When the Growing Season Ends Before the Crop is Mature

Joel Ransom, NDSU Extension Agronomist
NDSU Fargo
joel.ransom@ndsu.edu

EXTENDING KNOWLEDGE ❯❯ CHANGING LIVES

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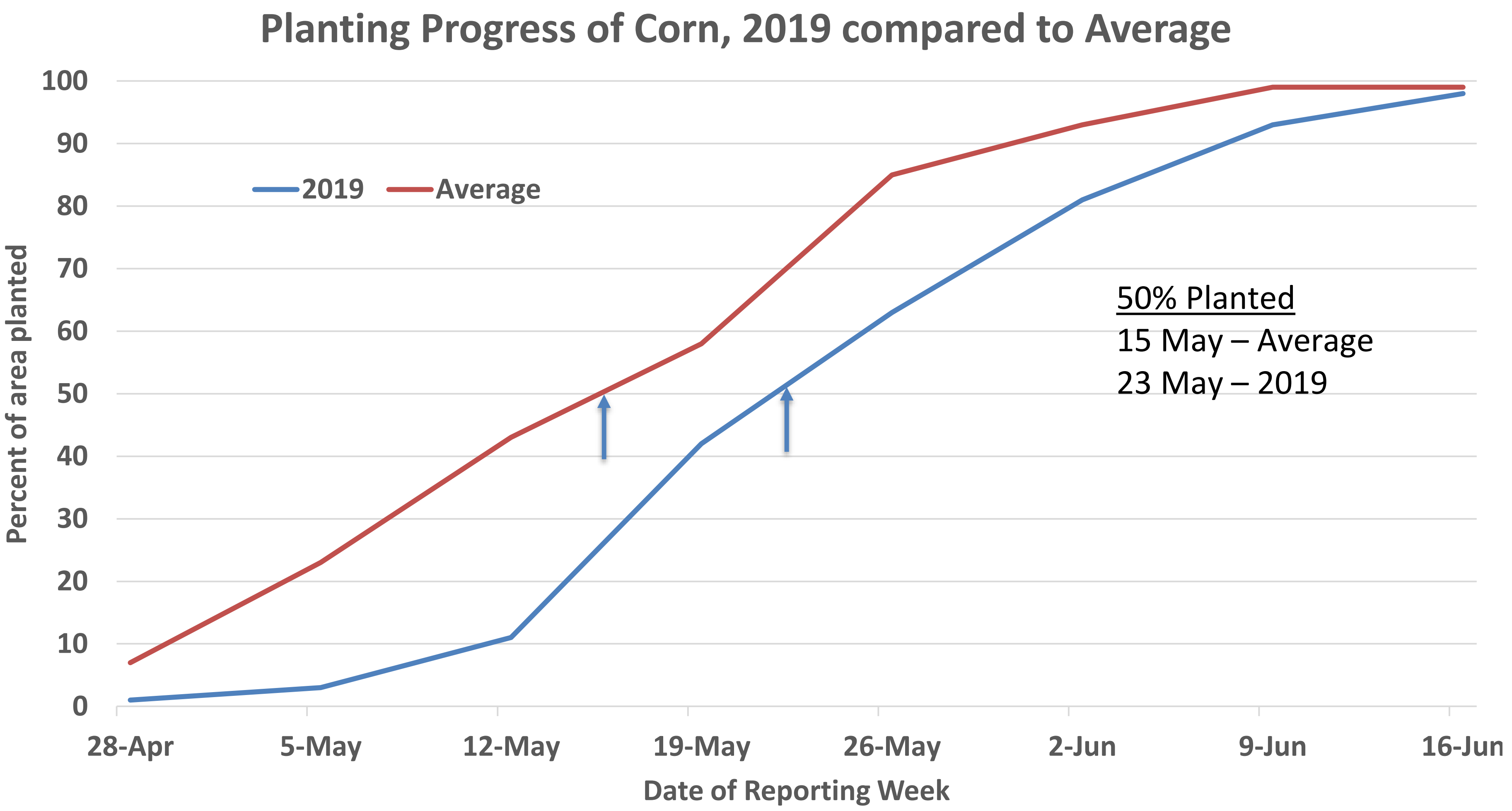
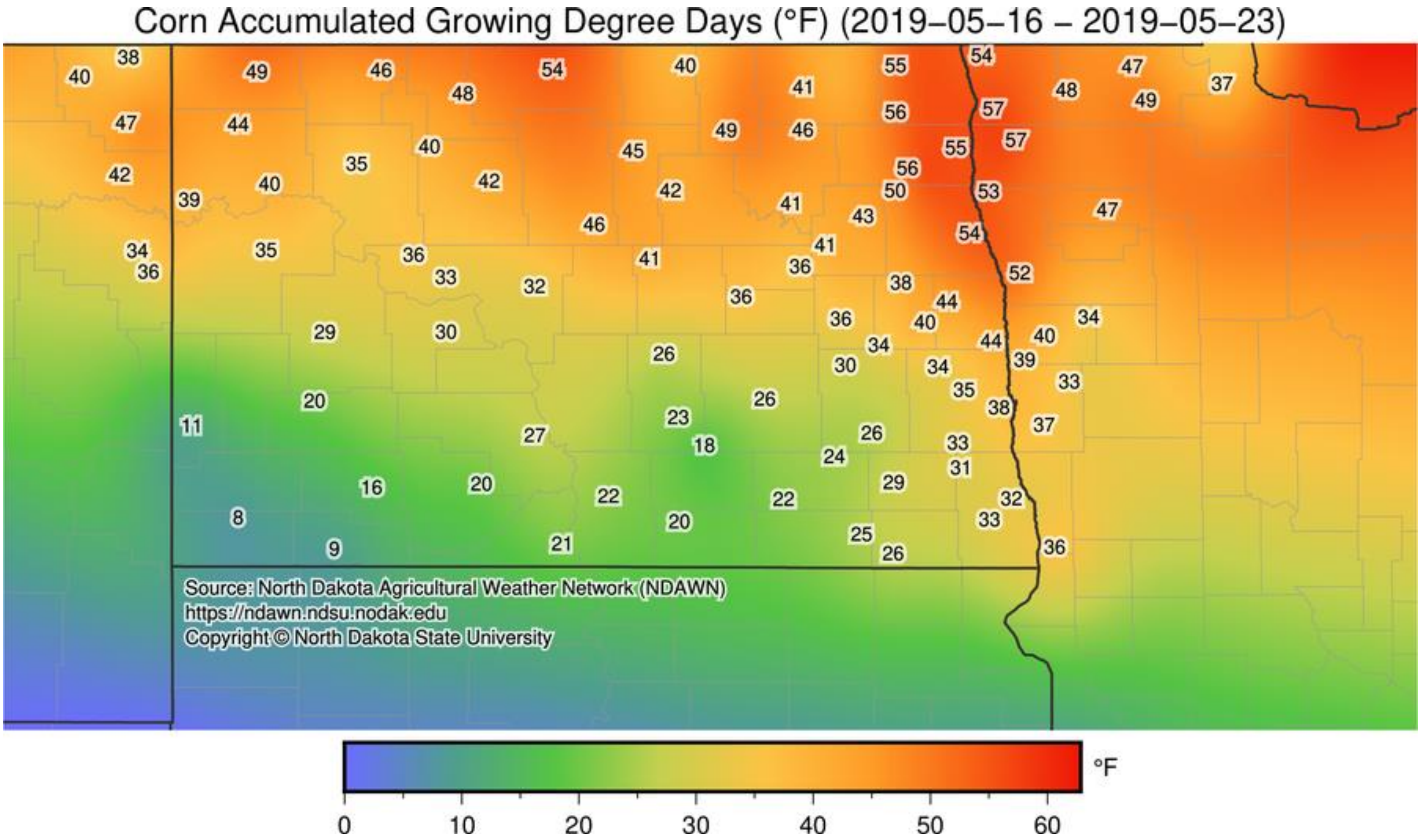
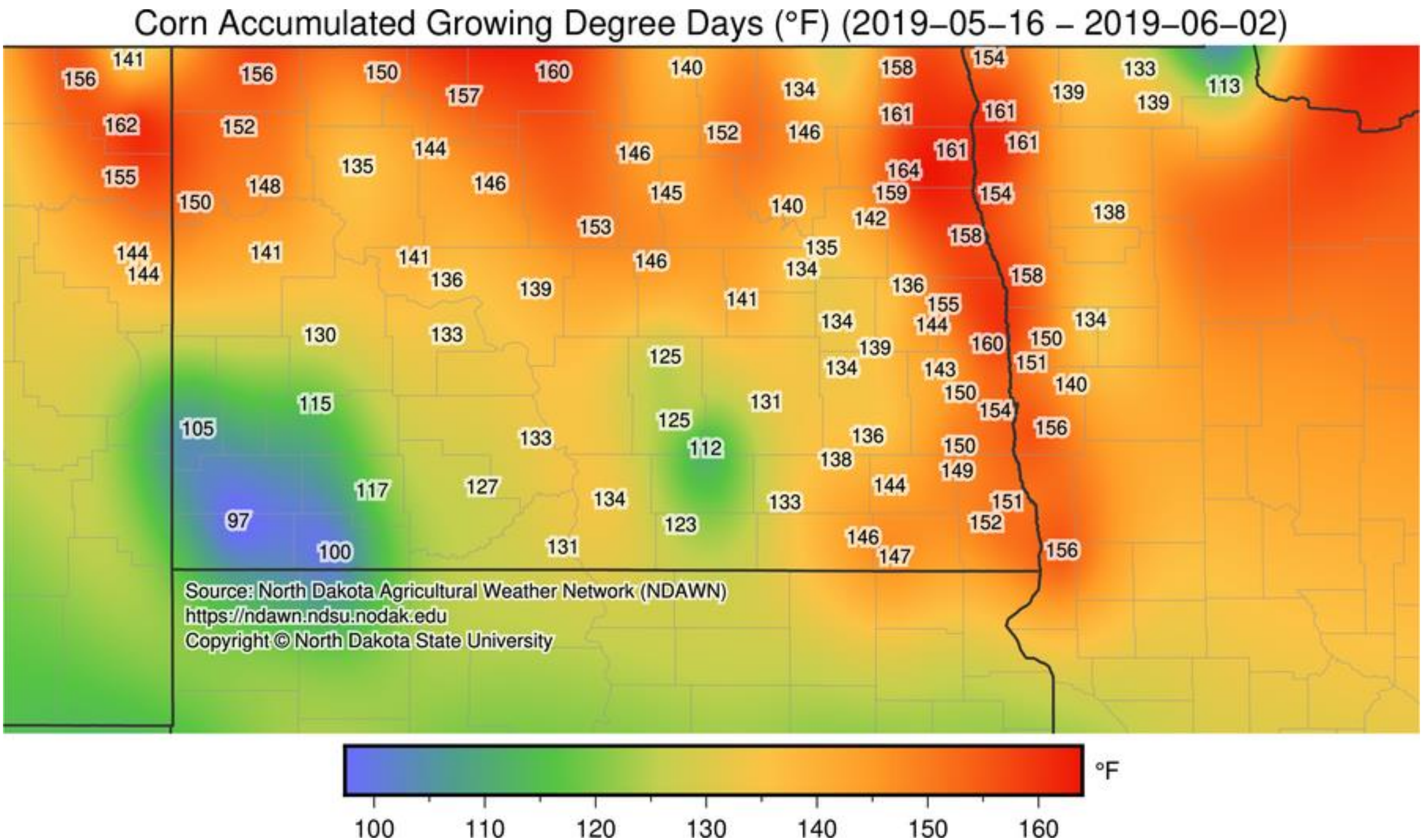
Corn Growing Season in Review



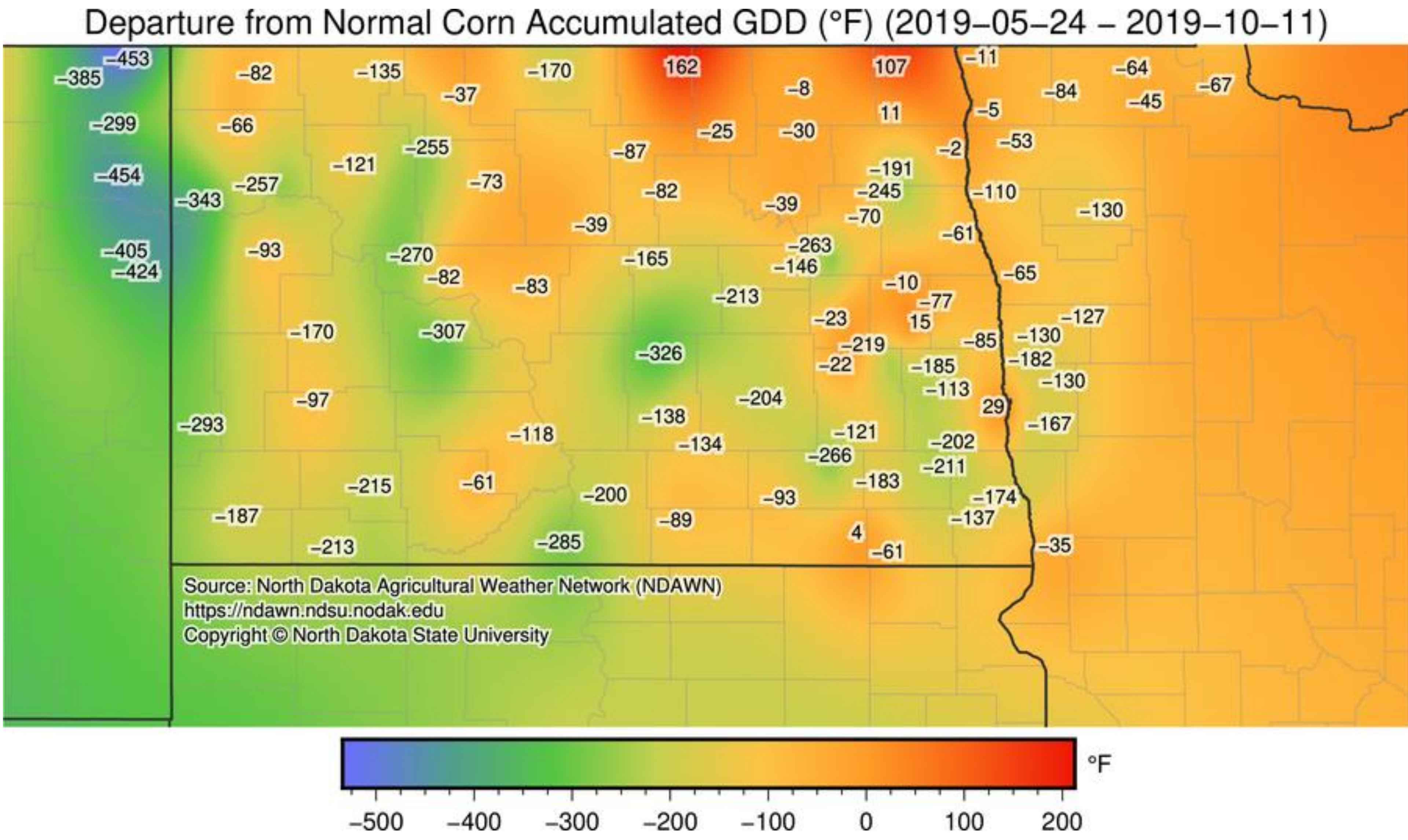
Average late planting penalty was modest in 2019



June planting GDD penalty more significant



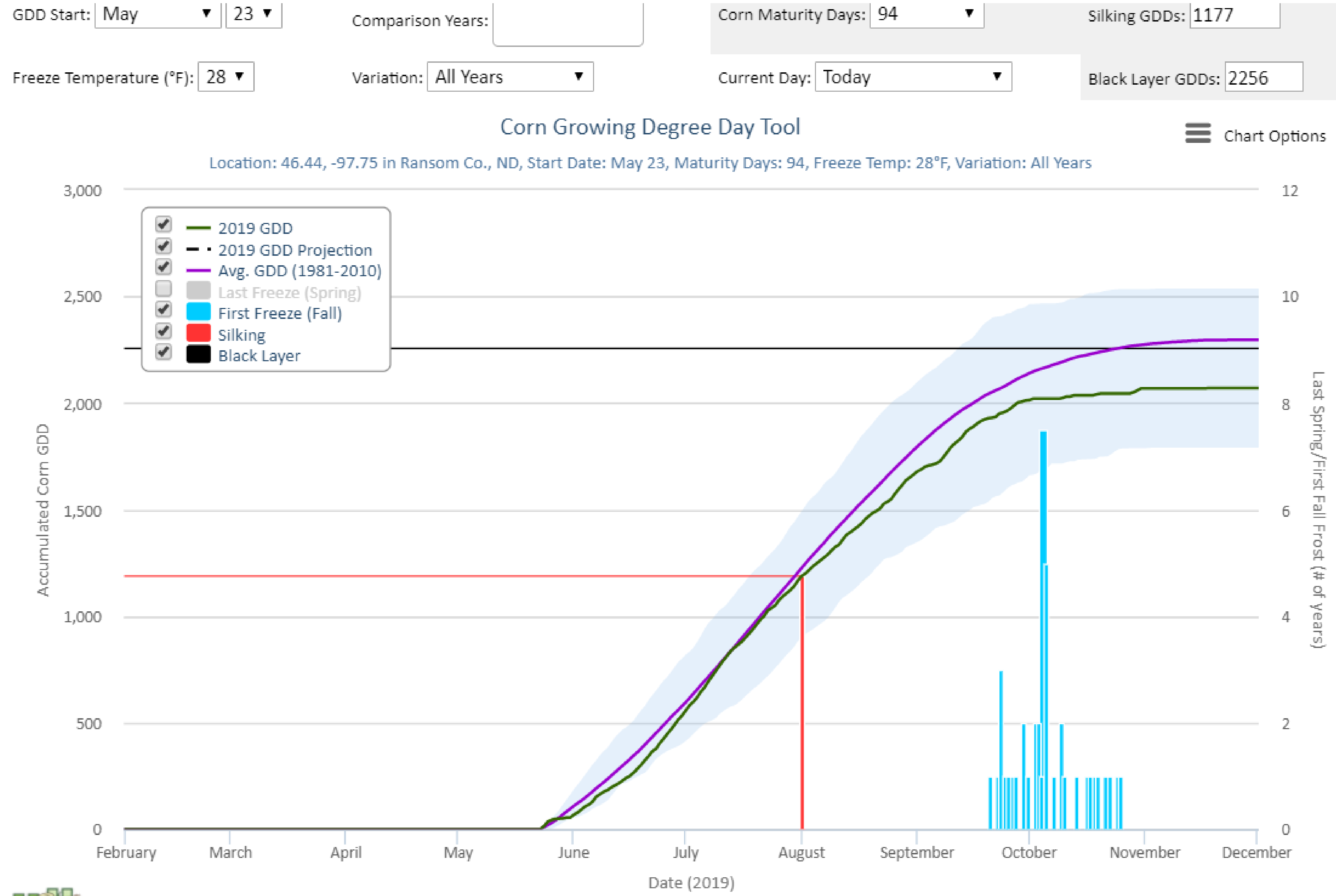
GDD accumulations, departure from normal in 2019, assuming May 23 planting date.



Season less than favorable for quality and moisture at harvest

- Corn planted at least 8 days later than average (loss of > 40 GDDs)
- GDD accumulations were 0-250 GDDs less than normal during season
- First killing frost ~ Oct 23rd
- Some (most?) corn immature
- Cold wet fall resulted in slow field drying, ~ 50% of corn is unharvested

GDD accumulations from near Lisbon, 2019



Effect of RM and planting date on growing degrees needed to reach P.M. near Lisbon, 2019

	Planting date			
Hybrid RM	**1-May**	**15-May**	**23-May**	**2-Jun**
80	**-261**	**-177**	**-127**	**-48**
85	**-140**	**-56**	**-6**	**73**
90	**-19**	**65**	**115**	**194**
95	**102**	**186**	**236**	**315**
100	**223**	**307**	**357**	**436**

Model output from: U2U – Corn GDD

GDD Start: May ▼ 23 ▼

Comparison Years: Choose a Year

Corn Maturity Days: 80 ▼

Silking GDDs: 1017

Freeze Temperature (°F): 28 ▼

Variation: All Years ▼

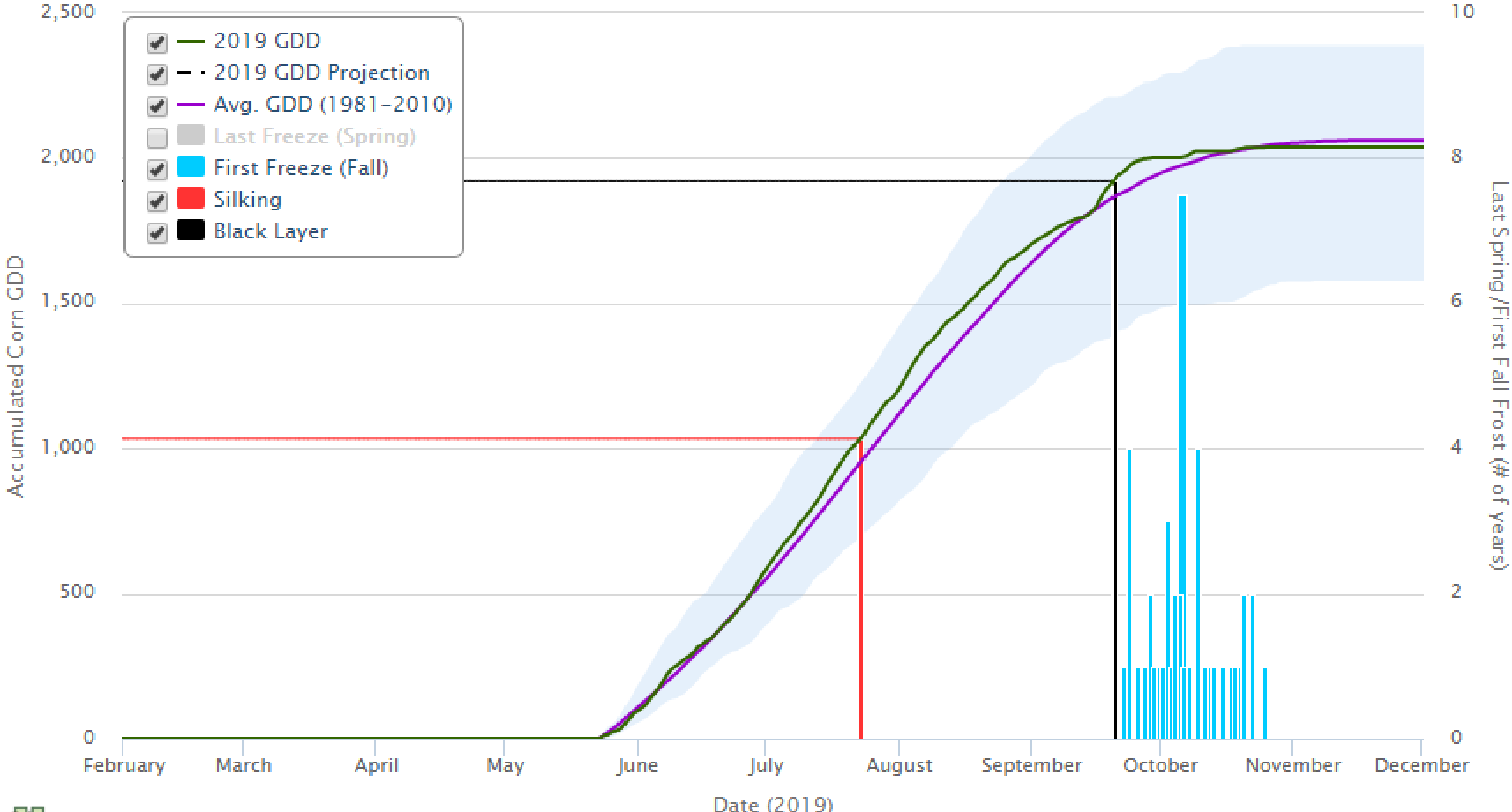
Current Day: Today ▼

Black Layer GDDs: 1917

Corn Growing Degree Day Tool

Chart Options

Location: 48.46, -96.88 in Marshall Co., MN, Start Date: May 23, Maturity Days: 80, Freeze Temp: 28°F, Variation: All Years



GDD Base 50/86 (degrees F); Created: 02/08/2020

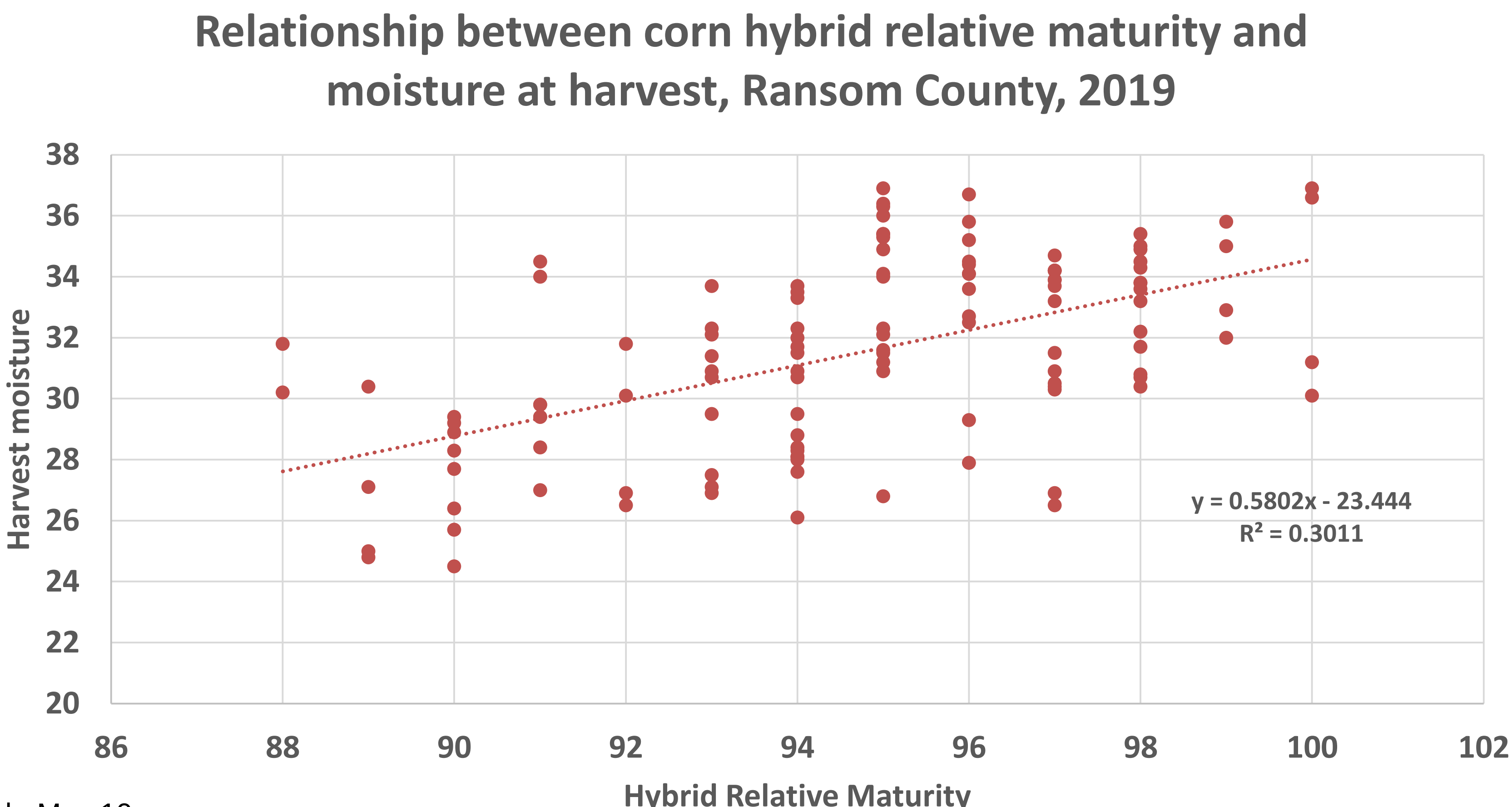
Tool Tips:

Effect of RM and planting date on growing degrees needed to reach P.M. Warren, MN, 2019

	Planting date			
Hybrid RM	**1-May**	**15-May**	**23-May**	**2-Jun**
75	**-379**	**-298**	**-226**	**-132**
80	**-256**	**-178**	**-106**	**-12**
85	**-138**	**-57**	**15**	**109**
90	**-17**	**186**	**236**	**230**

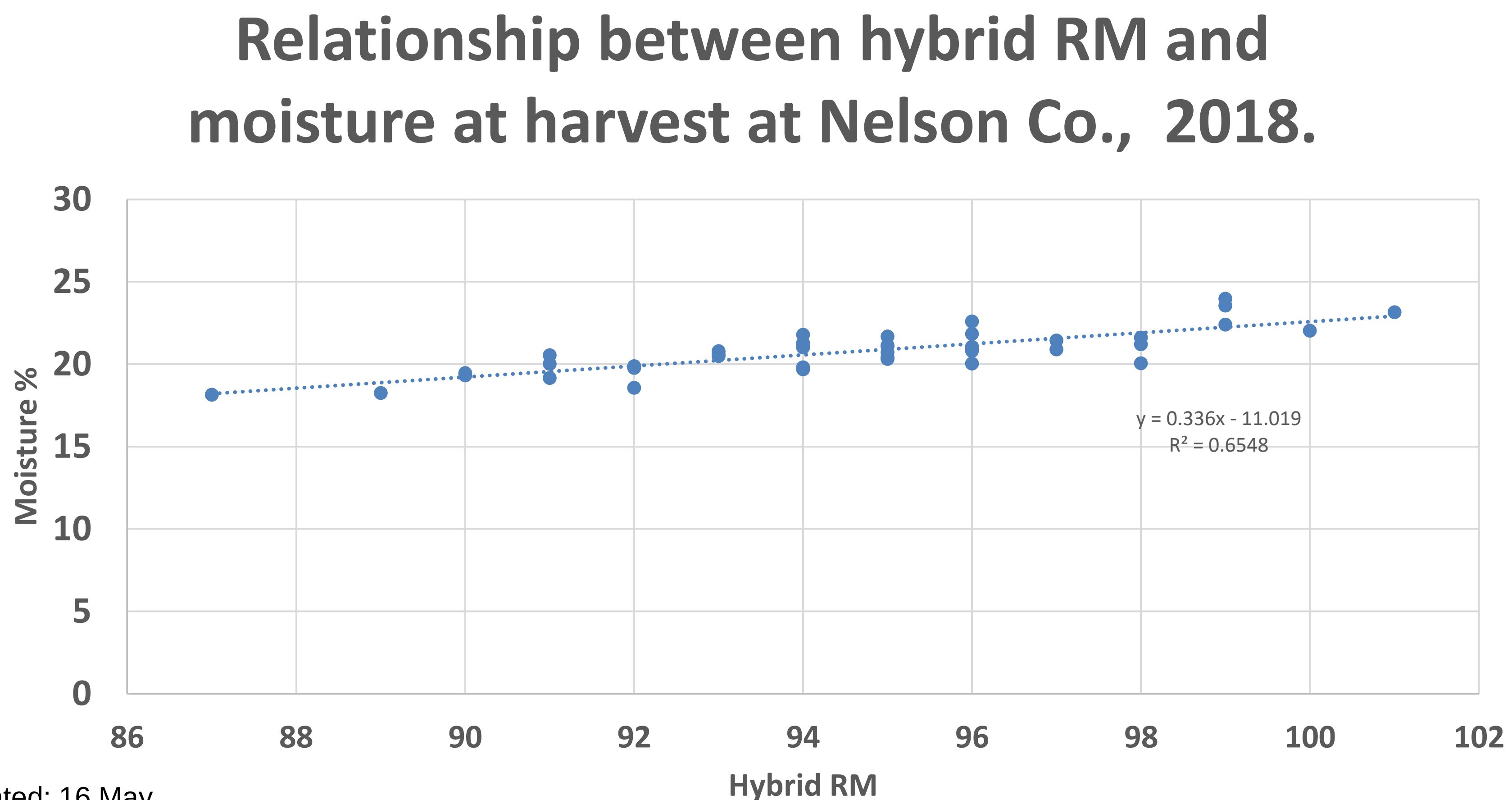
Model output from: U2U – Corn GDD

Depending on planting date and hybrid used, end of season moisture levels were very high.



Planted - May 10
Harvested - Oct. 31

Depending on planting date and hybrid used, end of season moisture levels were very high.

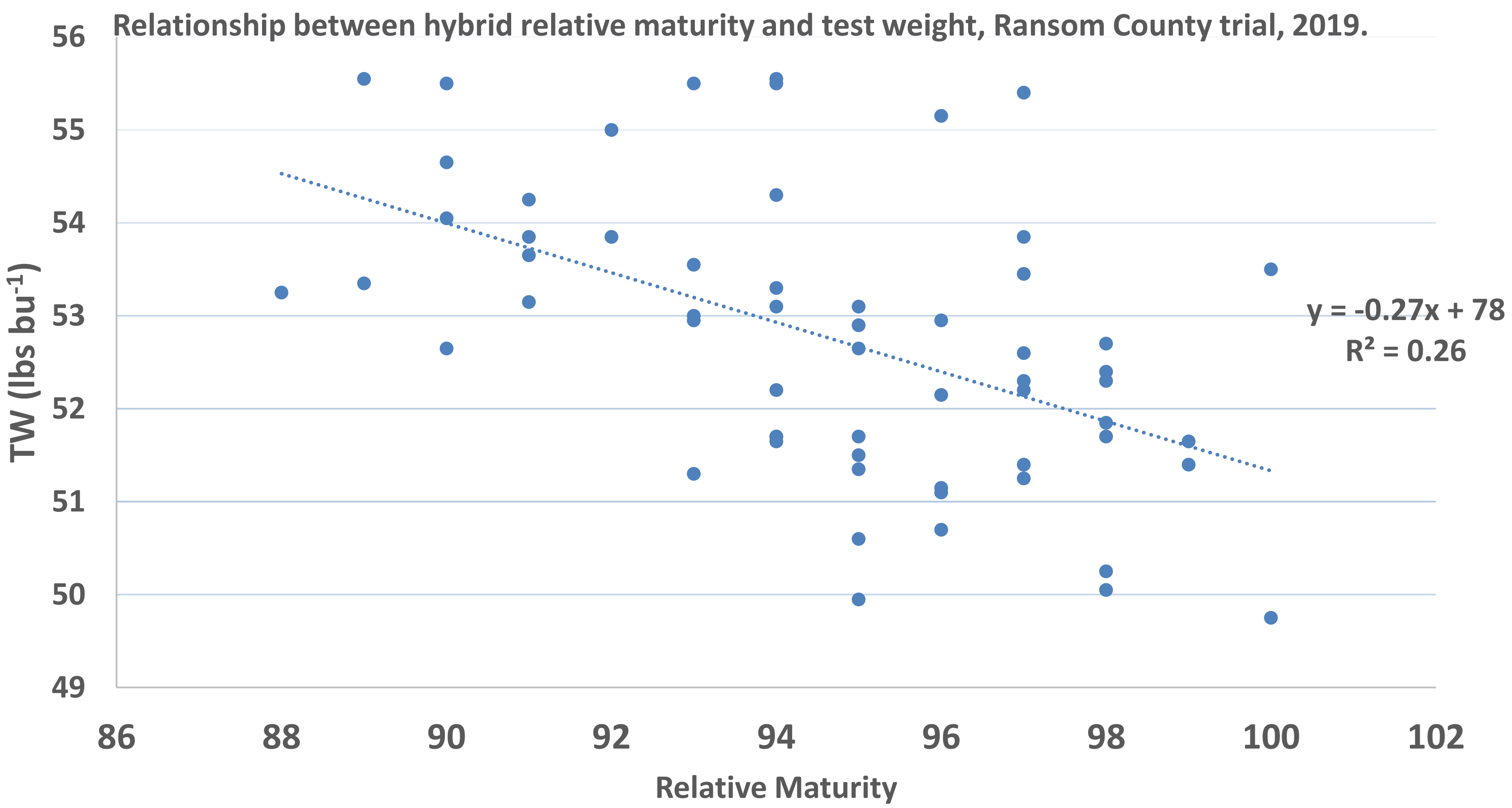


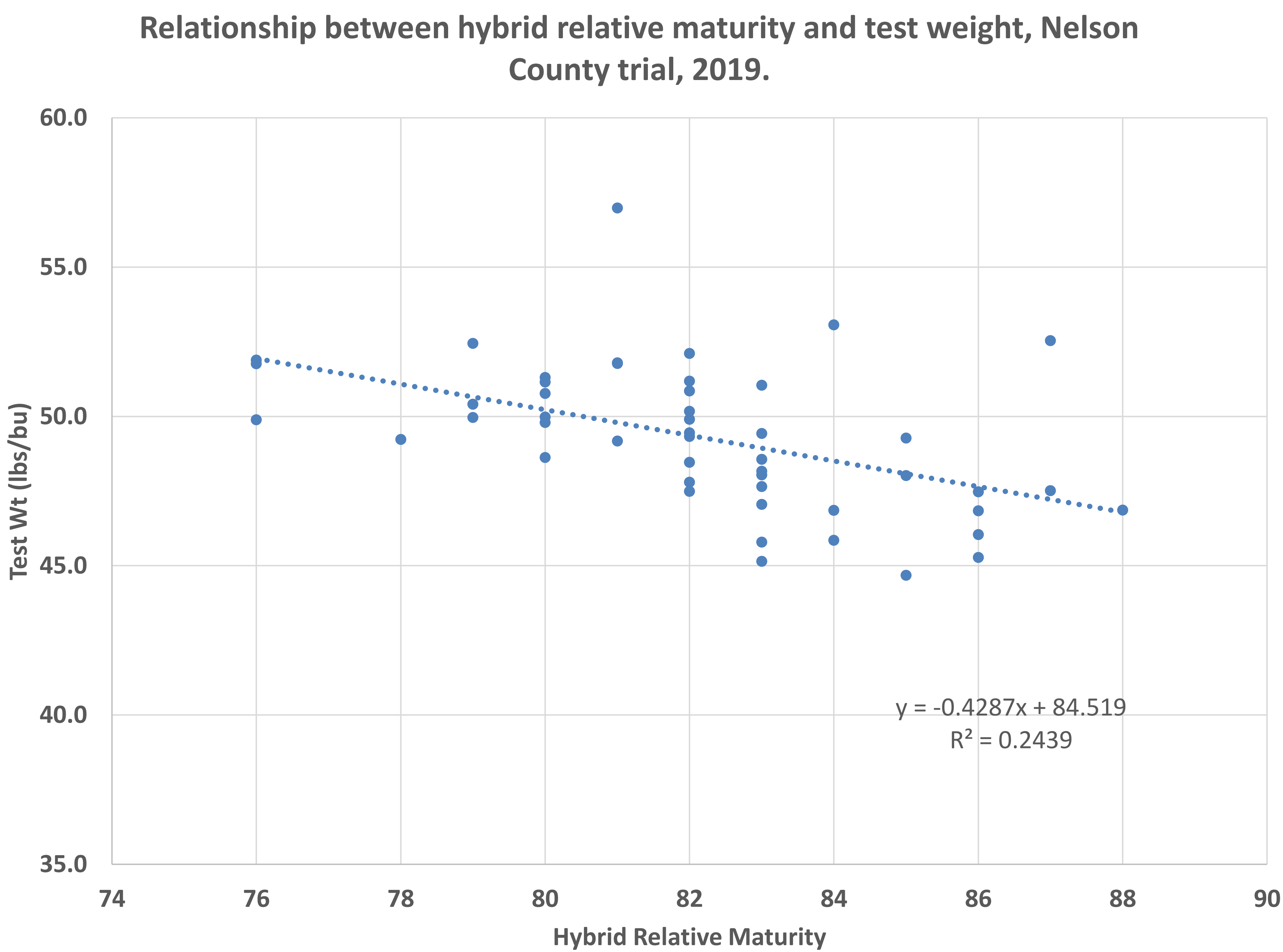
Planted: 16 May
Harvested: 30 Nov

How much of the corn matured in 2019?

- Depending on region, planting date and hybrid relative maturity, some corn, but not all, did not reach physiological maturity
  - Moisture greater than 30% soon after killing frost in some hybrids
  - Test weights substandard
  - Inadequate growing degrees for hybrids planted
- How much yield loss?

Test weights where low and variable




Relationship between hybrid relative maturity and test weight, Nelson County trial, 2019.
Test Wt (lbs/bu)
60.0
55.0
50.0
45.0
40.0
35.0
74
76
78
80
82
84
86
88
90
Hybrid Relative Maturity
y = -0.4287x + 84.519
R² = 0.2439

Characteristics of lower test weight kernels

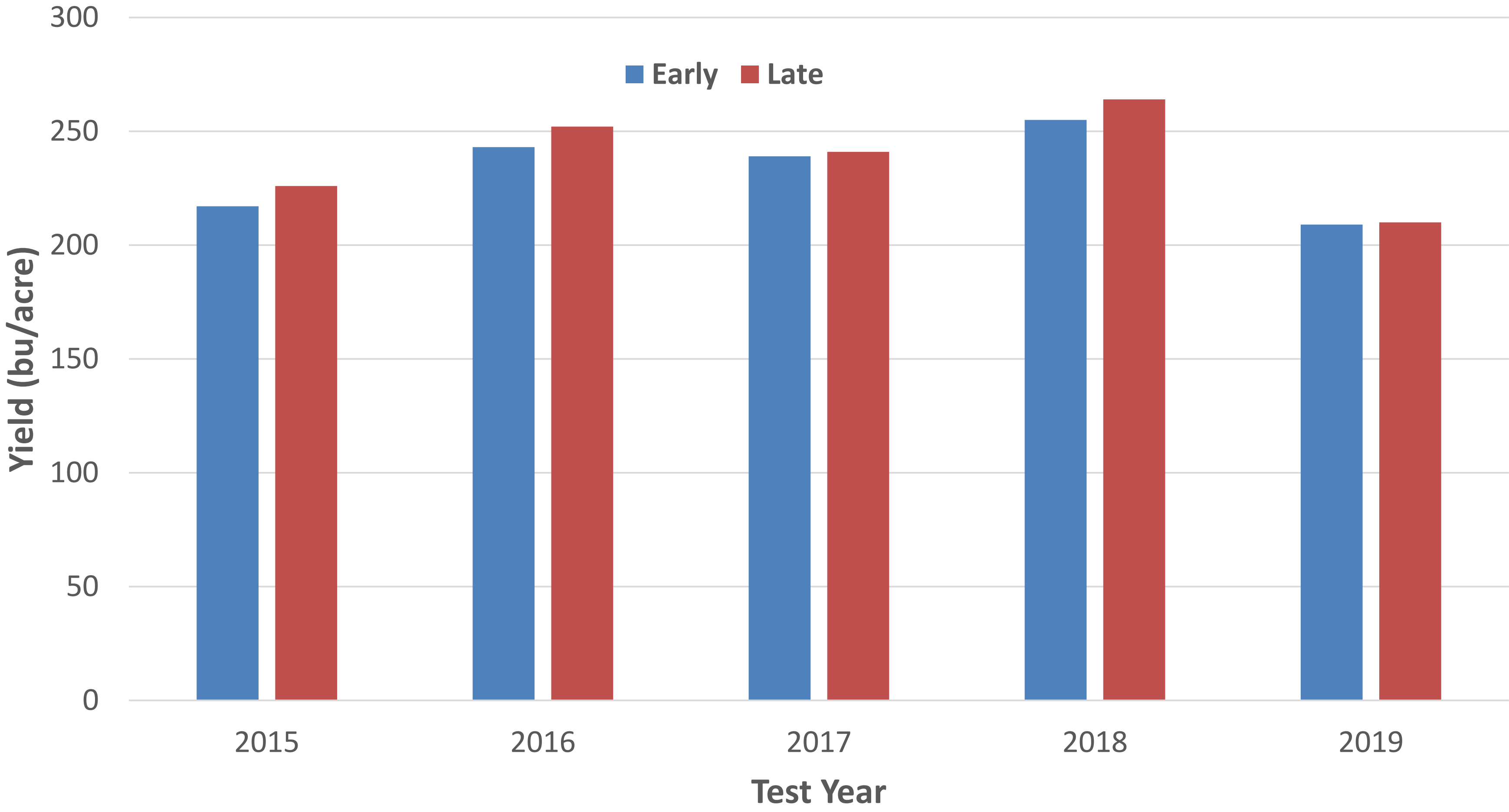
- No obvious shriveling
- Endosperm more chalky in later maturing hybrid

Impact of killing frost prior to PM depends on timing and severity

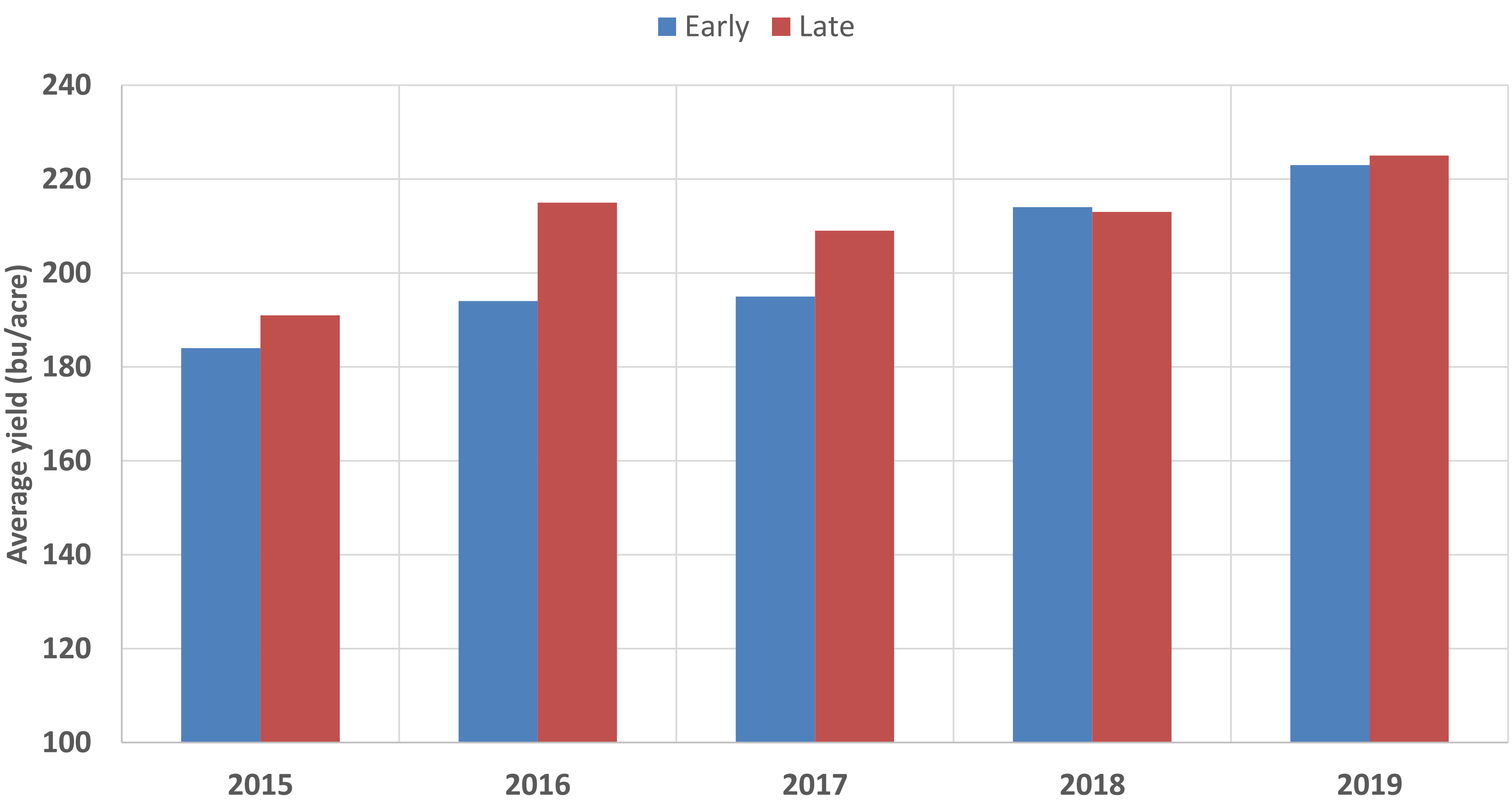
Effect of growth stage and frost severity on yield loss in corn.		
Growth Stage	Leaves only	Total plant death
Soft dough	34-36	51-58
Full dent	22-31	39-42
Half-milk line (~190 GDD to PM)	4-8	11-12

Source: Afuakwa and Crookston, 1984

Yield trends from hybrid trials, southern zone, early and late tests, average of all hybrids.

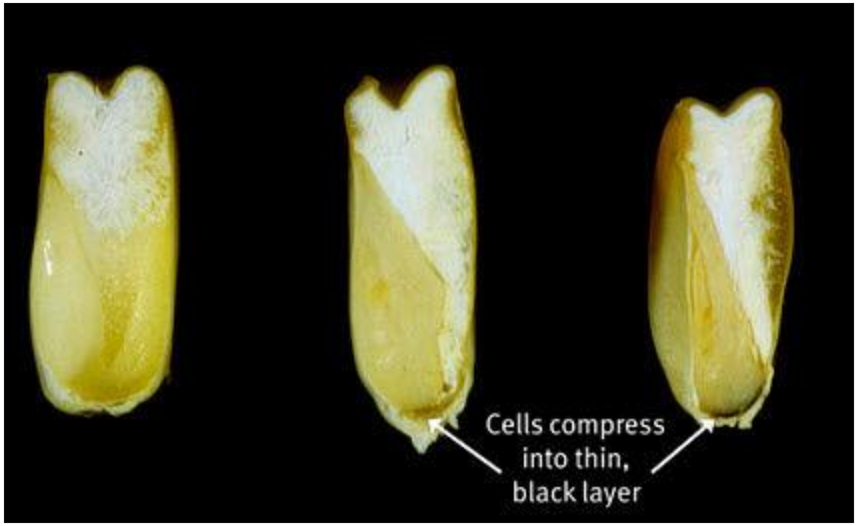


Yield trends for hybrid performance trials, 2015-19, northern zone.

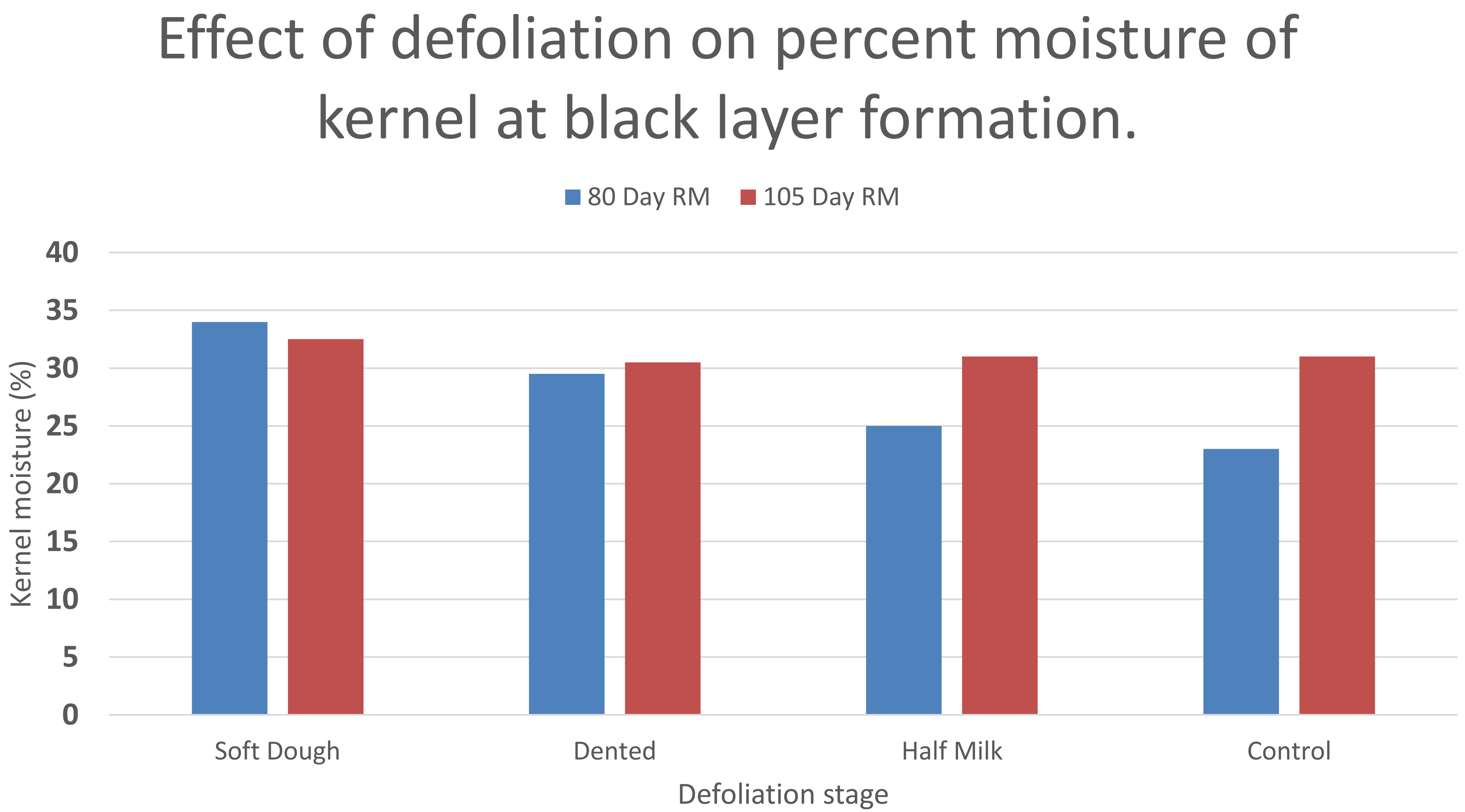


Early black layer formation

- Field and lab experiments have shown that black layer can form whenever sucrose supply to the developing kernel falls below a threshold
- Factors that can stop this flow:
  - plant maturity
  - leaf loss due to hail, frost, and disease
  - periods of very cool temperatures during grain fill



Stress induced black layer formation



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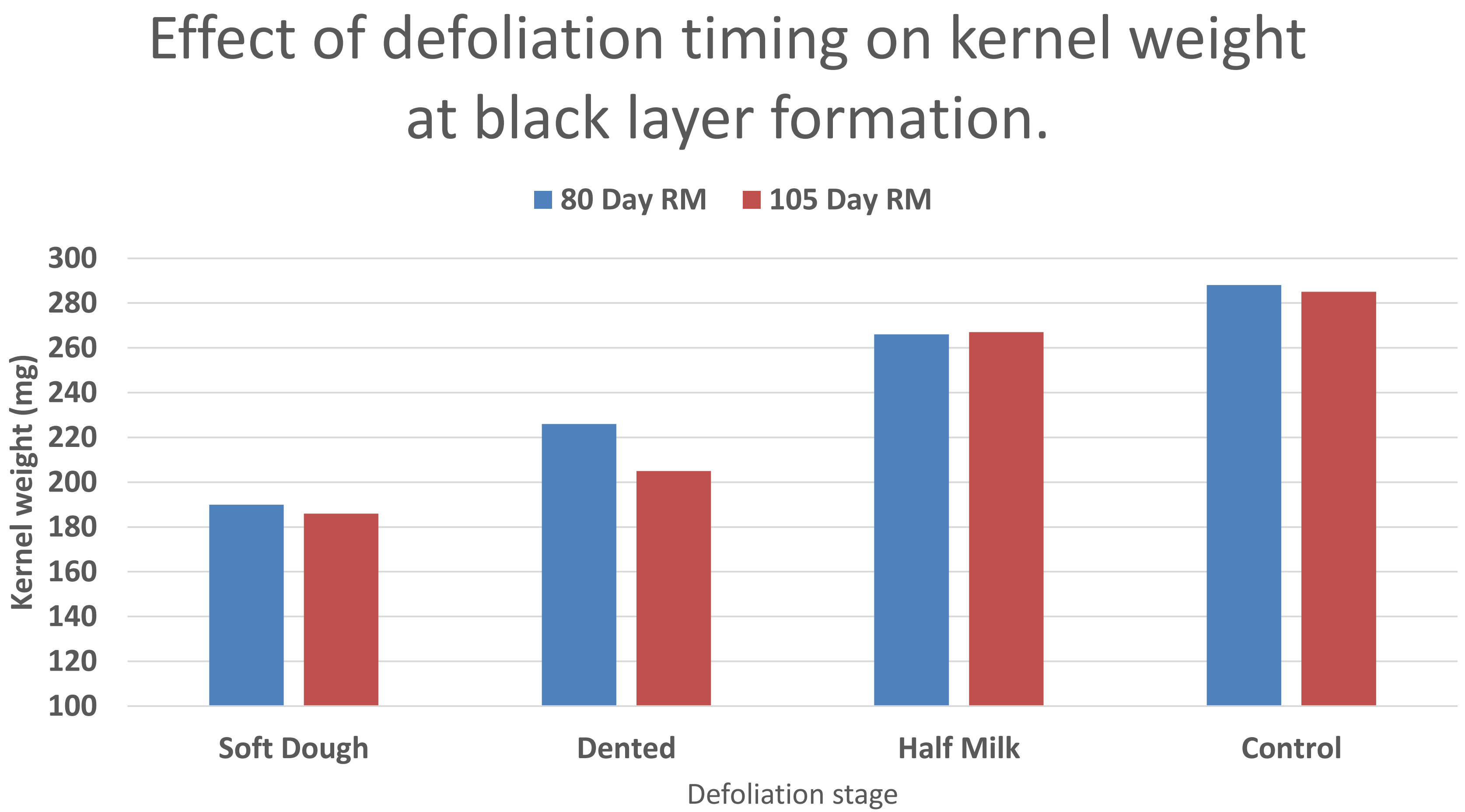
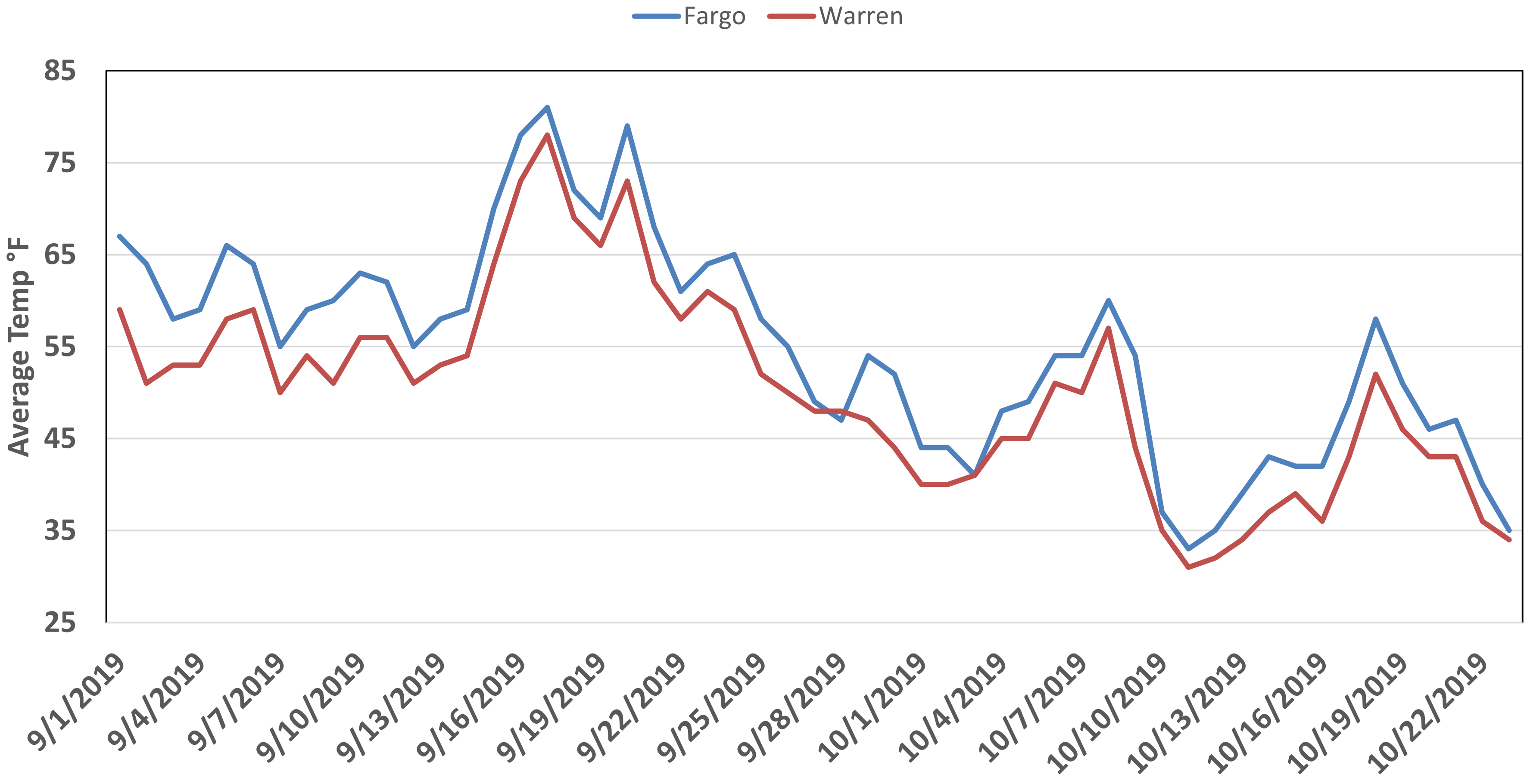


Could premature black layer have impacted yield and test wt?

- Reported that BL can occur when max. temps. were below 55º F for a week
- Average daily temperature met this threshold in late September, or earlier in northern tier of the state
- Could this have accentuated the problem of immature corn?

Daily average temperatures from Sept 1, Fargo and Warren, 2019.



Immature corn means high moisture corn. Moisture loss mechanism:

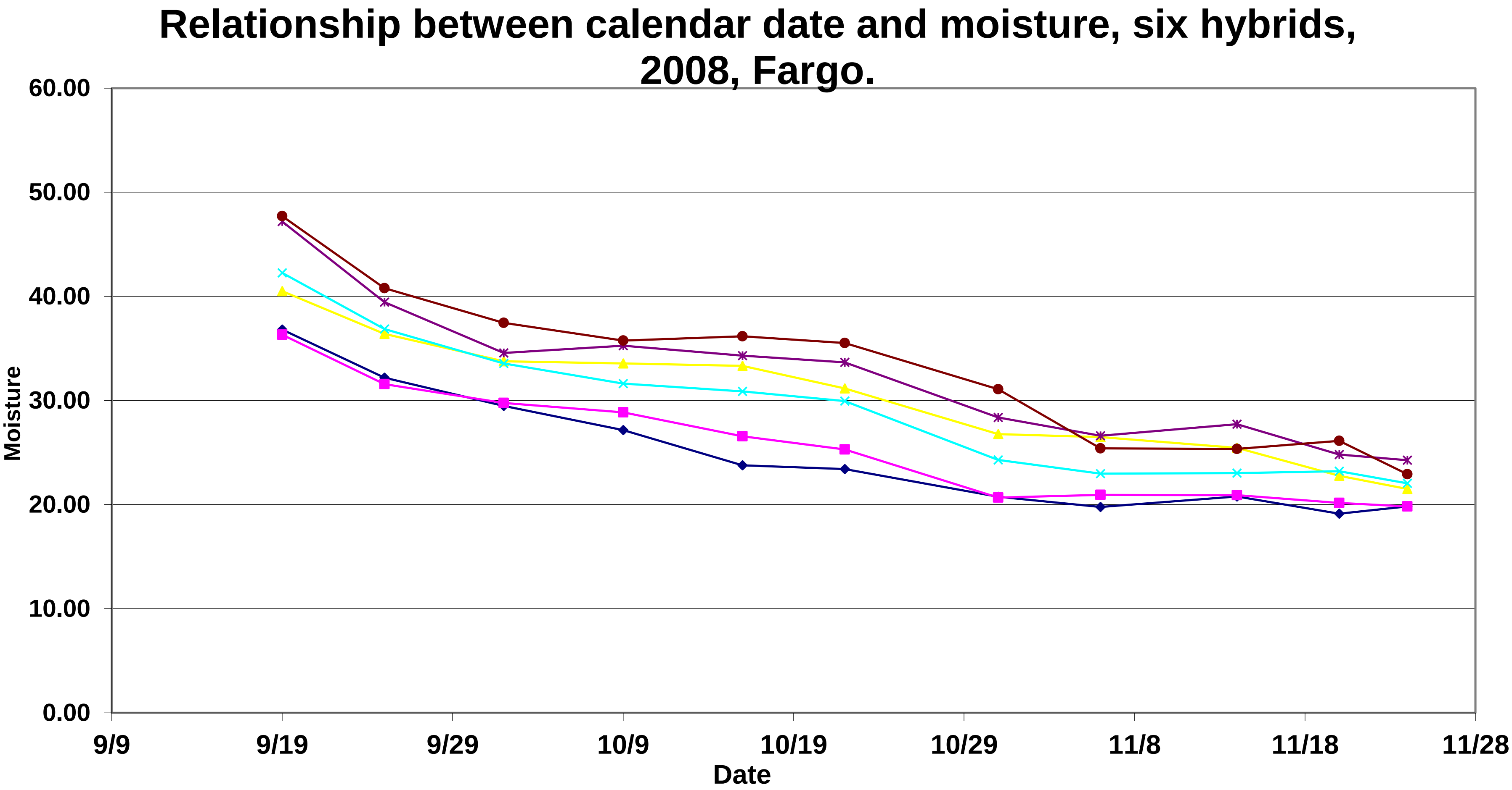
Prior to PM

- Addition of new solids
- Evaporation of moisture from surface of kernel
- Rate of change impacted by growth rate and evaporative demand

After PM or plant death

- At black layer, death of placental cells block movement of soils to kernel
- Evaporation of moisture from surface of kernel
- Moisture loss starts at higher level if not mature

Moisture loss slows as temperature cools and as kernel moisture content declines



"Estimated" Corn Field Drying

PET=Potential Evapotranspiration

	EMC (%)	GDD	PET (in)	Est. Drying (%pt) Month	Week
Sep	15	250-350	4.0-5.0	18	4.5
Oct	16	100-125	2.8-3.5	11-12	2.5
Nov	19	20-30	0.8-1.2	4-5	1
Dec	20	0	0.5-0.8	2	0.5
Jan	21	0	0.5-0.8	2	0.5
Feb	21	0	0.5-0.9	3	0.8
Mar	19	0	1.3-1.6	5	1
Apr	16	50-90	3.2-4.5	16	4
May	14	200-300	6.5-8.5	30	7

NDAWN, Weather, Total PET, Estimate:1-inch = 4% drying
EMC-equilibrium moisture content, GDD-growing degree days

Corn Drydown Calculator

Corn Drydown Calculator

HIDE

Welcome!

This tool offers predictions of corn drydown in the field using algorithms developed for the northern Corn Belt. The tool can help you plan logistics and assess risk by estimating the changes in grain moisture content that are likely to occur under a set of field conditions.

To use it, follow these simple steps:

1. Select a location on the map and click submit
2. Provide an initial date and corn grain moisture content

Further information is available in the *About* tab.

Map Graph About

Generalized equations for moisture loss in corn after PM

$$M(x) = (Mo - M_e) * e^{-kx^n} + M_e$$

$$M_e = \left[\frac{\ln(1 - \frac{RH}{100})}{-0.0001557(T + 45.5)}\right]^{\frac{1}{2}}$$

Based on R.A. Martinez-Feria et al., 2019
Nature, Scientific Reports

Generalized equations for moisture loss in corn after PM

$$M_e = \left[\frac{\ln(1 - \frac{RH}{100})}{-0.0001557(T + 45.5)}\right]^{\frac{1}{2}}$$

$$15\% = M_e = \left[\frac{\ln(1 - \frac{80}{100})}{-0.0001557(0 + 45.5)}\right]^{\frac{1}{2}}$$

Based on R.A. Martinez-Feria et al., 2019
Nature, Scientific Reports

Factors that affect rate of corn dry down after PM

Initial moisture

Kernel characteristics (corn differs from other grains)

Equilibrium moisture content (EMC)

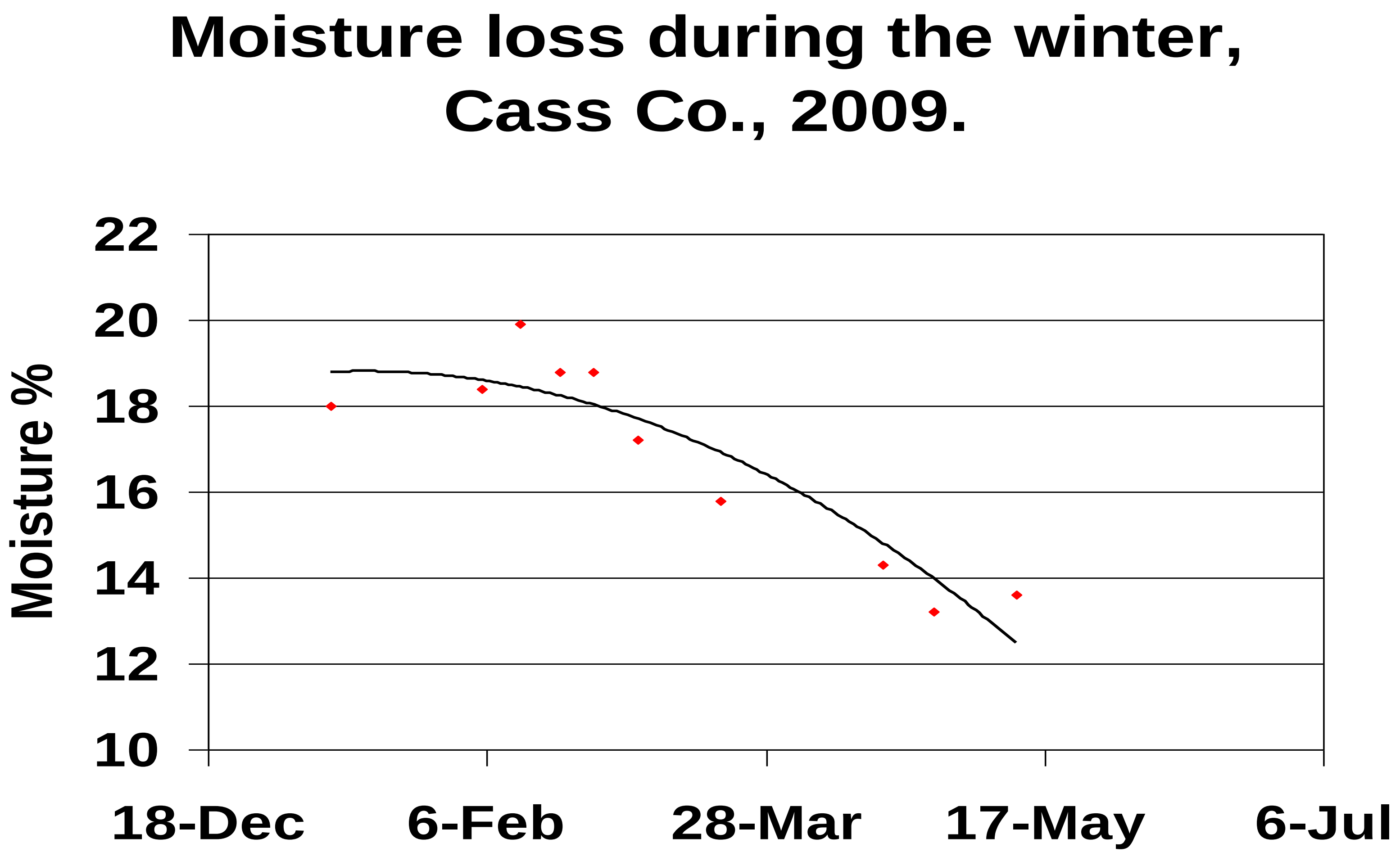
Temperature and relative humidity

Low temps > EMC, high RH>EMC

- RH averages ~75% in winter, 50% in May

Rate of change can be impacted by wind speed but found to be minor compared to temperature

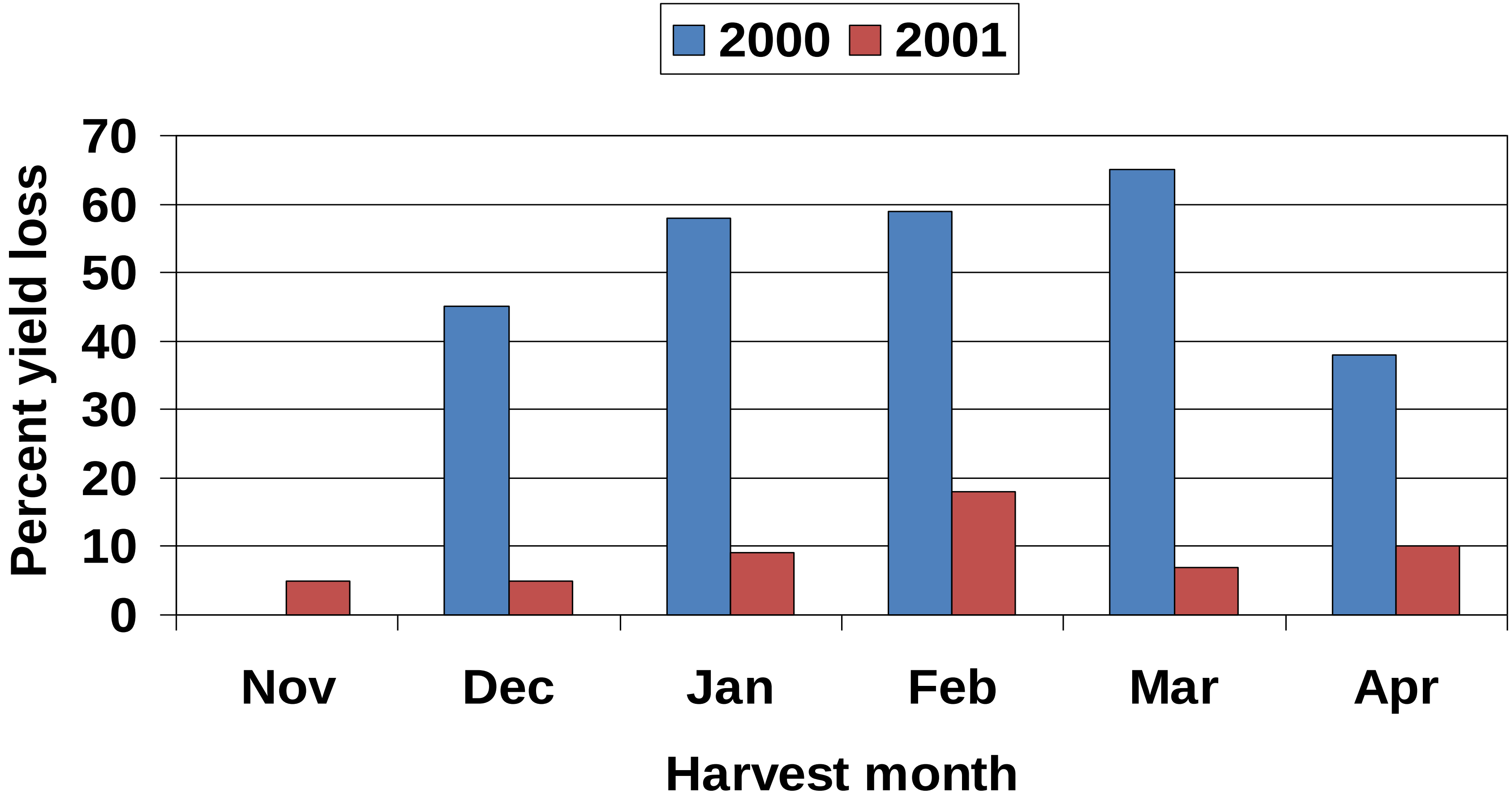
Most moisture loss is in the spring



Current grain moisture of corn left standing

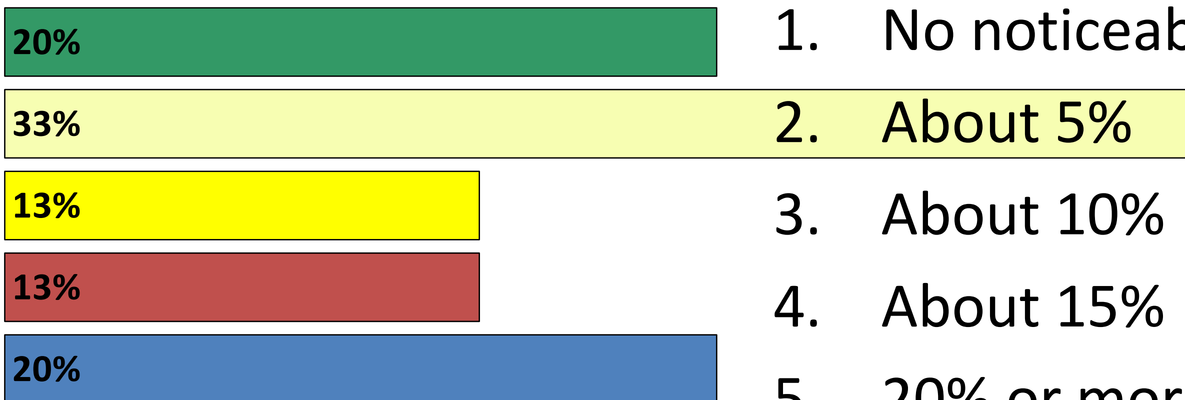
		Sampling date		
Field	RM	12/15	1/7	1/27
Steele Co	83	20.2	18.7	18.8
Steele Co	95	NA	20.8	20.8
Steele Co	Border	29.4	24.2	NA
Steele Co	89	NA	20.2	19.6
Comstock	Farmer/s field	NA	21.8	19.5

Yield losses from corn left standing over the winter, Wisconsin (Lauer, 2004)



Ear diseases may be problematic in some fields

If you harvested corn in the spring, what was your estimated yield loss?



1. No noticeable loss
2. About 5%
3. About 10%
4. About 15%
5. 20% or more

What was the main cause of losses?

33%	1. Deer
20%	2. Lodged plants
27%	3. Ear drop
20%	4. Rotten ears

How to manage grain to improve test weight

- Harvest so as to minimize mechanical damage
  - greater moisture, lower temps result in greater damage
- Slower drying better than fast drying
  - Dryer temps below 180 ˚
  - Field drying better than artificial drying with heat
- Combine diseased areas of the field separately

Conclusions

- Late planting and cool growing season resulted in considerable immature corn
  - Reduced yield, lower test weight, very wet grain
- Cool weather in may have cause premature black layer formation
- Amount and rate of field drying this winter determined by the equilibrium moisture content
- Test weight may improve with field drying, but challenges will remain with immature corn