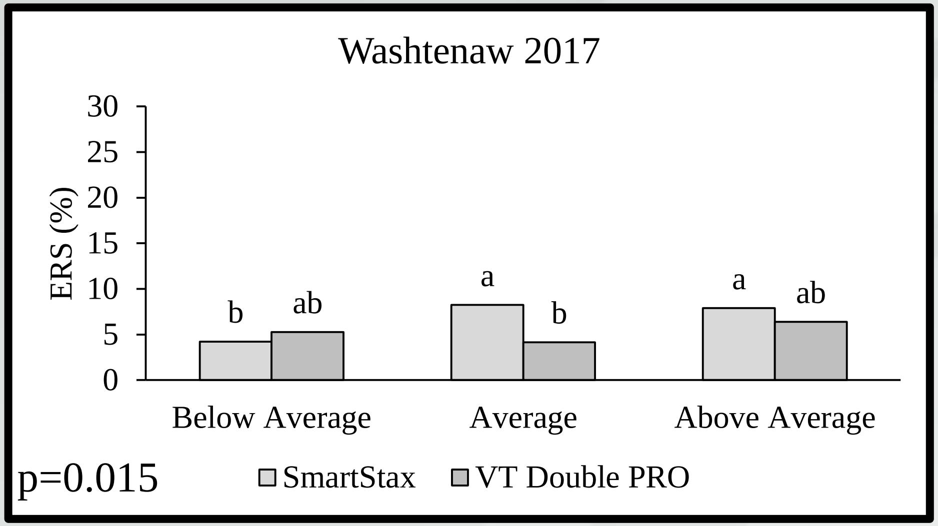
Host

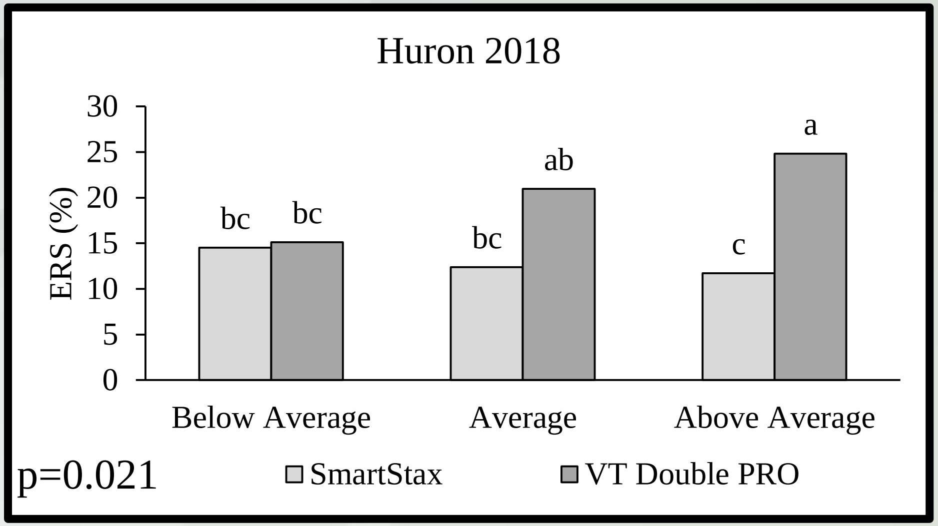


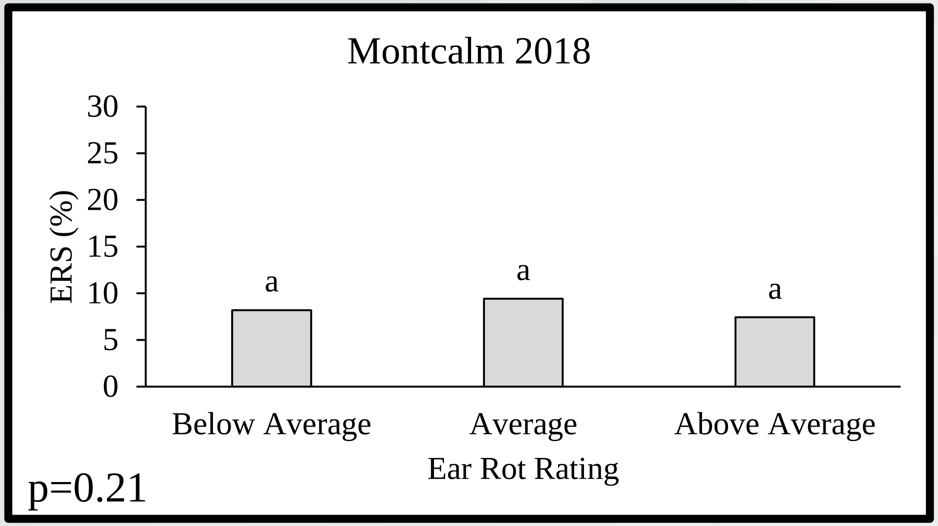
No consistent difference

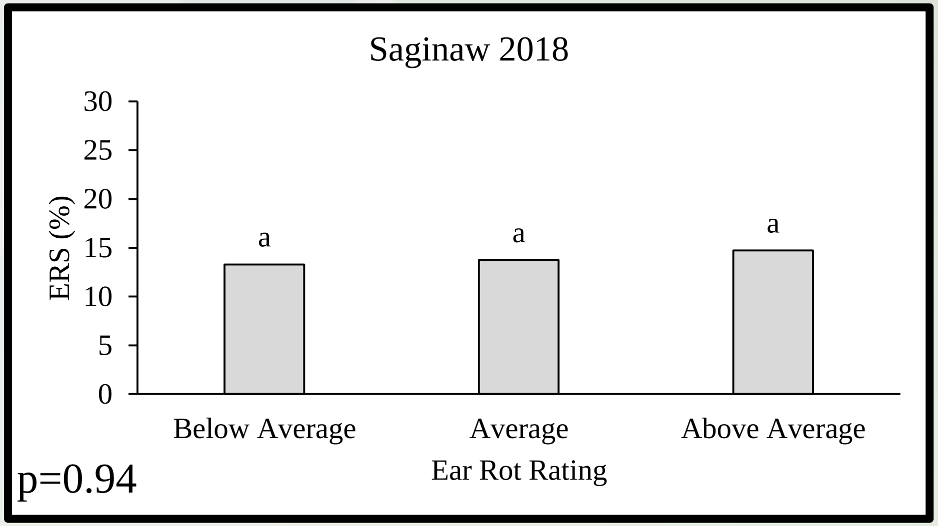
Host Plant Resistance- Ear Rot Severity

Host









No consistent difference

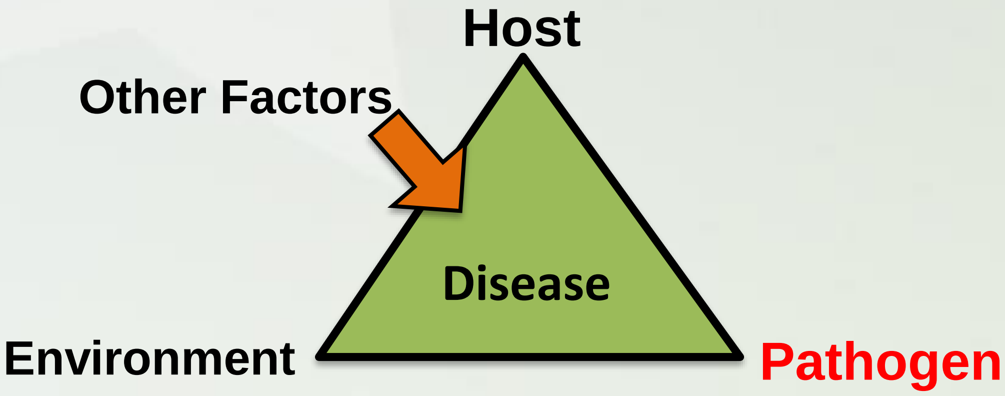
Reduce Overall Plant Stress

Host

- Drought stress can increase aflatoxins in corn due to increased susceptibility to *A. flavus*
- High aflatoxin levels have been associated with fertility and weed stress
- In one study increased nitrogen rates consistently reduces aflatoxin levels

Aspergillus, DuPont Pioneer

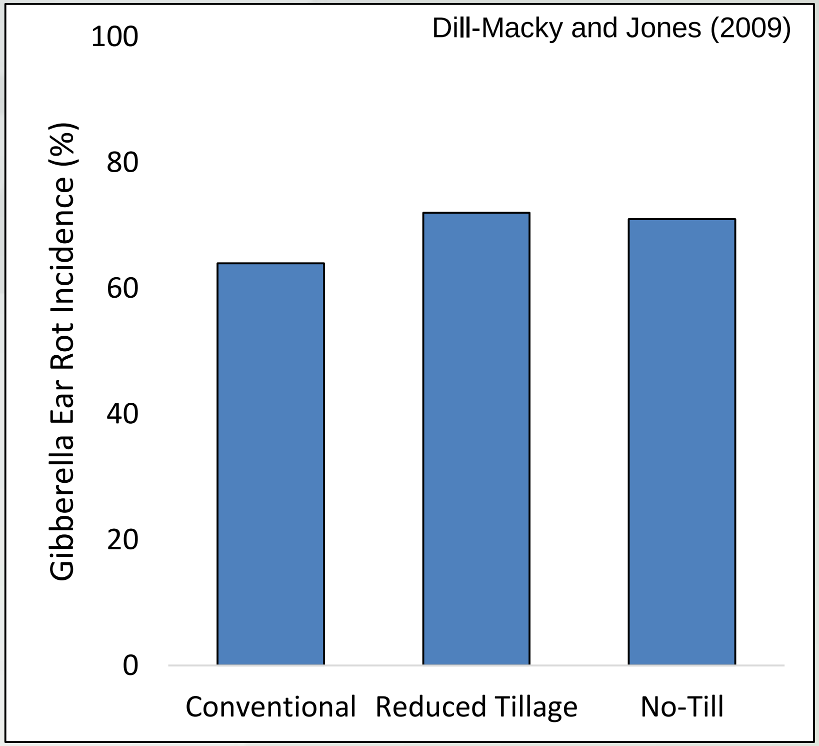
Management of Mycotoxins in Corn Grain
Pathogen



Pathogen

Residue Reduction: Crop rotation and Tillage

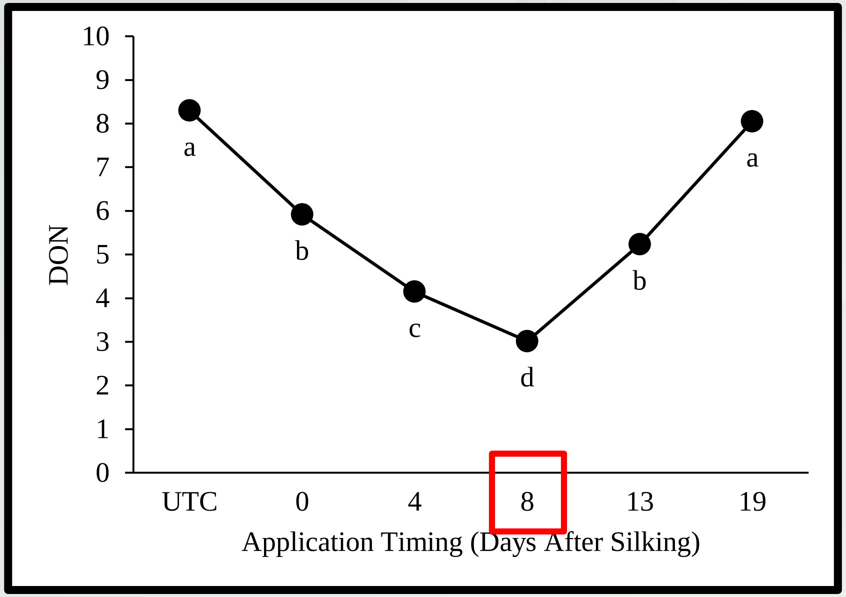
- Inoculum is often from infected residues left in the field
- Avoid corn on corn
- Wheat affected by Fusarium head blight *Fusarium graminearum = Gibberella zeae*
- Greater risk of infection in corn following wheat vs alfalfa
- Conventional tillage may reduce ear rot incidence



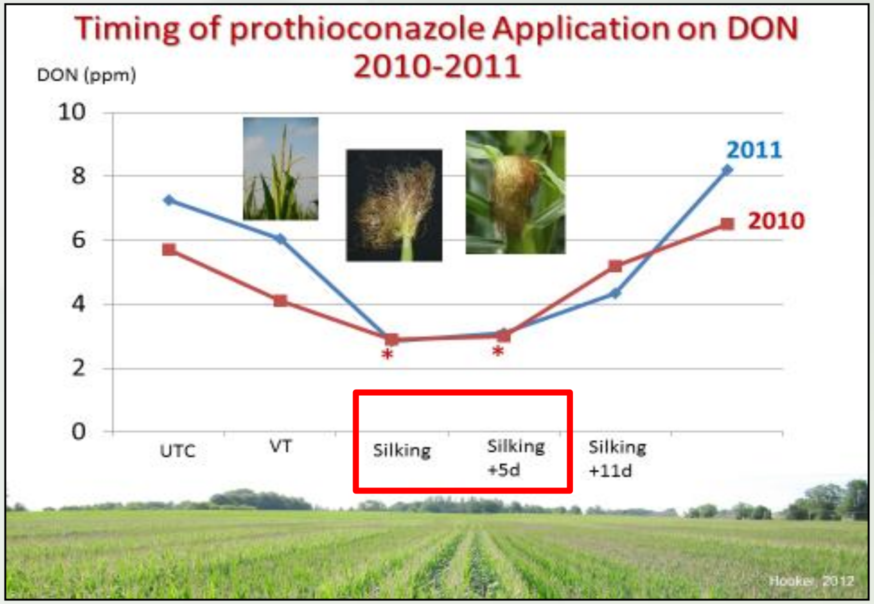
Fungicide application

Pathogen

- Fungicides have been shown to decrease DON levels in some experiments, but this reduction is not always present
- Timing is important
- Fungicide chemistry is important (do not use strobilurins)
- Environmental conditions may determine fungicide efficacy

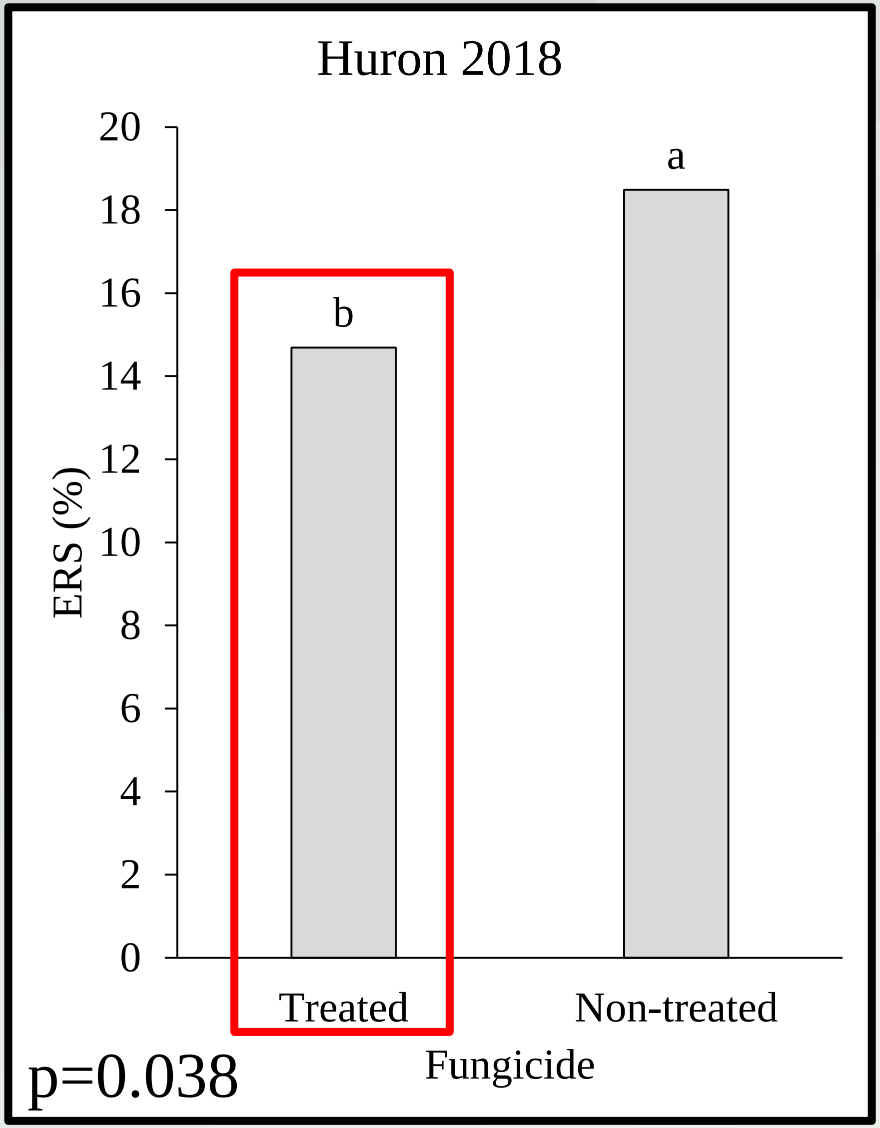


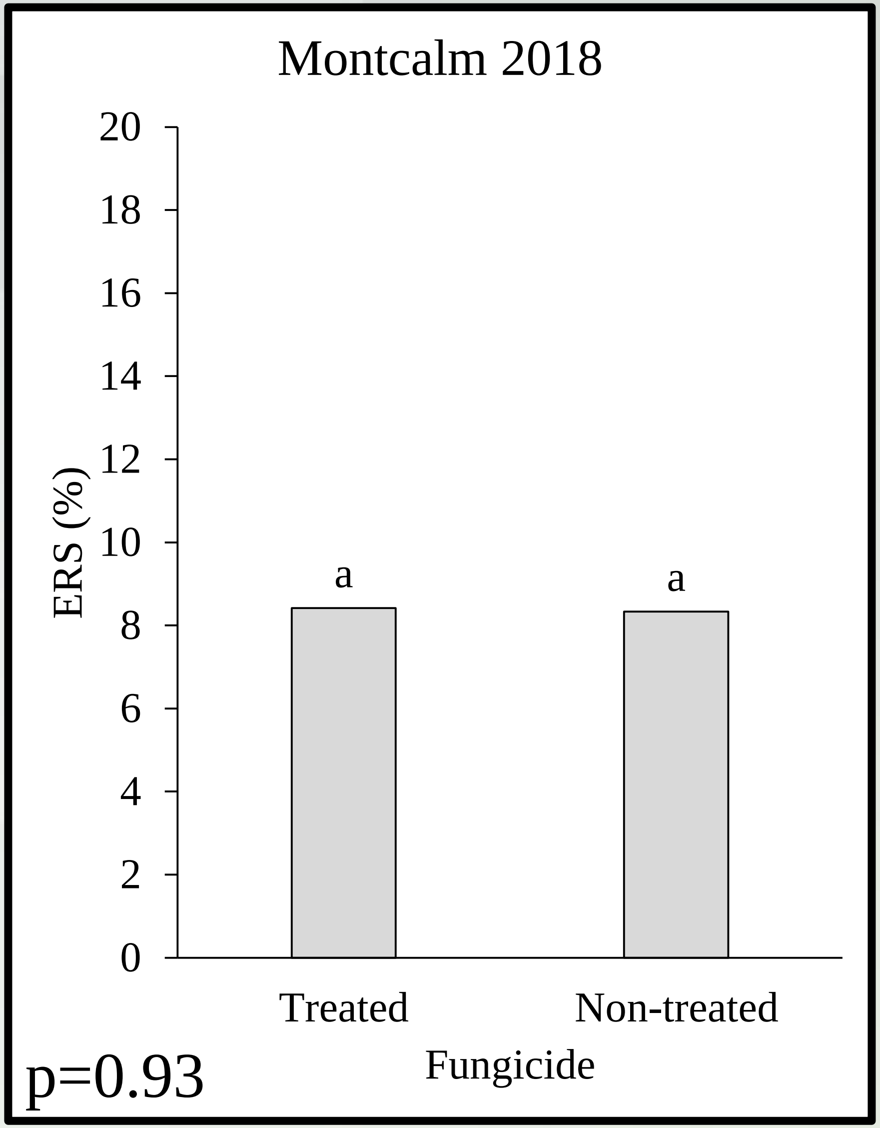
(Limay-Rios and Schaafsma, 2018)



Fungicide- Ear Rot Severity

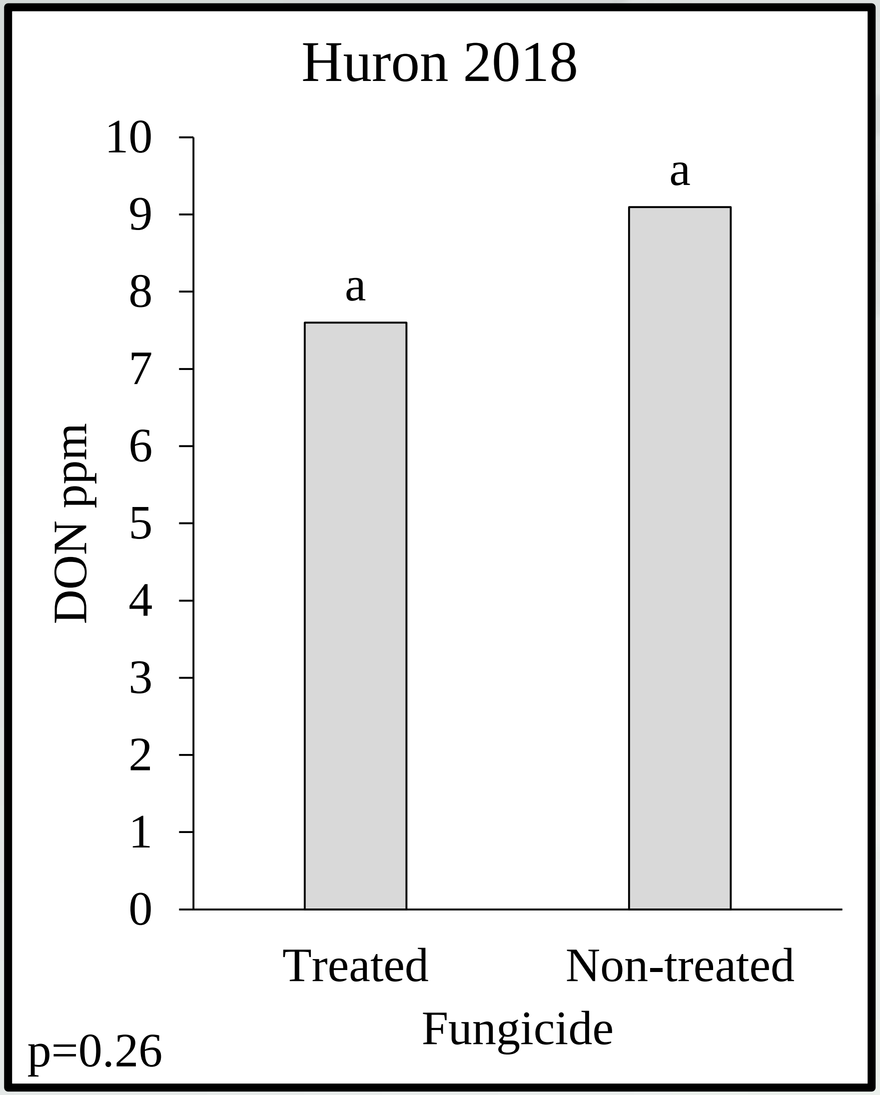
Pathogen

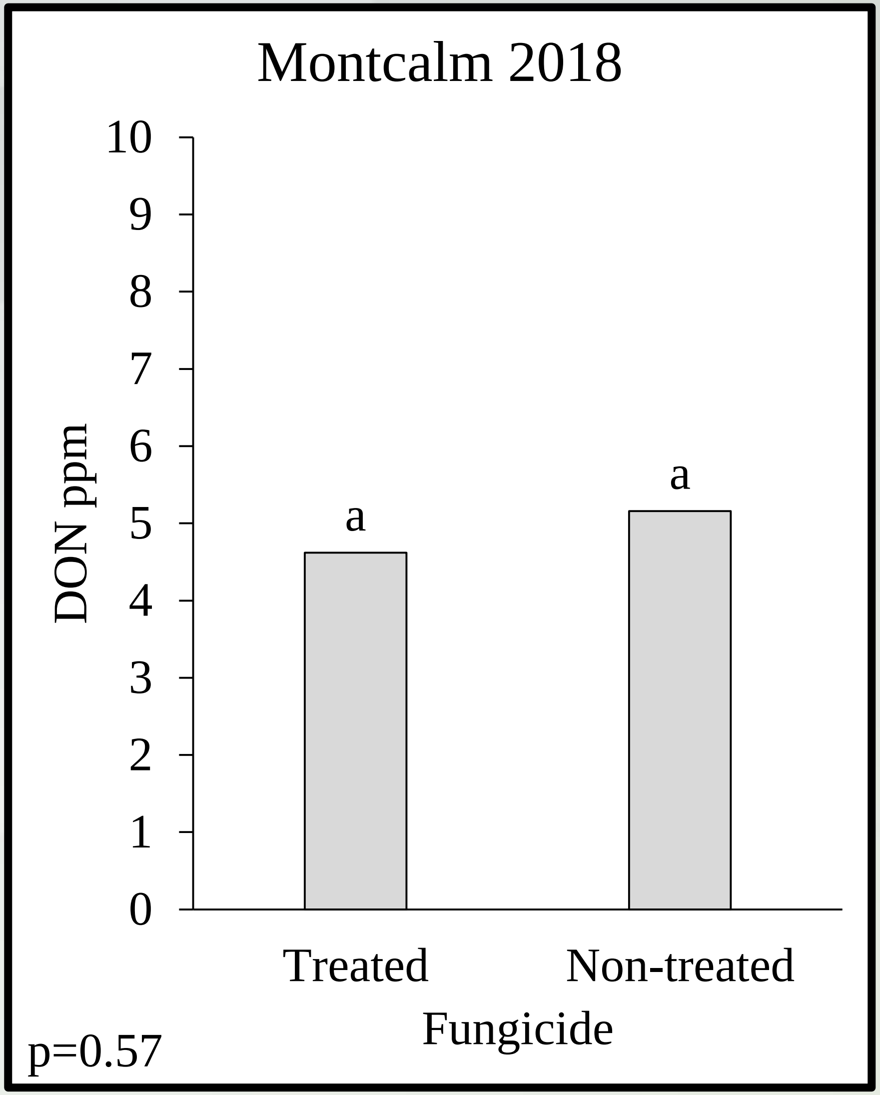




Fungicide- Deoxynivalenol

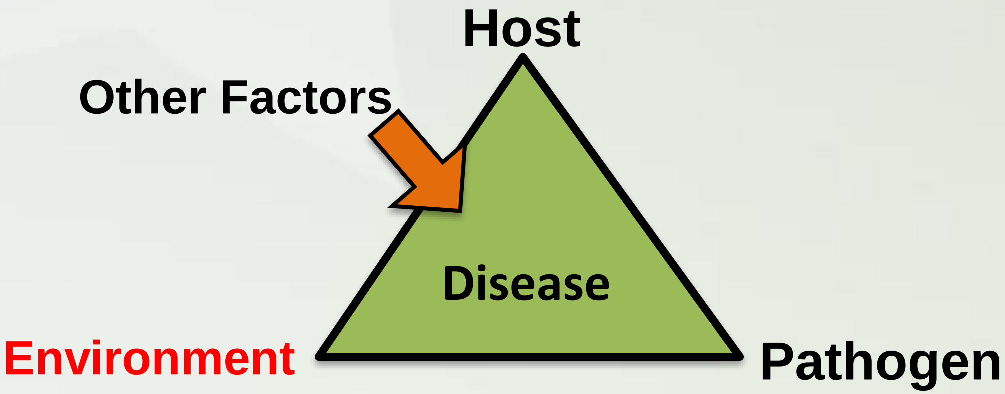
Pathogen





Fungicide did not reduce DON levels

Management of Mycotoxins in Corn Grain
Environment



Planting Date

Environment

- Earlier planting dates generally result in a lower risk of fungal infection
  - Later planting dates generally lead to a delay in harvest which can affect dry down conditions that the crop is exposed to
- Yearly weather differences can jeopardize this advantage

Planting Population

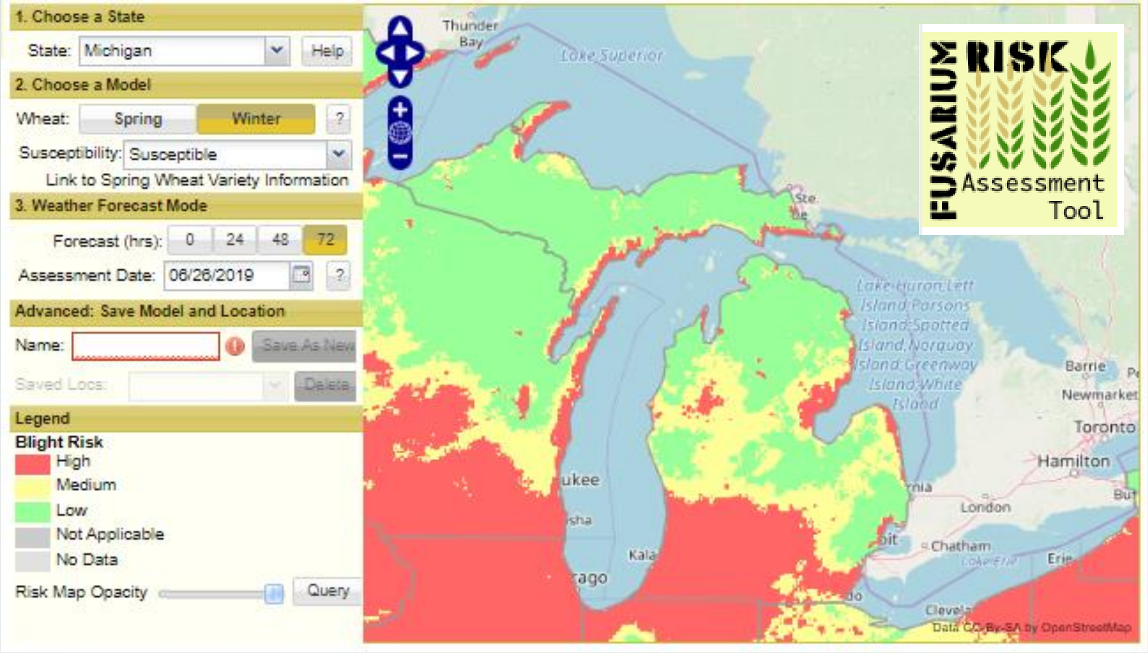
Environment

- Higher population densities result in higher ear rot and mycotoxin levels
  - 15-56% increase in ear rot severity in three out of four years with a high population (33,200 plants a^{-1}) vs. a low population (26,300 plants a^{-1})
- Microclimatic conditions are altered as population increases
- Higher populations lead to lower air flow and higher relative humidity

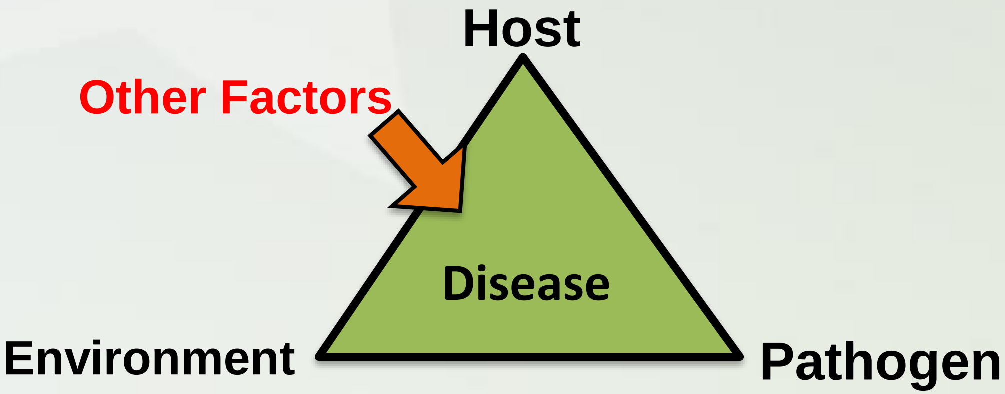
DON Forecasting

Environment

- Modeling efforts can be used to do a better job estimating the probability of disease in a specific region or field
- Models can be used to make decisions about other management strategies
- Researchers in Michigan and other nearby regions such as Ontario are working to create DON forecasting models



Management of Mycotoxins in Corn Grain
Other Factors



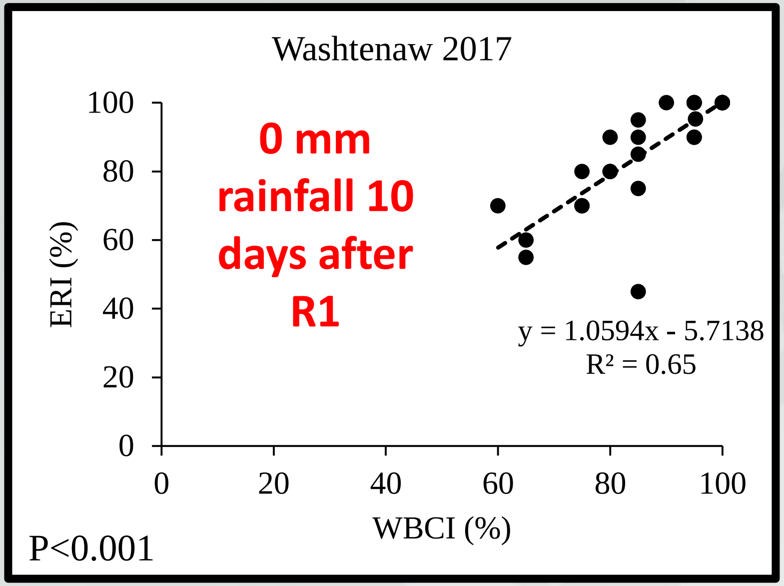
Managing Ear Feeding Insects

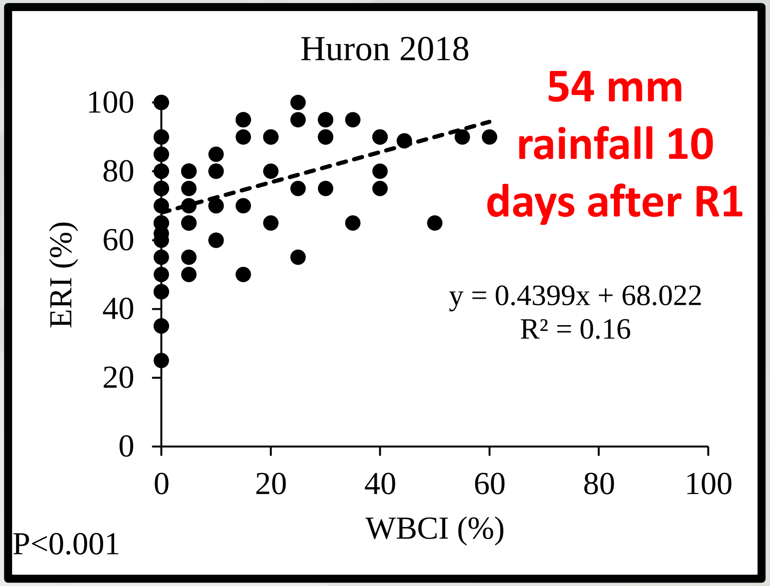
Other Factors

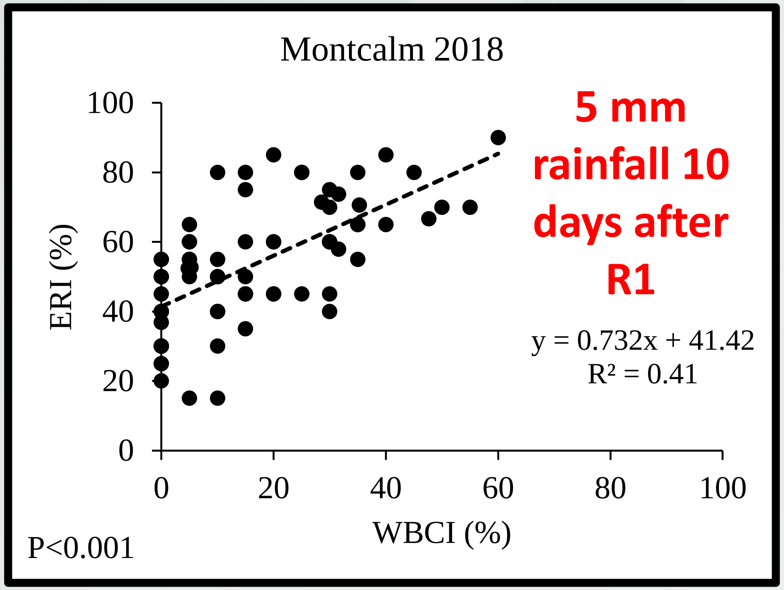
- Physically injured kernels have a higher incidence of ear rot injury
- Wounds are an entry point for fungal spores into the ear
- Studies have found correlations between western bean cutworm damage and Gibberella ear rot

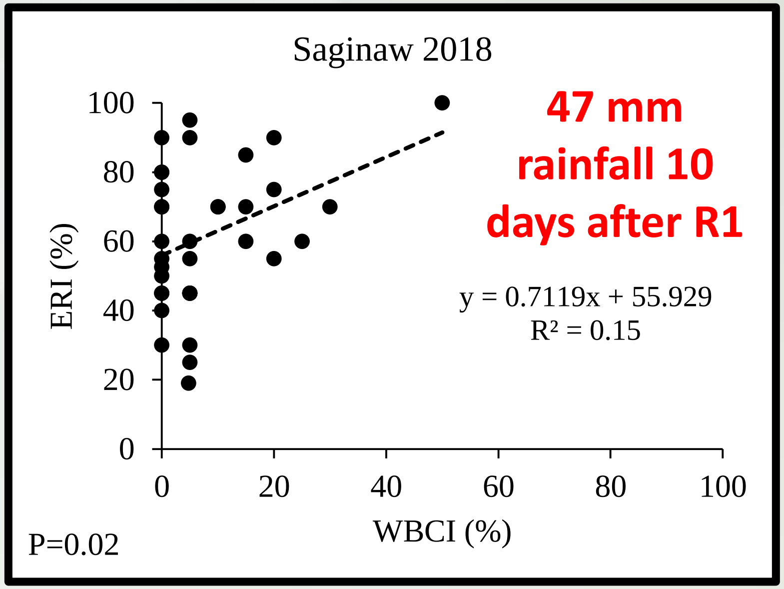
WBC and Ear Rot Incidence

Other Factors









Ear Feeding Insect Issues in Michigan

Other Factors

- Western Bean Cutworm
  - Has been in Michigan since 2006
  - Cry1F no longer offers control due to resistance

- European Corn Borer
  - Regularly found in Michigan on organic or non-Bt corn
  - Not much of an issue in Michigan on Bt corn
  - Resistance found in eastern Canada to Cry1F Bt

- Corn Earworm
  - Little concern in the past 20 years due to Bt traits
  - Surprise for many growers in 2019- moved north earlier along with resistance issues to Cry1A.105 and Cry2Ab2

Hybrid Selection

Other Factors

- The use of Bt traits to control European corn borer was associated with a reduction in mycotoxin contamination

- Knowing what traits to use is important
  - Handy Bt Trait Table

Other Factors

The Handy Bt Trait Table

for U.S. Corn Production

The latest version of the table 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 (web site host)

Updated May 2019

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. This latest version incorporates two new findings of resistance, and categorizes western & northern corn rootworm separately.

Breaking News #1: Entomologists at the University of Guelph in Canada confirmed European corn borer (ECB) resistance to Cry1F Bt (the Herculex I trait) in corn. In 2018, ECB populations were collected from multiple locations in the Maritime Provinces of eastern Canada where unexpected damage was reported. Lab bioassays showed a high level of resistance to Cry1F; the registrant of the trait independently confirmed the results. *This is the first case of field-evolved resistance by ECB to Bt corn.*

Use of single-trait hybrids likely contributed to the problem. In eastern Canada, hybrids with only one Bt trait (Cry1F) were still being sold & planted, well after an expected phase out in favor of multi-Bt pyramids to allow for reduced 5% refuge. Although the Maritime provinces are far from the major corn production area in the central U.S., the bioassay results demonstrate that ECB resistance to Bt corn can happen, and that phasing out single-trait hybrids is critical. In short-growing season areas of the U.S. and Canada, seed options tend to be limited, so single-trait hybrids may still be available. Using them risks the development of additional resistant insect populations.

Breaking News #2: Entomologists at North Dakota State University confirmed northern corn rootworm resistance to Cry3Bb1 and Cry34Ab1/Cry35Ab1. Although resistance to multiple traits is well-documented in the Midwest for western corn rootworm, this is the *first confirmation of field-evolved resistance by the northern corn rootworm.*

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

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 herbicide detoxification*
Herculex I (HXI) or CB	TC1507	Cry1Fa2 + *PAT*	corn borer + *glufosinate*
Herculex CRW	DAS-59122-7	Cry34Ab1/Cry35Ab1 + *PAT*	rootworm + *glufosinate*
(None – part of Qrome)	DP-4114	Cry1F + Cry34Ab1/Cry35Ab1 + *PAT*	corn borer + rootworm + *glufosinate*
Roundup Ready 2	NK603	*EPSPS*	*glyphosate*
Yieldgard Corn Borer	MON810	Cry1Ab	corn borer
Yieldgard Rootworm	MON863	Cry3Bb1	rootworm
Yieldgard VT Pro	MON89034	Cry1A.105 + Cry2Ab2	corn borer & several caterpillar species
Yieldgard VT Rootworm	MON88017	Cry3Bb1 + *EPSPS*	rootworm + *glyphosate*

Abbreviations used in the Trait Table

Herbicide traits
GT *glyphosate tolerant*
LL Liberty Link - *glufosinate-tolerant*
RR2 Roundup Ready 2, *glyphosate-tolerant*

Insect targets
BCW black cutworm
CEW corn earworm
ECB European corn borer
FAW fall armyworm
CR corn rootworm (NCR = Northern & WCR = Western)
SB stalk borer
SCB sugarcane borer
SWCB southwestern corn borer
TAW true armyworm
WBC western bean cutworm

The Handy Bt Trait Table for U.S. Corn Production, updated May 2019

Trait packages in alphabetical order (acronym)	Bt protein(s) in the trait package	Marketed for control of: BCW	CEW	ECB	FAW	SB	SCB	SWCB	TAW	WBC	CR	Resistance confirmed to the combination of Bts in package (check local situation)	Herbicide trait: GT RR2	LL	Non-Bt Refuge % (cornbelt)
AcreMax (AM)	Cry1Ab Cry1F	x		x	x	x	x	x				FAW WBC	x	x	5% in bag
AcreMax CRW (AMRW)	Cry34/35Ab1										x	NCR/WCR	x	x	10% in bag
AcreMax1 (AM1)	Cry1F Cry34/35Ab1	x		x	x	x	x	x			x	ECB FAW SWCB WBC NCR/WCR	x	x	10% in bag 20% ECB
AcreMax Leptra (AML)	Cry1Ab Cry1F Vip3A	x	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			x	FAW WBC WCR	x	x	10% in bag
AcreMax Xtra (AMX)	Cry1Ab Cry1F Cry34/35Ab1	x		x	x	x	x	x			x	FAW WBC NCR/WCR	x	x	10% in bag
AcreMax Xtreme (AMXT)	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x	x			x	FAW WBC WCR	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	WCR	x	x	20%
Agrisure Viptera 3110	Cry1Ab Vip3A	x	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	x	WCR	x	x	20%
Agrisure 3120 E-Z Refuge	Cry1Ab Cry1F	x		x	x	x	x	x				FAW WBC	x	See bag tag for code EZ0 NO EZ1 YES	5% in bag
Agrisure 3122 EZ Refuge	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x	x			x	FAW WBC WCR	x		5% in bag
Agrisure Viptera 3220 E-Z Refuge	Cry1Ab Cry1F Vip3A	x	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			x		5% in bag
Agrisure Duracade 5122 E-Z Refuge	Cry1Ab Cry1F mCry3A eCry3.1Ab	x		x	x	x	x	x			x	FAW WBC WCR	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	x	WCR	x		5% in bag
Herculex I (HXI)	Cry1F	x		x	x	x	x	x				ECB FAW SWCB WBC	x	x	20%
Herculex RW (HXRW)	Cry34/35Ab1										x	NCR/WCR	x	x	20%
Herculex XTRA (HXX)	Cry1F Cry34/35Ab1	x		x	x	x	x	x			x	ECB FAW SWCB WBC NCR/WCR	x	x	20%
Intrasect (YHR)	Cry1Ab Cry1F	x		x	x	x	x	x				FAW WBC	x	x	5%
Intrasect TRIsect (CYHR)	Cry1Ab Cry1F mCry3A	x		x	x	x	x	x			x	FAW WBC WCR	x	x	20%
Intrasect Xtra (YXR)	Cry1Ab Cry1F Cry34/35Ab1	x		x	x	x	x	x			x	FAW WBC NCR/WCR	x	x	20%
Intrasect Xtreme (CYXR)	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x	x			x	FAW WBC WCR	x	x	5%
Leptra (VYHR)	Cry1Ab Cry1F Vip3A	x	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	x				CEW WBC	x	x	[a] 5% [b] 5% in bag
QROME (Q)	Cry1Ab Cry1F mCry3A Cry34/35Ab1	x		x	x	x	x	x			x	FAW WBC WCR	x	x	5% in bag
SmartStax [a] Smartstax Refuge Advanced [b] SmartStax RIB Complete [b]	Cry1A.105 Cry2Ab2 Cry1F Cry3Bb1 Cry34/35Ab1	x	x	x	x	x	x	x			x	CEW WBC WCR	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			x		[a] 5% [b] 5% in bag
TRIsect (CHR)	Cry1F mCry3A	x		x	x	x	x	x			x	ECB FAW SWCB WBC WCR	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 Cry3Bb1		x	x	x	x	x	x			x	CEW NCR/WCR	x		[c] 20% [d] 10% in bag
Yieldgard Corn Borer (YGCB)	Cry1Ab			x			x	x					x		20%
Yieldgard Rootworm (YGRW)	Cry3Bb1										x	NCR/WCR	x		20%
Yieldgard VT Triple	Cry1Ab Cry3Bb1			x			x	x			x	NCR/WCR	x		20%

Bt Trait Selection

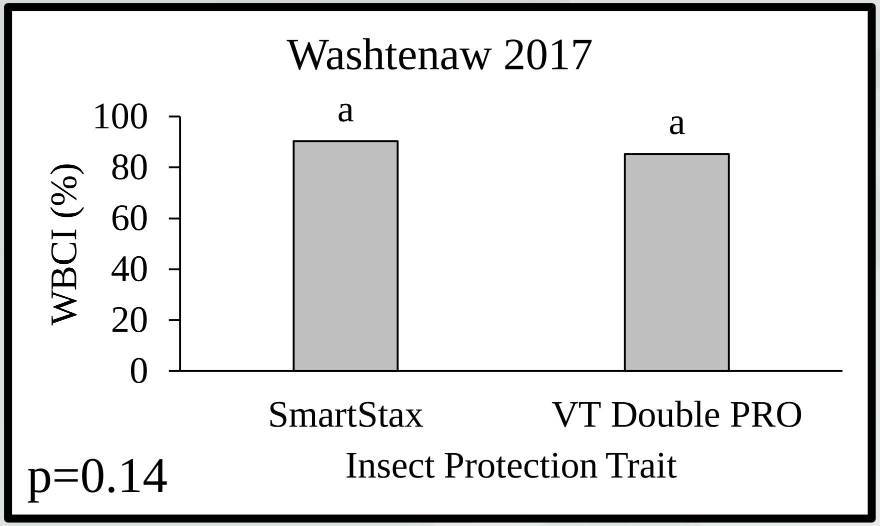
Other Factors

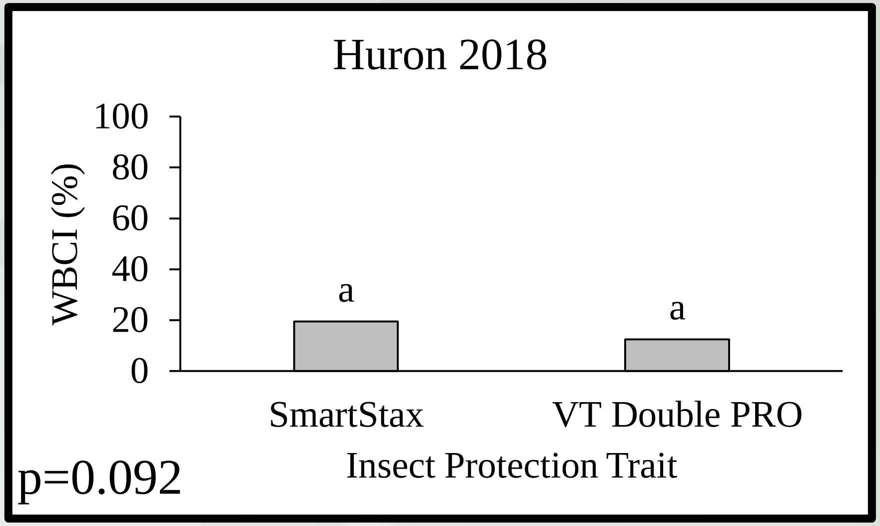
- Bt trait selection is important
  - Traits that control for European corn borer (Cy1A, Cry1Ab, and Cry2Ab) have no effect on WBC
  - Western bean cutworm
    - Cry1F
    - Vip3A

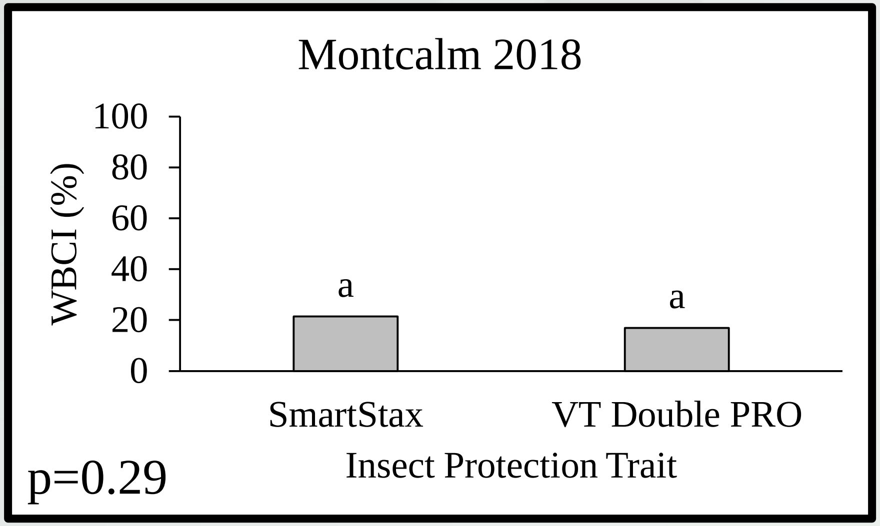
Western Bean Cutworm feeding

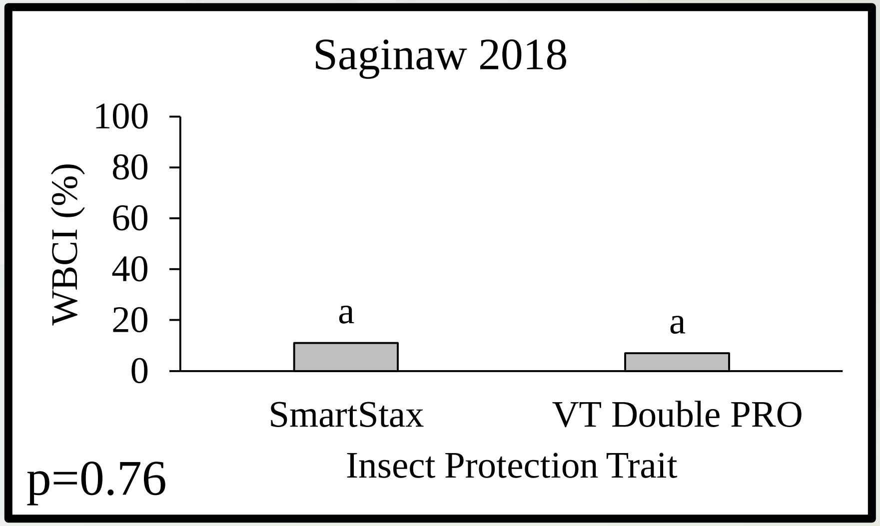
Cry1F for WBC control

Other Factors





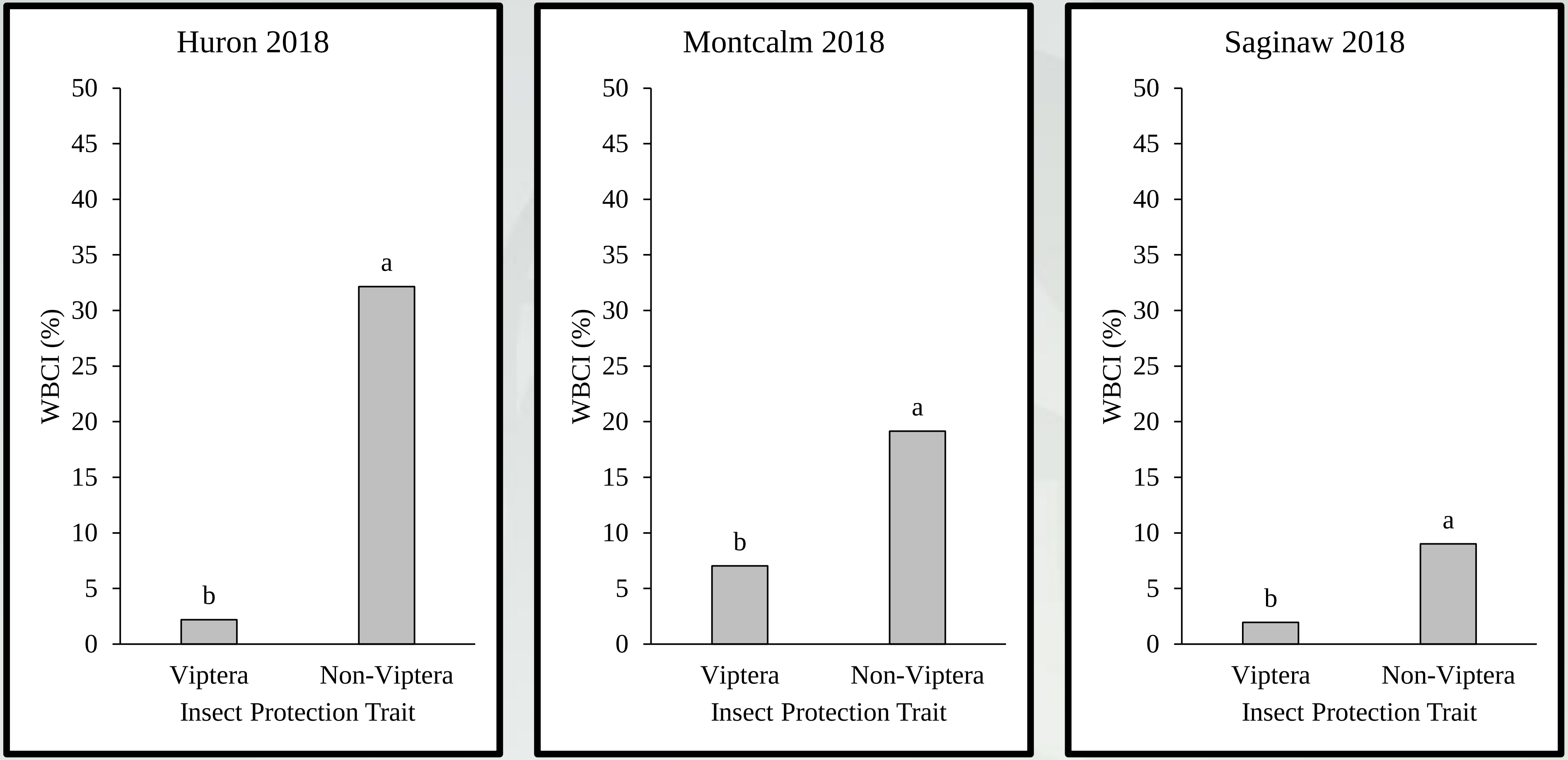




No difference between SmartStax & VT Double PRO hybrids

Other Factors

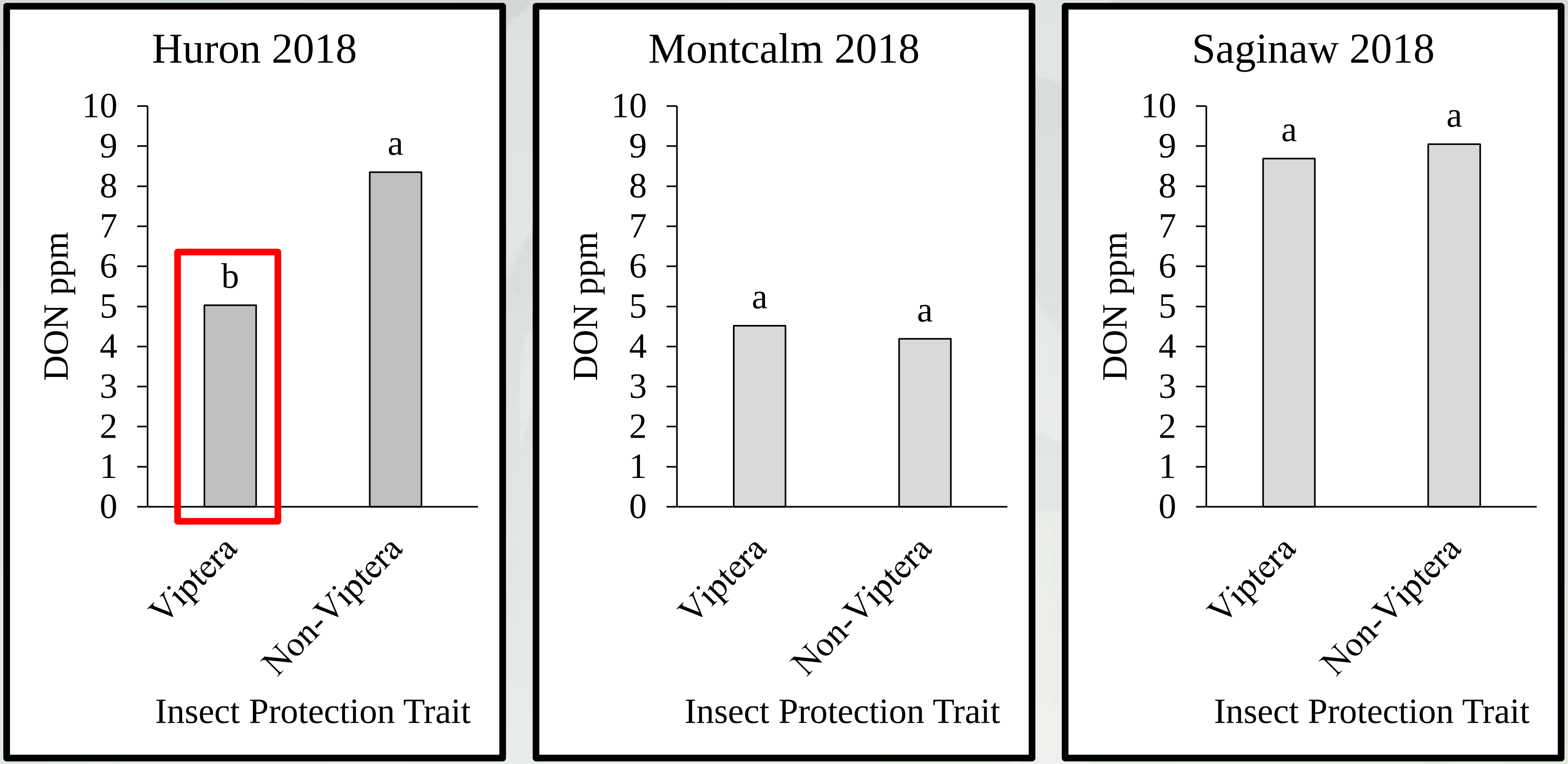
Insect Trait Package-Agrisure Viptera



Viptera lowered WBC levels during the 2018 growing season

Other Factors

Insect Trait Package-Agrisure Viptera



Viptera effect on DON levels was limited to one out of three locations in 2018

Insecticide

- Recommended threshold in the Great Lakes region for WBC control
  - Cumulative threshold of 5% of plants
- One study in the Great Lakes region has shown 38-88% decrease in WBC incidence and 55-95% decrease in WBC severity
  - Plots with insecticides targeting early instar generally had lower DON levels than fungicides alone
  - Insecticides did not provide complete protection from injury
- Insecticide-fungicide tank mix recommended at R1 (silking) to optimize fungicide protection

Integrated Mycotoxin Management

- Hybrid selection
- Residue management
  - Crop rotation
  - Tillage
- Reduce plant stress
- Manage for uniformity
- WBC control (traits, scout and spray)
- Fungicide application (timing, chemistry)
- Harvest high risk fields first
- Post-harvest drying

Future Research- Silage Mycotoxin Management

- Objectives: Study how various management strategies impact ear rots, mycotoxins, silage yield, and silage quality
  - Determine the effects of a **foliar fungicide** in hybrids with differing **ear rot resistance** and **insect protection traits**
  - Quantify the role of **planting date** and **population**
  - Investigate impacts of various **agronomic practices**

Experiment #1

- Huron, Ingham, Ottawa counties
- 6 hybrids
- Fungicide application

Experiment #2

- Ingham county
- 3 planting dates (5/17, 5/27, 6/19)
- 4 populations (28k-46k)

Experiment #3

- Collect samples from across the state of Michigan
- Gather info about field management

Questions?

Contact Us:

Manni Singh

msingh@msu.edu

Katlin Fusilier

blaineka@msu.edu