Growing High Quality Corn Silage

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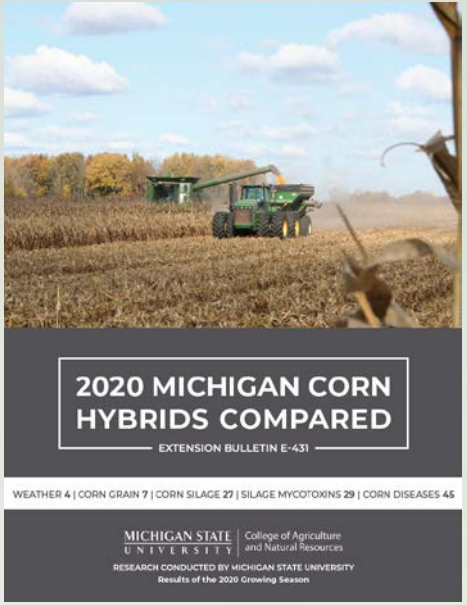

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Desirable Corn Silage Characteristics

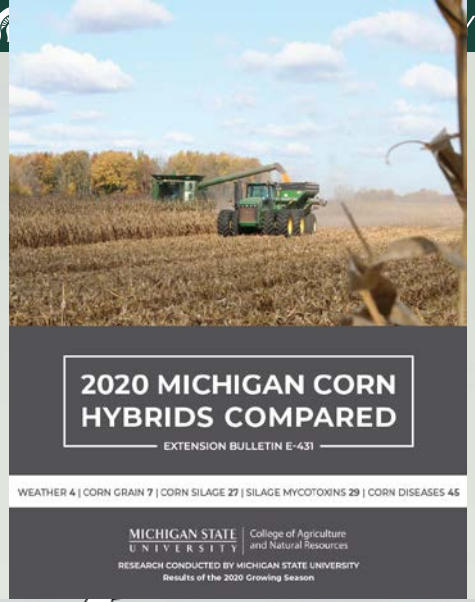
- What makes a good corn silage?
  - High yield
  - High energy (high digestibility)
  - High intake potential (low fiber)
  - High protein
  - Proper moisture at harvest for storage

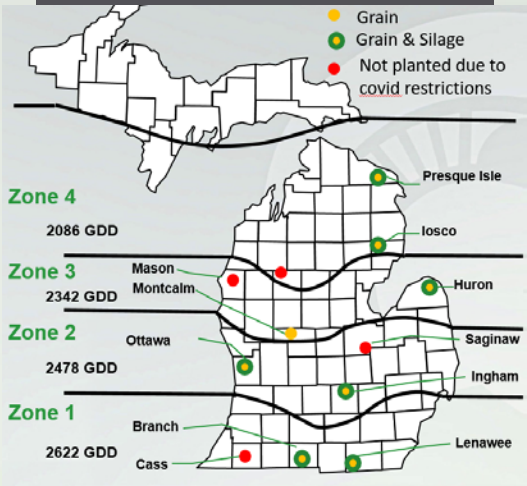
- Both **hybrid selection** and **management** are critical for high quality silage production

Corn Silage Hybrid Selection

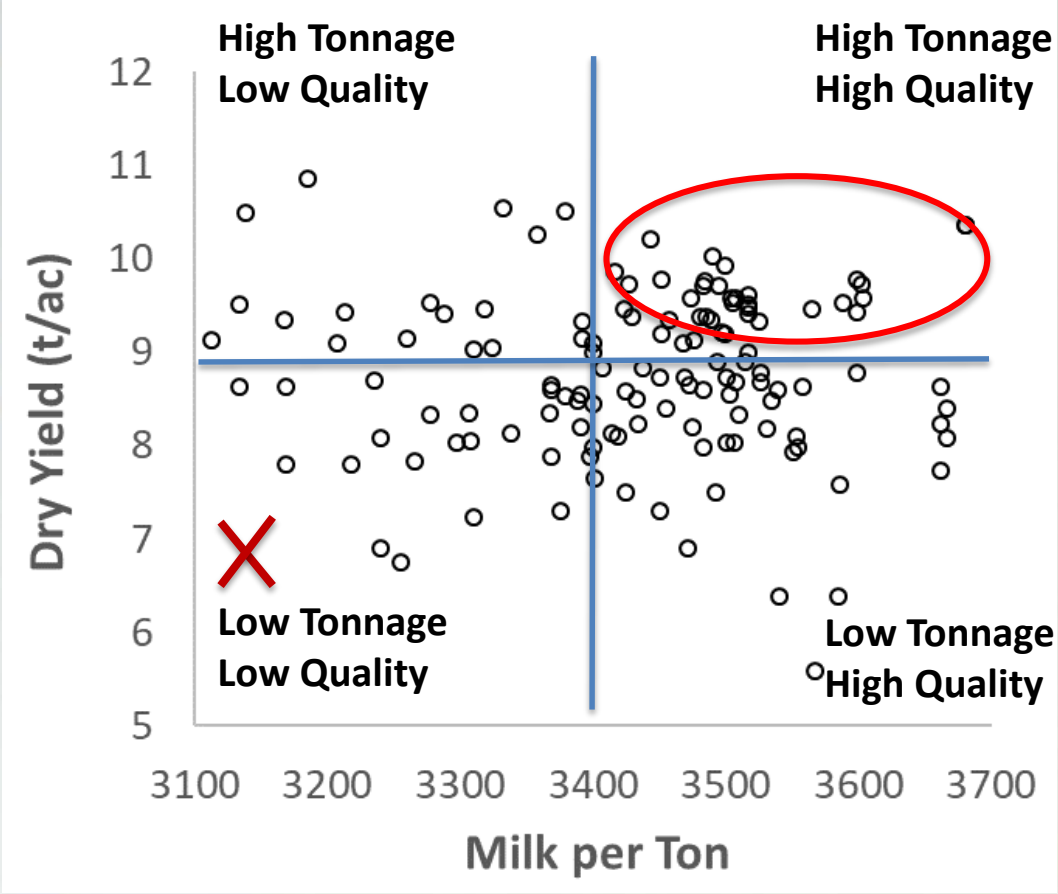
- Hybrid performance data
  - Trustworthy data, replicated, over locations and/or years
  - Consistent top performance in your region (reduces risk)

- Evaluate both yield and quality
  - **Yield** (on % DM basis)
  - NDF: Low NDF increases silage digestibility and intake
  - NDF digestibility (NDFD): increase DM intake and milk production
  - High Crude protein, Starch content
  - Overall Silage quality (**Milk/ton** is a good indicator)
  - **Milk/Acre** (DM yield x Milk/ton)
  - Goal: Identify hybrids with **high yield & milk/ton**





Importance of Hybrid Selection



Michigan Corn Trials
Zone 4 (2018, 2019)

Importance of Hybrid Selection

- Dry tonnage: 25% diff b/w best and worst hybrid
- Milk per Acre: 11% diff b/w best and worst hybrid
- Milk per Ton: 30% diff b/w best and worst hybrid

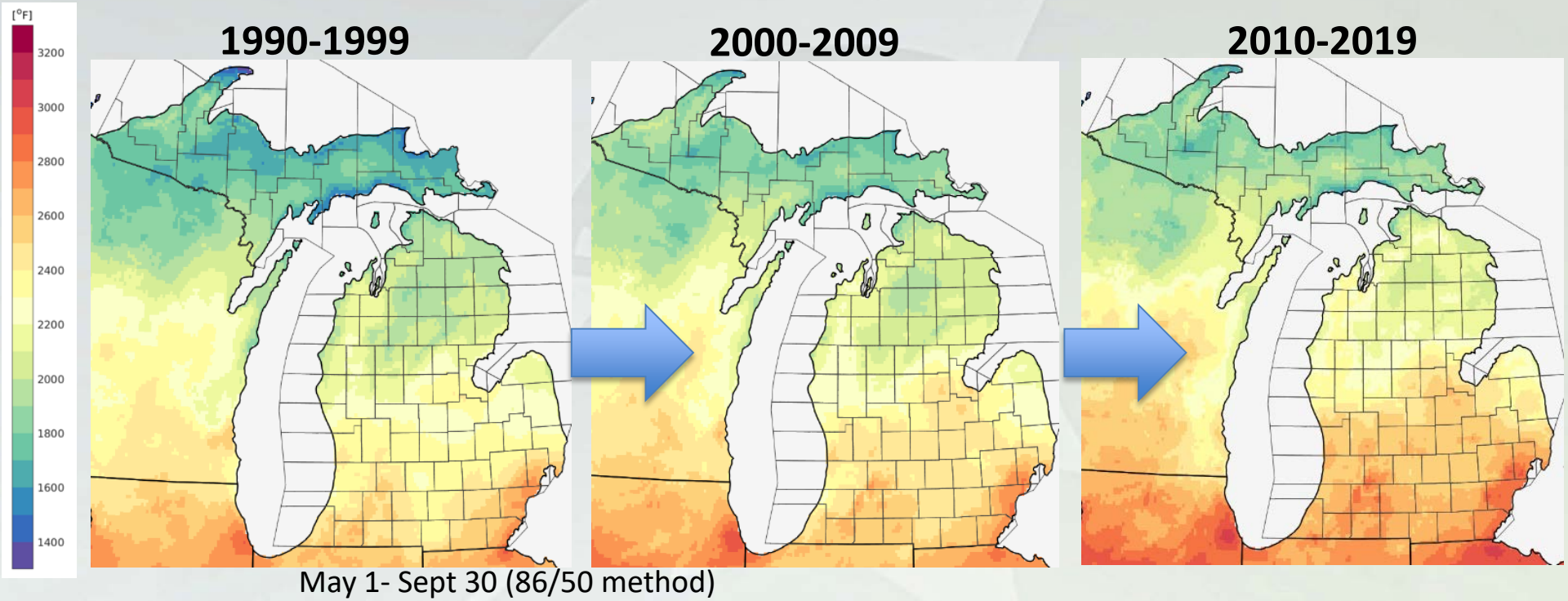
- Assume 5,000 ton corn silage feed requirement

- 42 acres x 150 bu/A = 6,300 bu (to sell or feed)
- 6,300 bu x $3.50/bu = $22,050

	Silage yield (T/A @65%)	Acres required
Hybrid A	30	167
Hybrid B	24	208
Difference	6	42
Diff. (%)	25%	

Source: Michigan Corn Trials (2015 onwards)

Corn Maturity Selection- GDD maps

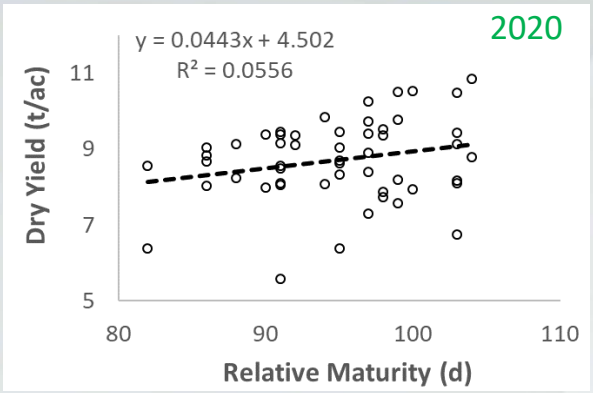


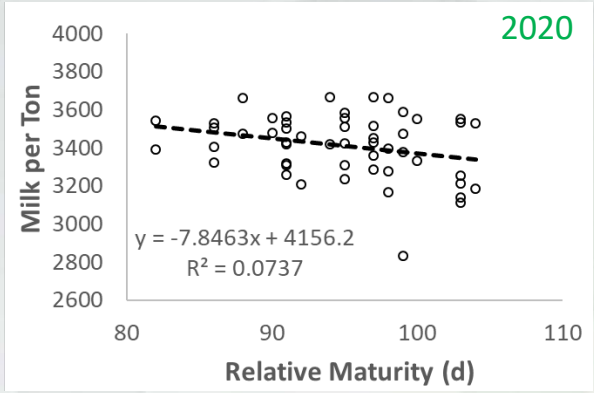
May 1- Sept 30 (86/50 method)

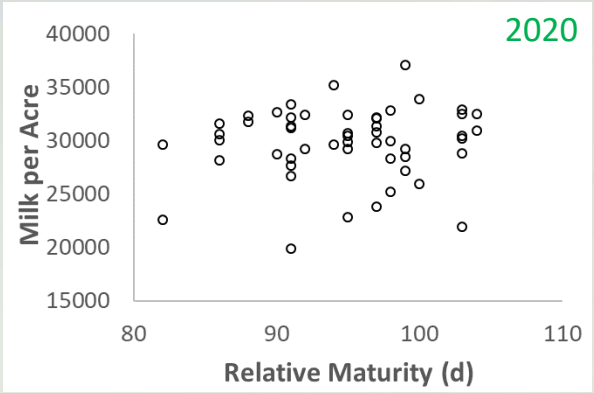
- Seasonal GDD totals are increasing with time, use GDD rating vs “relative maturity”?
- ~5-8 units longer ‘relative maturity’ than grain hybrids

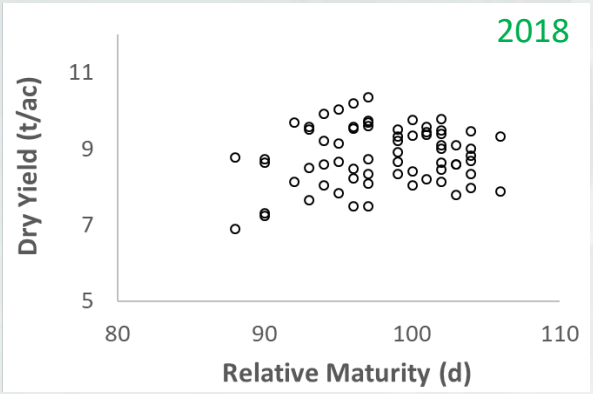
Relationships with Relative Maturity

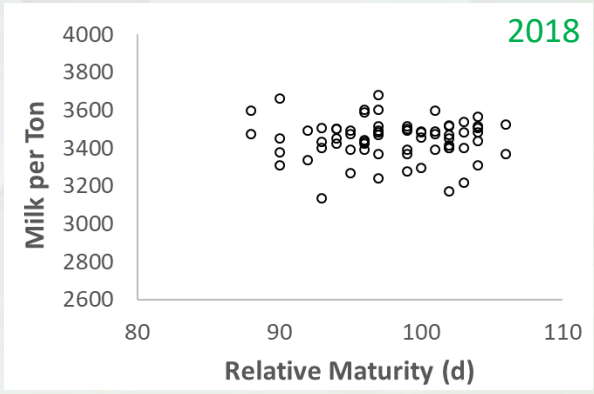
Data from Zone 4 (3 locations)- One planting time: mid-season

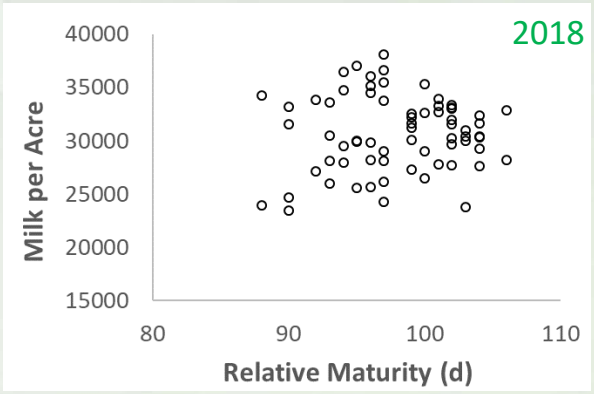












Silage Dry Yield of Hybrids with Transgenic Traits

Includes herbicide tolerance

	All entries	Conv. Only	Herbicide tolerance only	Above ground insect protection	Above and below ground insect protection
Av. Yield (t DM/A)	9.7	9.5	9.5	9.8	9.7
Range (t DM/A)	8.3-10.9	8.9-10.6	8.3-10.5	9.0-10.7	8.6-10.9
No. of hybrids	165.0	13 (8%)	9 (5%)	67 (41%)	76 (46%)
3-yr Av. Yield	9.1	8.8	8.8	9.1	9.2

What if Mycotoxins (VOM) are an issue?

Pest pressure is mostly absent in these trials

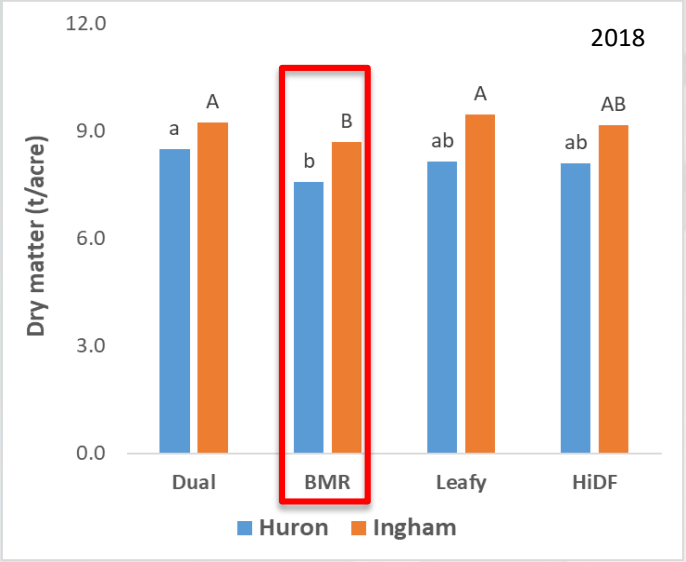
Corn Silage Hybrid Types

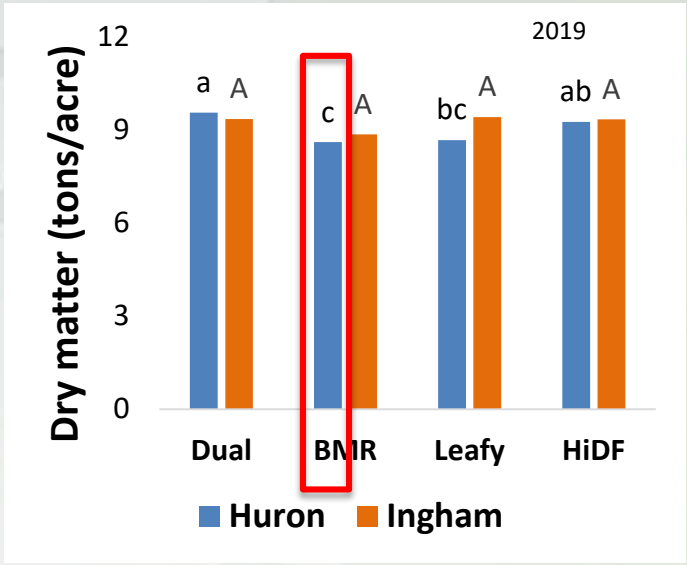
Hybrid type	DM Yield (tons/ac)	Quality (% of DM)				Milk Yield	
		Starch	CP	NDF	NDFD	(lb/ton)	(lb/ac)
Dual Purpose Avg: DeKalb DKD61-69 DeKalb DKC63-42 Pioneer 33T55 Pioneer 34A89	9.9 a	34 a	8.4 b	40 b	58 b	3370 b	33,400 a
Brown Midrib Avg: Mycogen F2F566 Mycogen F2F610	9.2 b	32 b	8.6 a	42 a	73 a	3650 a	33,600 a
Difference:	-7%	-6%	+2%	+5%	+26%	+8%	+0%
Notes on BMR:	-20% in 1990s				Similar in 1990s		

Data from Cox & Cherney, 2011 (*Agronomy Journal*)

BMR hybrid Dual hybrid

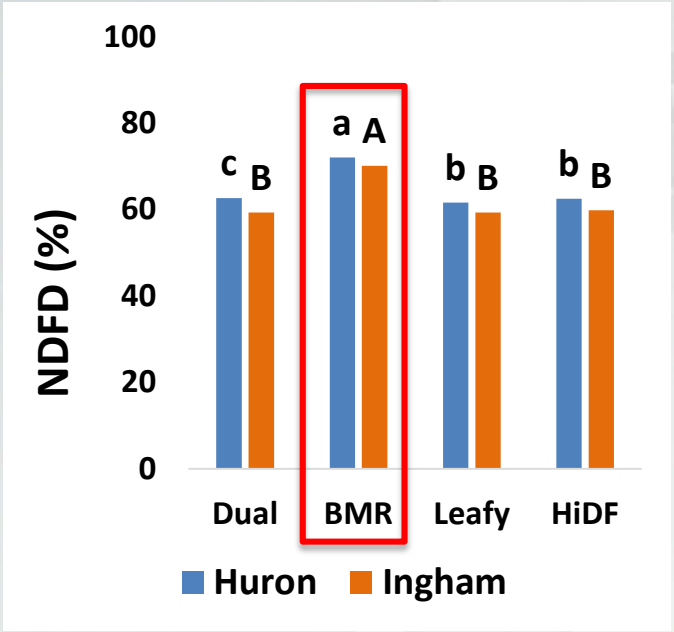
Corn Silage Hybrid Types- Dry matter

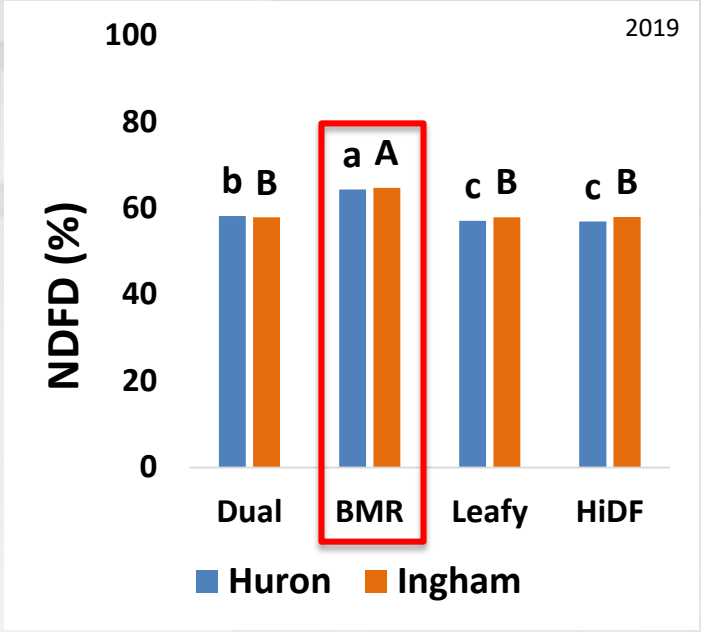




- Highest yield in Dual hybrid, similar to HiDF and Leafy hybrid
- BMR hybrids had lower yield than Dual in 3 out of 4 site years
- Similar response to seeding rates among hybrid classes

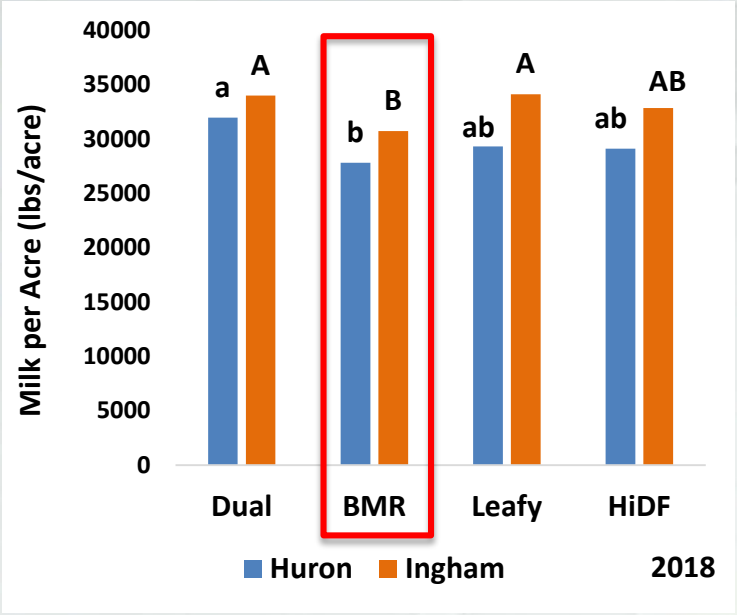
Corn Silage Hybrid Types- Quality

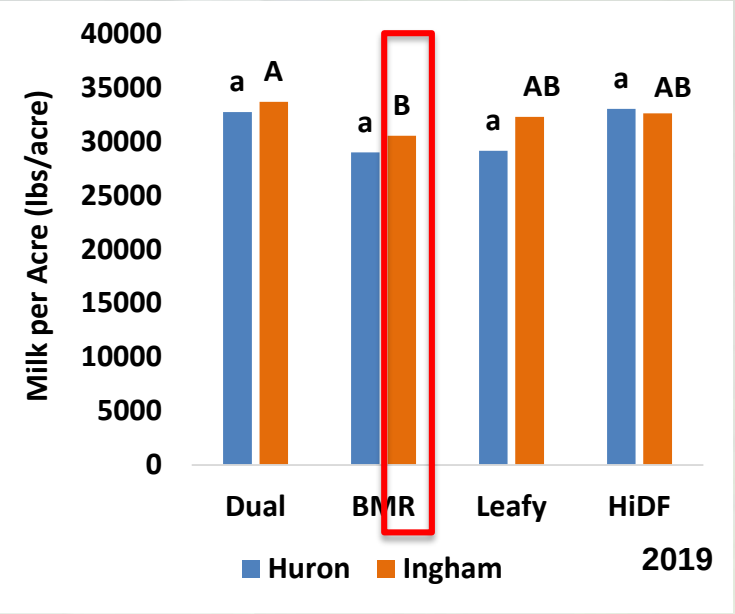




- Lower NDFD in Dual hybrid compared to BMR
- BMR hybrid had highest NDFD

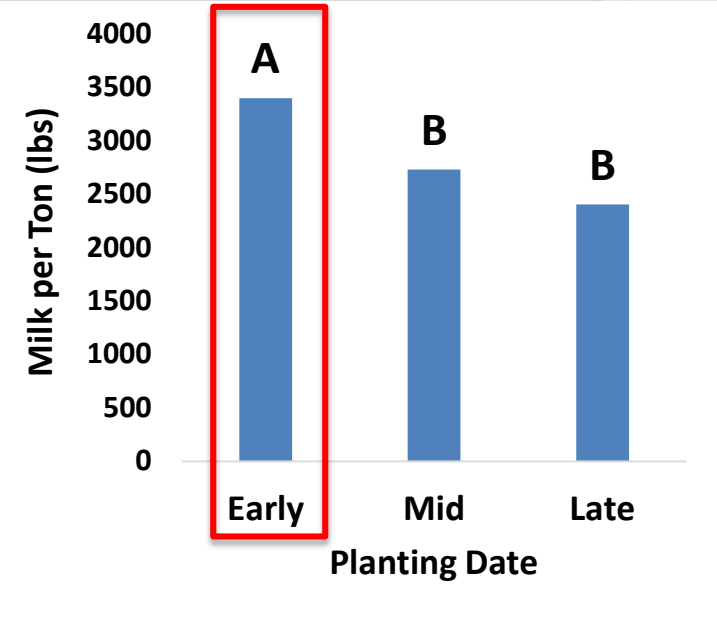
Corn Silage Hybrid Types- Milk yields

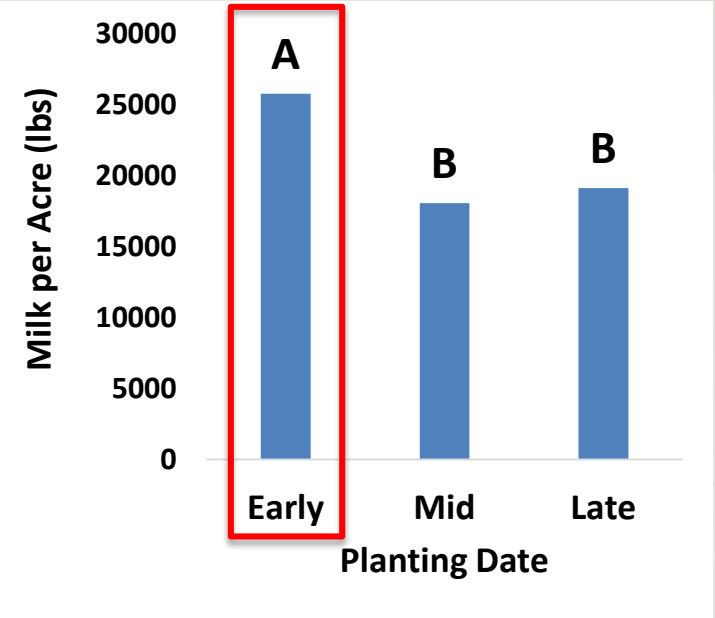




Planting Date

Early: May 7
Mid: May 22
Late: June 7
Hybrid: 109 RM

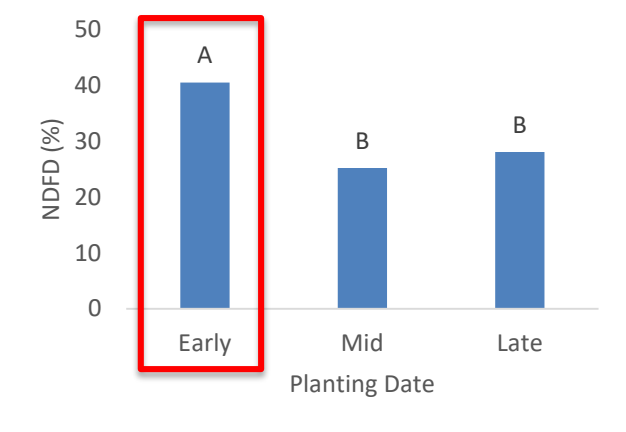


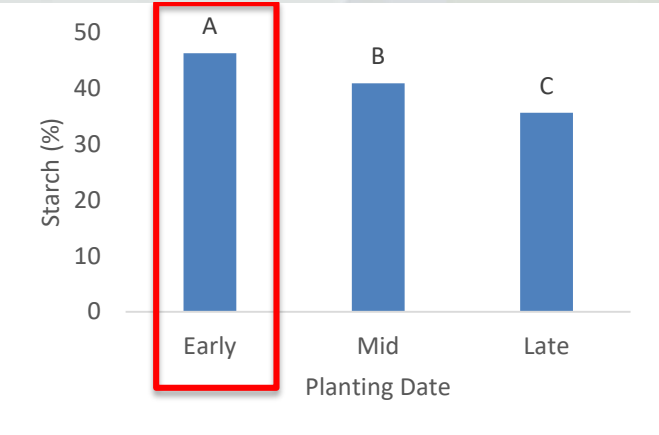


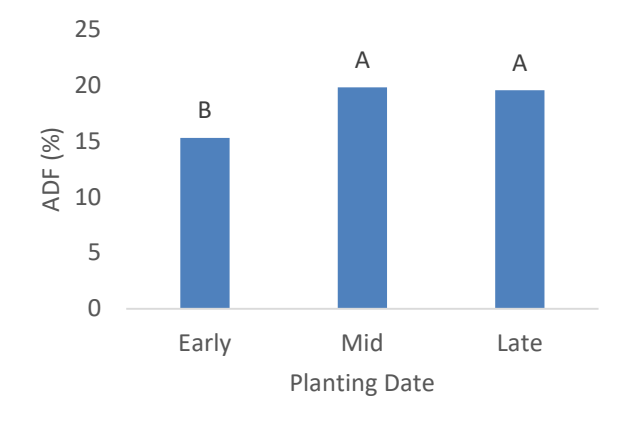
- Early Planting resulted in higher silage/grain yield and quality
- Yield and quality declines with delayed planting

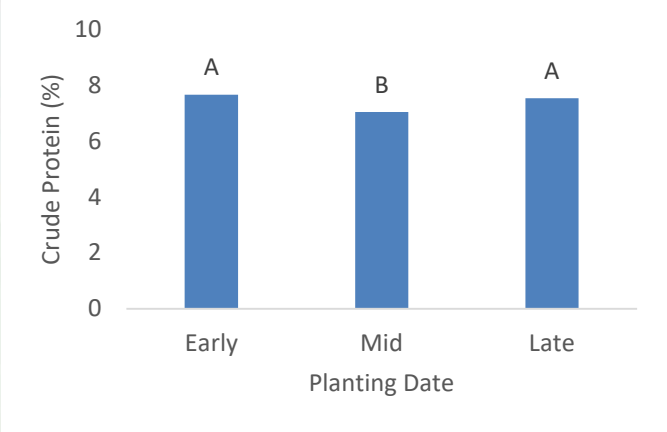
Planting Date

Early: May 7
Mid: May 22
Late: June 7
Hybrid: 109 RM

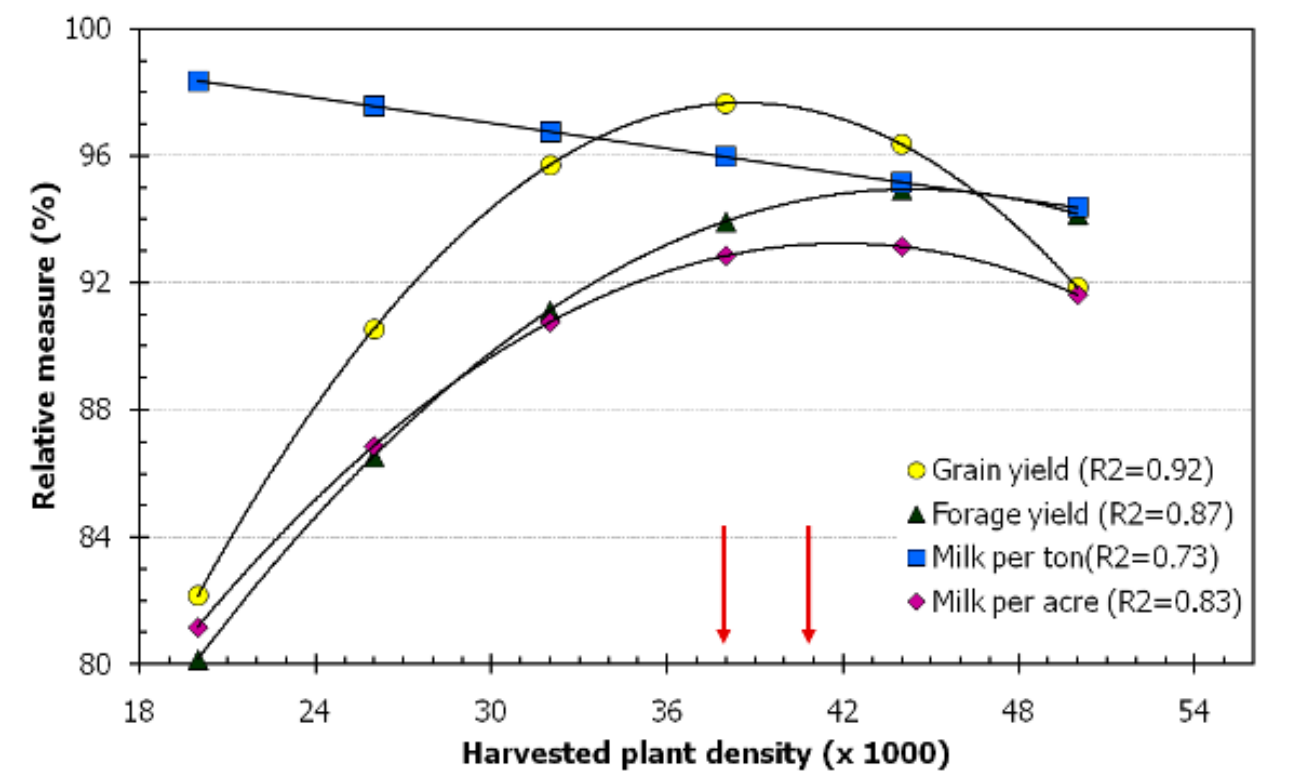








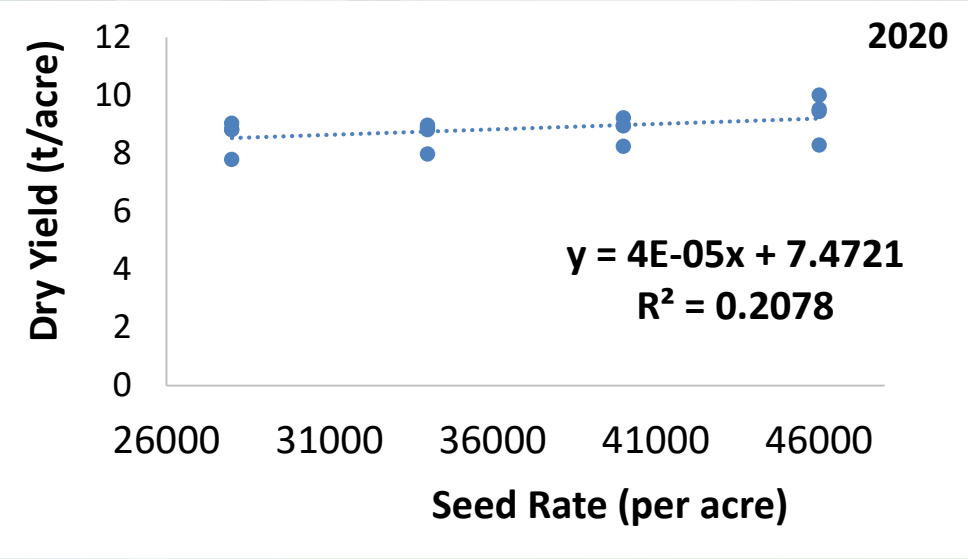
Seeding Rates



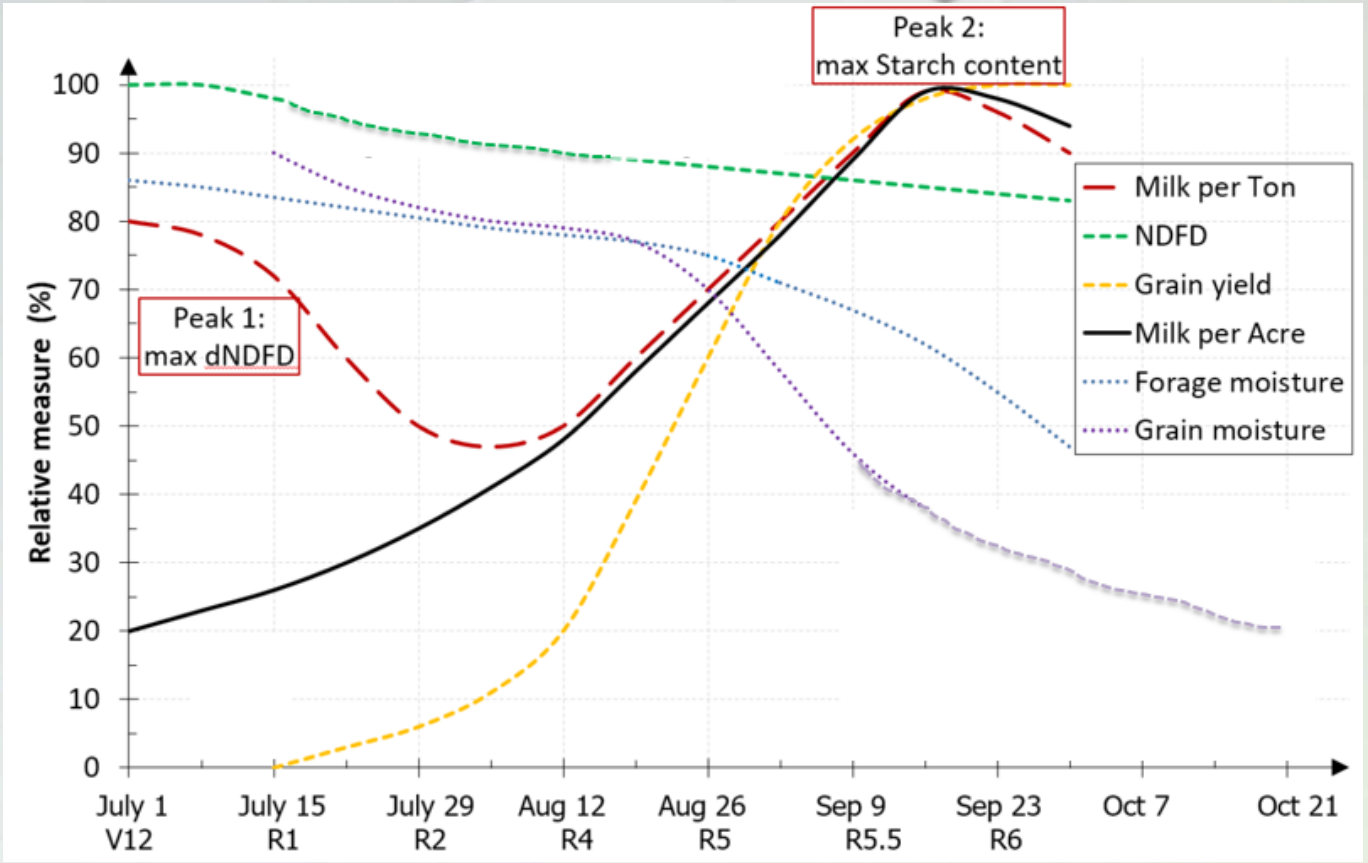
Joe Lauer, 2018

Seeding Rates

- Trials in 2018-2019 showed minimal differences in seeding rate responses between hybrid types (NO hybrid x seed rate interaction)
- Optimal seed rate ≥36k/ac, ~3,000 more than corn grain
- Some benefit of narrow rows in northern Corn Belt



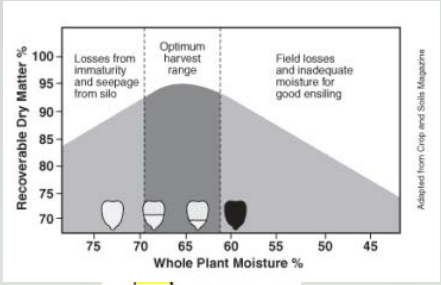
Harvest at Peak Quality

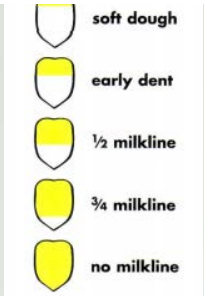


Source: Joe Lauer, UW (2019)

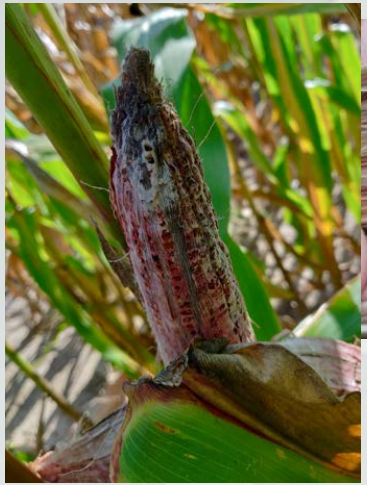
Optimal Harvest Considerations

- Allow dry down to 65-70% whole-plant moisture (60-65% in upright silos)
- Poor relationship between kernel milk-line stage and whole-plant %DM
- Use kernel milk-line as trigger to begin sampling for whole-plant %DM
- Begin around full-dent stage (~35 d after silking; half milk-line is ~45 d after silking)
- **~0.5% per day dry-down** on a whole-plant basis
- Kernel processing is important





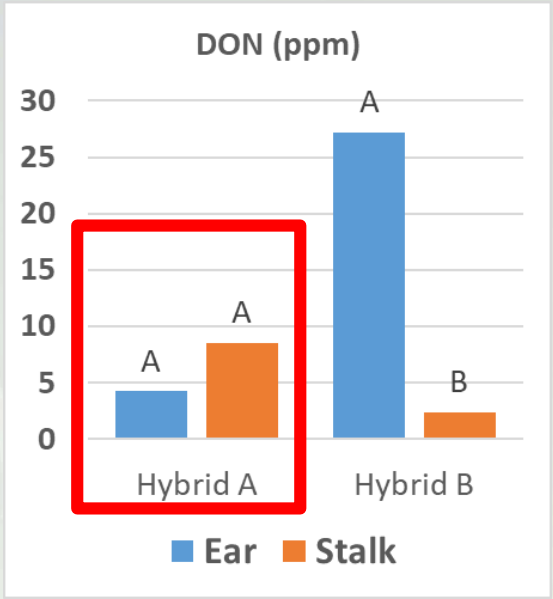
Mycotoxins in Corn Silage



Gibberella Ear and Stalk Rot
DON (VOM), ZON

Grad student: H. Kaur

Fusarium Ear and Stalk Rot
Fumonisin



Source: Damon Smith, UW

Mycotoxin Dietary Limits

Potentially Harmful Toxin Levels for a Total Diet (DM)					
	Dairy	**Feedlot**	**Swine**	**Poultry**	**Equine**
Toxin Type	Values listed in blue are PPM, all other listed are in PPB				
Aflatoxin	20	20	20	20	20
Deoxynivalenol (DON or Vomitoxin)*	0.5 to 1.0	10	1	2	500
Fumonisin	2	7	10	20	500
T-2 Toxin	100	500	100	100	NA
Zearalenone	400	5	300	10	50
Ochratoxin	5	5	700	700	35
Ergot Toxins (combined)	500	500	500	750	300

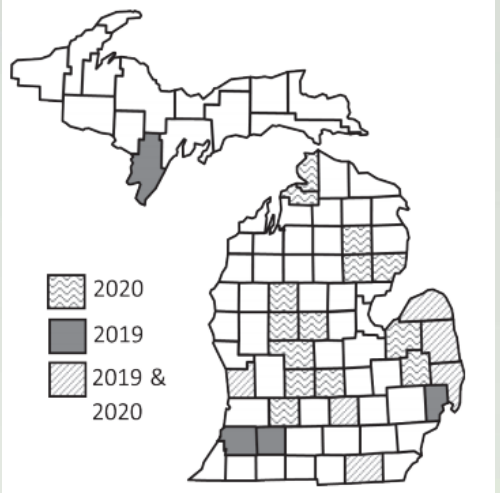
Total Diet DON Level = Feedstuff DON Level X (Feedstuff (lbs. DM) / Total Diet (lbs. DM)

e.g. Total Diet DON 2.5 ppm = 5.0 ppm (Corn Silage DON level) X (25 lbs. DM Corn Silage / 50 lbs. DM Total Diet)

Source: John Goeser (2015)

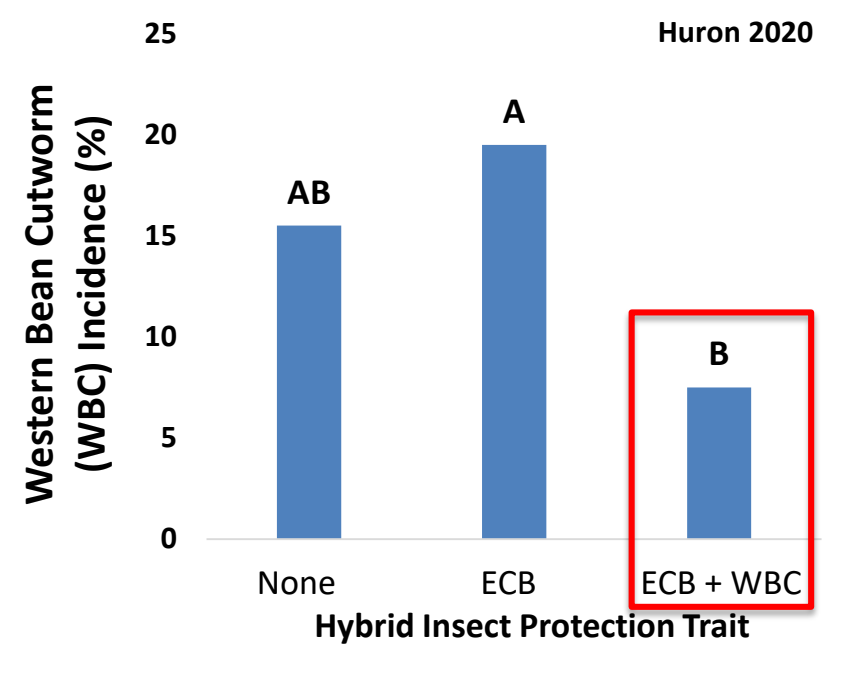
Mycotoxins in Michigan Fields- 2019 data

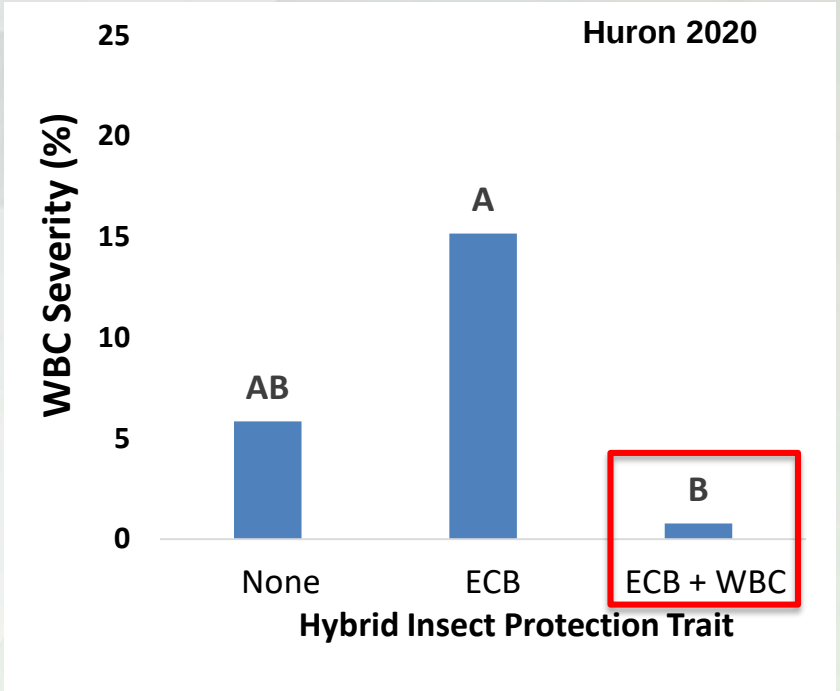
- 34 samples tested for 24 toxins, > 1 mycotoxin in all, most samples had multiple toxins
- DON and ZON were reported in all samples (co-occurrence was common)
- Low levels overall for most toxins but DON was >1ppm in ~50% samples)
- Environment was not conductive to fungal growth and toxin accumulation in 2019 and 2020



Mycotoxin	DON	D3G	15-ADON	CUL	ZON	HT2	FB1	FB2	FB3	BEAU
Positive samples	34	27	21	33	34	8	33	28	19	34
Percent positives	100	79	62	97	100	24	97	82	56	100
Highest levels (ppm)	5.34	0.76	1.59	0.54	2.69	0.59	2.76	0.69	0.67	0.54

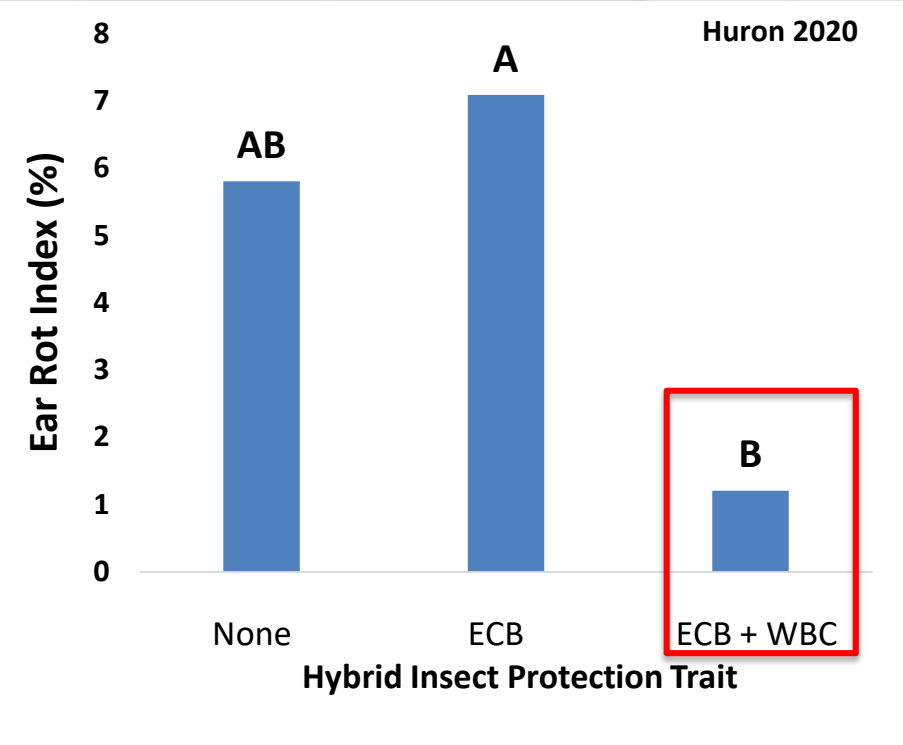
Hybrid Selection and Insect Protection Traits

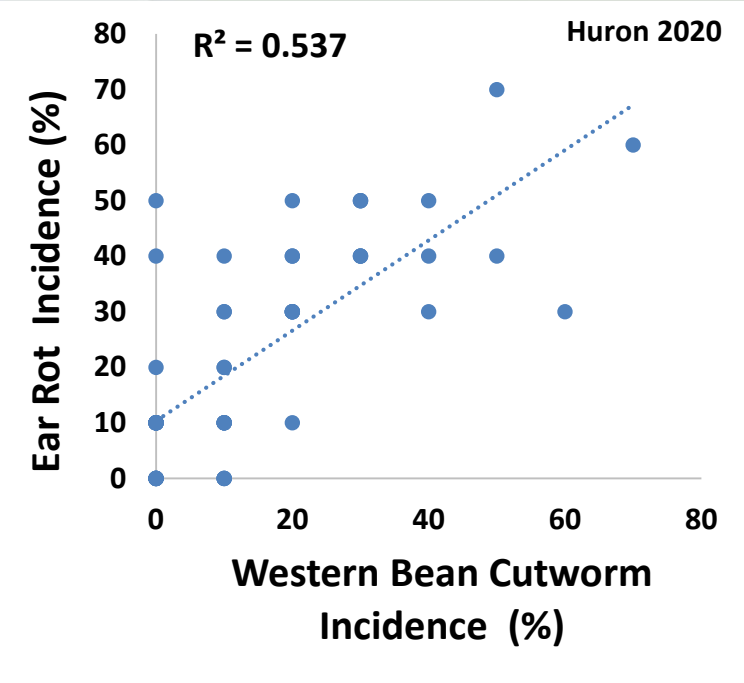




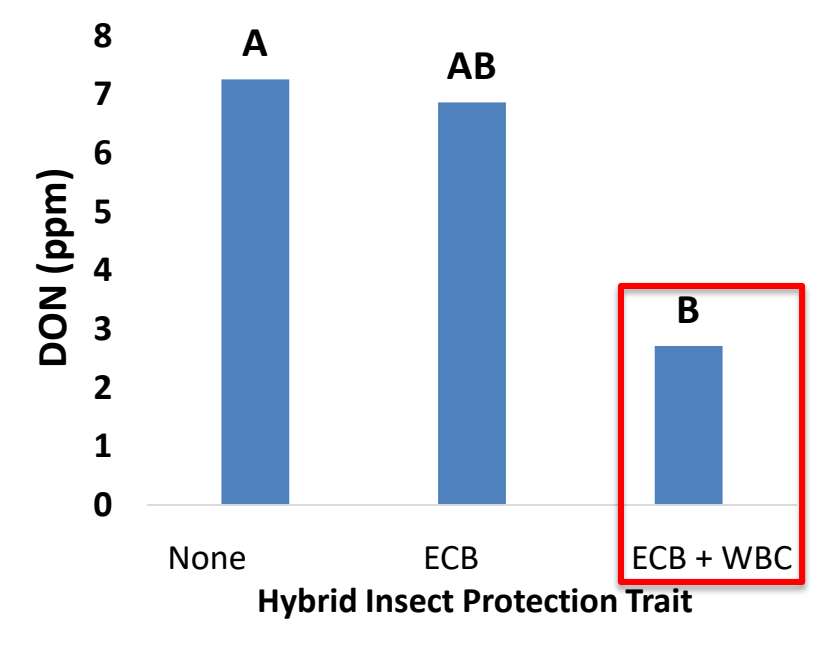
ECB- European Corn Borer; WBC- Western Bean Cutworm
Average of 2 hybrids/category, 5% RIB (refuge in bag) for Bt hybrids

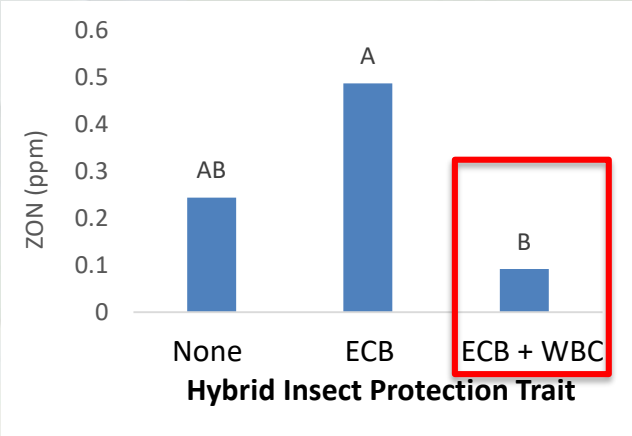
Hybrid Selection and Insect Protection Traits



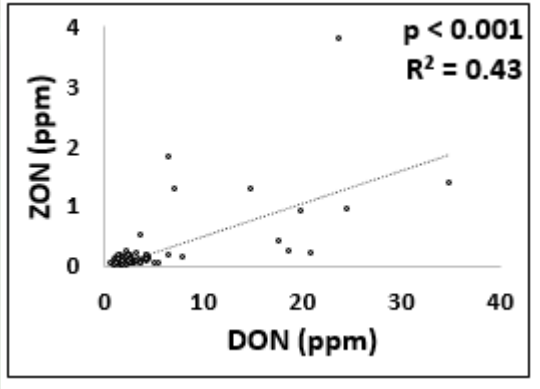


Hybrid Selection and Insect Protection Traits

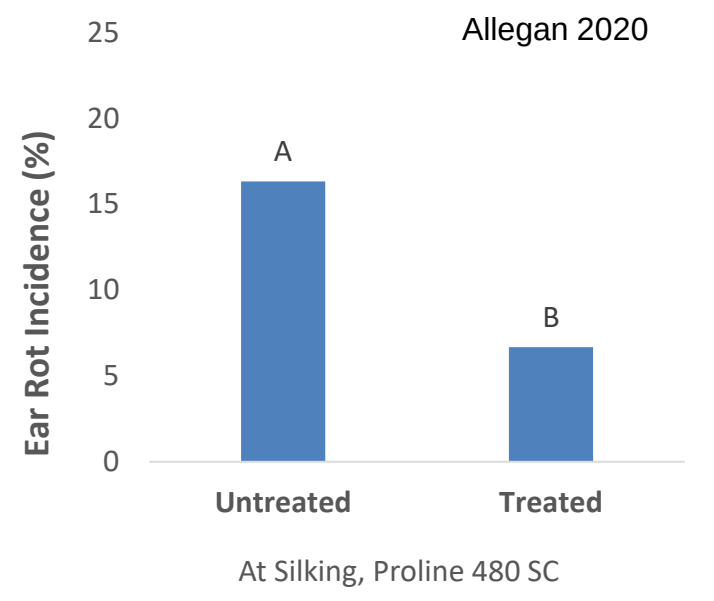


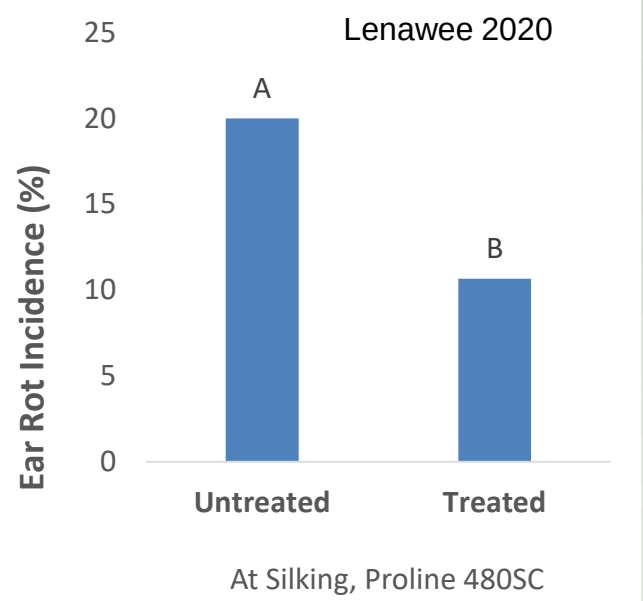


Ingham 2019 (Inoculated Study)



Fungicide Application

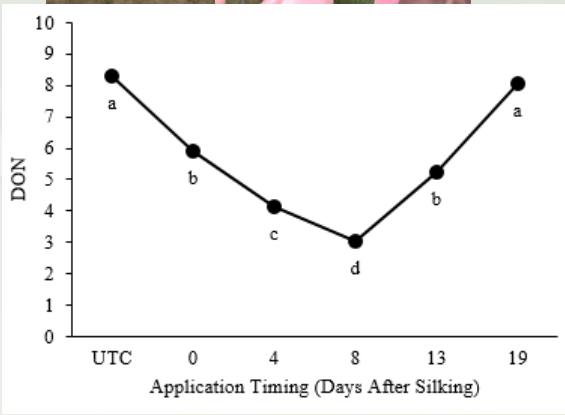




- No benefit of fungicide application in 2019
- 2020 showed reduction in ear rot levels at 2 locations, DON results are pending
- Other research has shown reduction in foliar and stalk rots, improved quality

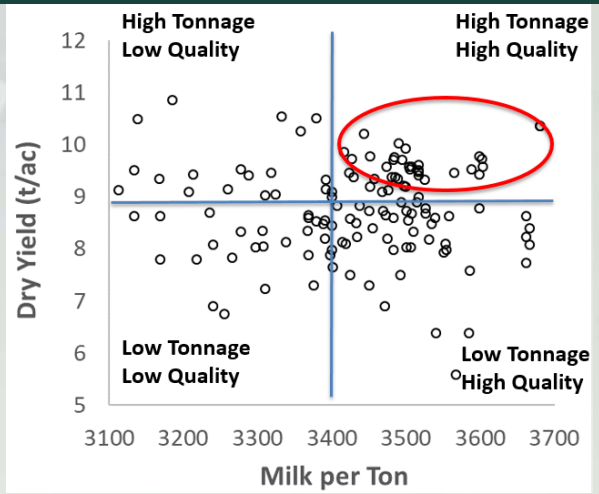
Integrated Mycotoxin Management

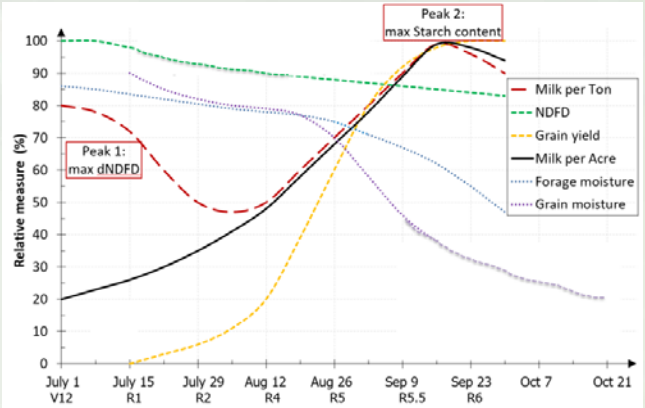
- Hybrid selection
- Residue management
  - Crop rotation
  - Tillage
- Reduce plant stress
- Manage for uniformity
- **Insect control** (Bt traits, scout and spray)
- **Fungicide** application (timing, chemistry)
- **Harvest** high risk fields first
- Diet: dilute, add adsorbents?



Summary

- Hybrid selection considerations:
  - High silage yield and quality
  - Relative maturity (match local GDD)
  - Trait package- based on pest pressure
  - Dual vs silage type hybrids?
  - Agronomic traits- disease/drought tolerance
- Key management decisions:
  - Early planting
  - Optimum seeding rate ($\geq$ 36,000 seeds/ac)
  - Harvest at peak quality
  - Fungicide/insecticide application?
  - Mycotoxin management





- **Harkirat Kaur**
- Bill Widdicombe
- Tom Siler
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- Kalvin Canfield
- Maddi Yaek
- Garrett Zuver
- Mike Particka
- Paul Horny
- Charles Scovill (Syngenta)
- **Undergrad students**
- **Farmer cooperators**

- Phil Kaatz
- Phil Durst
- Martin Mangual
- Brook Wilke
- **Farmer cooperators**

Thanks!

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