Grain Filling Rates in Corn

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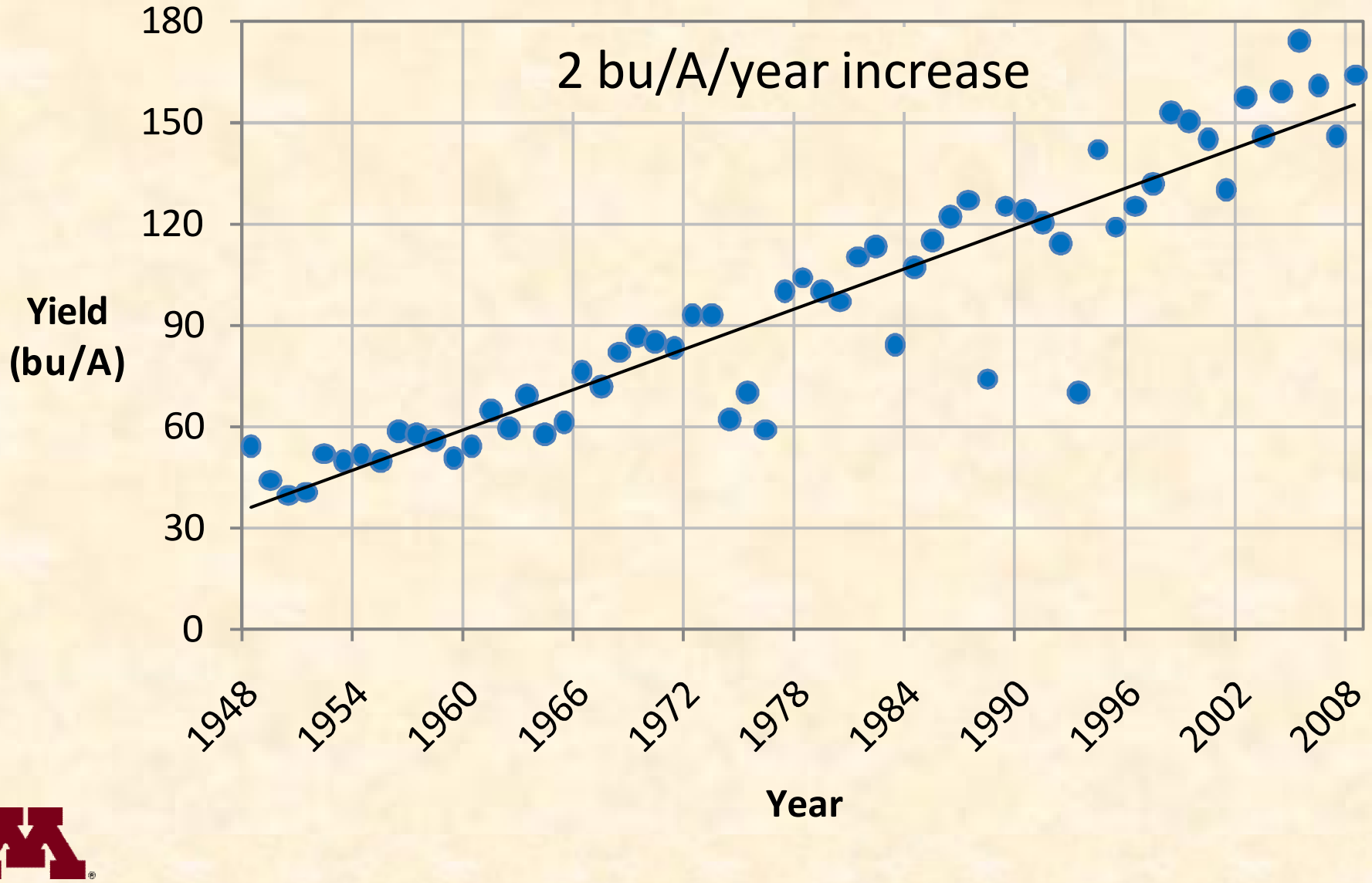
Minnesota Average Corn Yields



Components of Corn Yield

1) Kernels per acre
   - Dependent upon…
     - Plant population
     - Ear size determination prior to tasseling
     - Success at pollination (moisture & temp.)

2) Kernel weight
   - Dependent upon…
     - Rate & duration of grain fill (moisture & temp.)

Lamberton, 2009 – planted April 24

16 21.5 27 32.5 38 43.5

Final plant population (thousands/A)

44,000 plants/A

4.75” between plants in 30” rows

Future Yield Improvement in Corn

- Future yield improvement will be related to greater stress tolerance.
- What type of stress?
  1. Moisture stress (as with high plant populations)
  2. Nutrient stress
  3. Temperature stress

Past & Future Yield Improvement in Corn

1) Kernels per acre
   – Dependent upon…
      - ***Plant population***
      - Ear size determination prior to tasseling
      - Success at pollination (moisture & temp.)

2) Kernel weight
   – Dependent upon…
      - ***Rate & duration of grain fill*** (moisture & temp.)

Maturity Line Weight Appraisal Method

- For corn grain appraisals, from the milk stage until kernels are fully mature & moisture drops below 40%.

- Based on weighing ear samples which are grouped according to maturity, and converting production to bu/acre.

Source: Corn Loss Adjustment Standard Handbook

Maturity Line Weight Appraisal Method

- Research in Wisconsin & Pennsylvania found that at early stages of grain fill, the Maturity Line Weight Appraisal Method resulted in low appraisals when compared to actual yield at end of the season.

- This appraisal method is dependent upon “yield factors” for various kernel stages, which are based on the rate of grain fill.

Grain Filling Rates in Corn

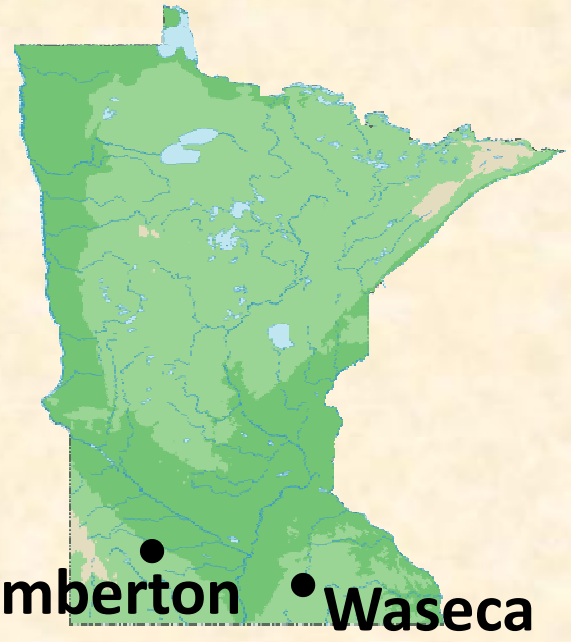
- Corn yield is closely tied to crop, weather, & soil conditions during the rapid grain-filling period.
  - Thus, factors influencing crop growth before grain fill, but not during grain fill, often have inconsistent effects on grain yield.
- Rapid grain filling in corn occurs from late R2 (blister stage) to late R5 (full dent).
  - Typically 35 to 40 days = 4 to 6 bu/A/day

Grain Filling Rates in Corn

- Daily grain filling rates & the duration of this period determine final yield.
- Grain filling rates & how they are affected by crop & weather conditions, are critical to understanding how grain yields develop.

Corn Grain Filling Study

- Objective:
  - To determine the rate of grain fill for modern hybrids to provide a better group of “yield factors” for the Maturity Line Weight appraisal method.
- Method:
  - Weekly ear samples collected from replicated plots during rapid grain filling stages.



A World Of Information
National Crop Insurance Services

Corn Grain Filling Study

- Lamberton & Waseca, MN, 2009 – following soybean
- Nicollet clay loam
- 2 hybrids with corn borer + rootworm resistance
  - Pioneer 38P43 (95-day)
  - Pioneer 35F44 (105-day)
- 4 replications of each hybrid at both locations
- Planted on April 24
- Final stand: 32,000 plants/A

Corn Grain Filling Study

- Ear samples were collected weekly from the milk (R3) stage in mid-August through maturity (black layer)
- Additional ear samples were collected through mid-November to monitor the rate of grain dry down.

2009 Rainfall

	Lamberton, MN	Waseca, MN
	Total rainfall & departure from 30-yr avg. (inches)	
May	1.6 (-1.7)	1.9 (-2.1)
June	3.2 (-0.7)	2.8 (-1.5)
July	1.7 (-2.2)	1.5 (-2.9)
August	3.5 (+0.4)	3.3 (-1.3)
September	2.8 (-0.2)	1.5 (-1.7)

2009 Air Temperature

	Lamberton, MN	Waseca, MN
	Avg. air temp. & departure from 30-yr avg. (°F)	
May	58.0 (-0.5)	58.0 (-0.4)
June	66.0 (-2.0)	65.8 (-2.0)
July	67.0 (-5.0)	66.1 (-5.2)
August	67.5 (-1.5)	66.4 (-2.5)
September	64.0 (+3.5)	64.1 (+3.9)

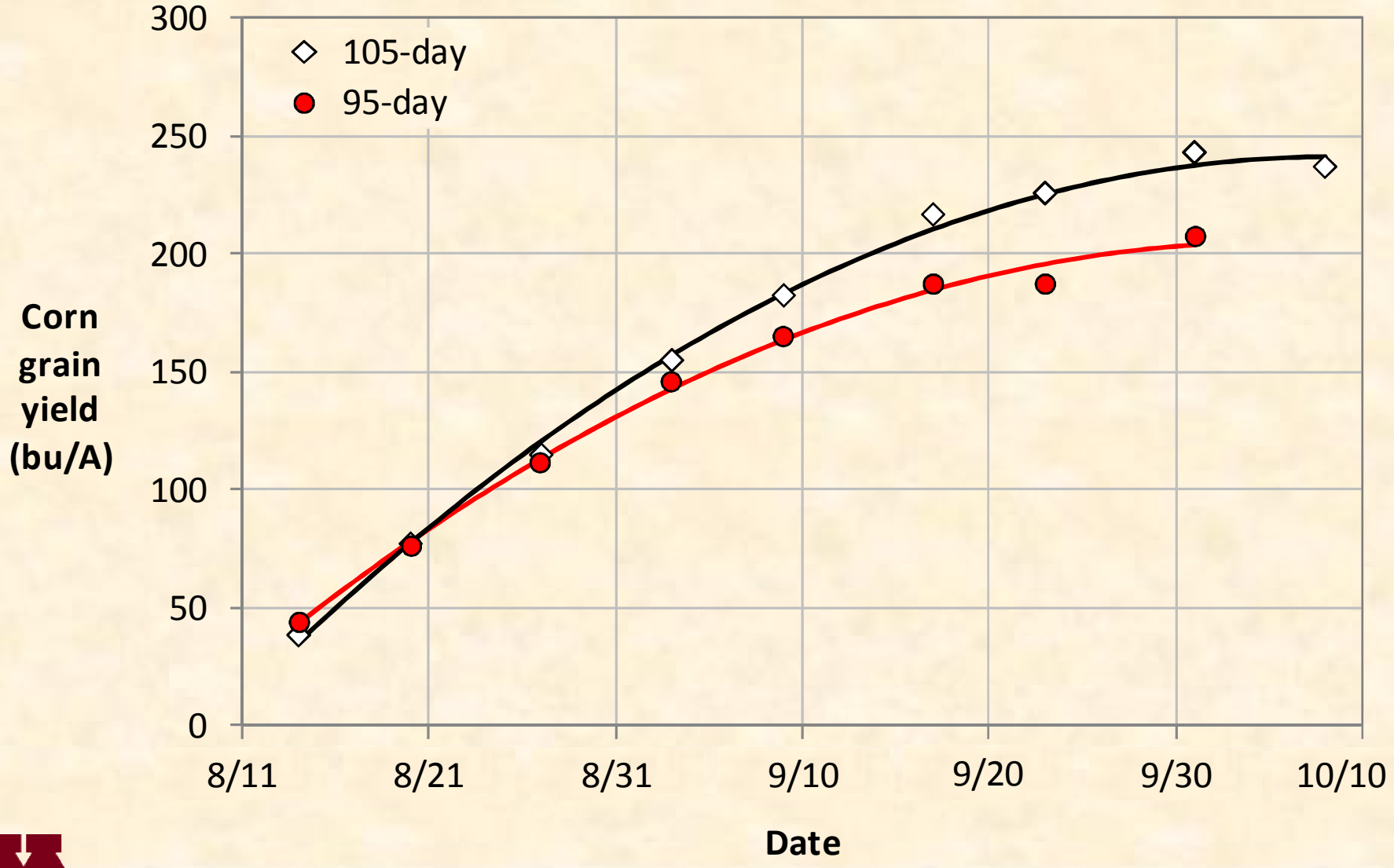
Corn Grain Filling Study

- Date of 50% silking (similar at both locations)
  - 95-day hybrid: July 24
  - 105-day hybrid: July 28
- Dry conditions following the July 28 silking date resulted in some pull-back on ears of the 105-day hybrid.

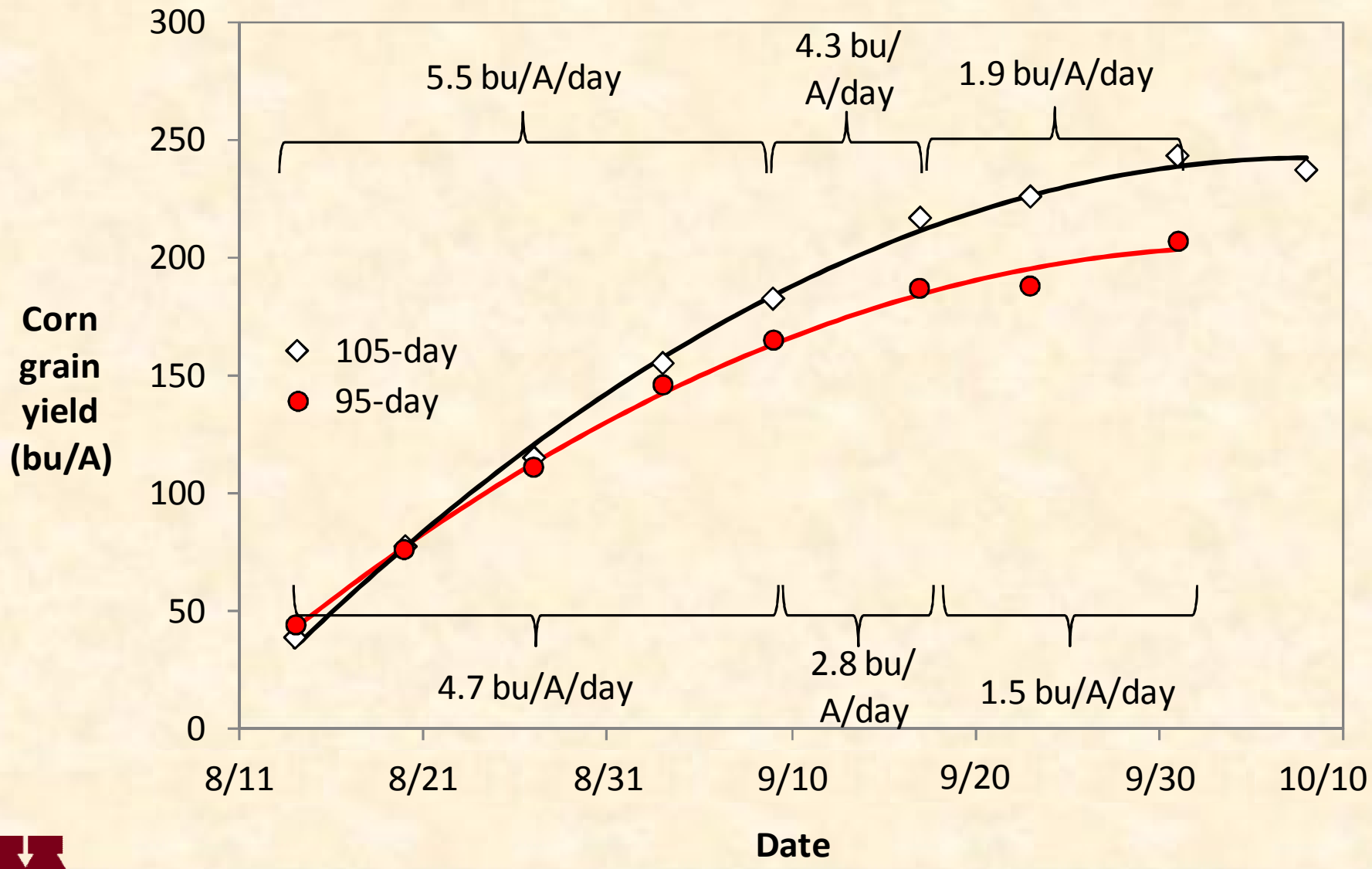
August 14 – Lamberton, MN

October 1 – Lamberton, MN

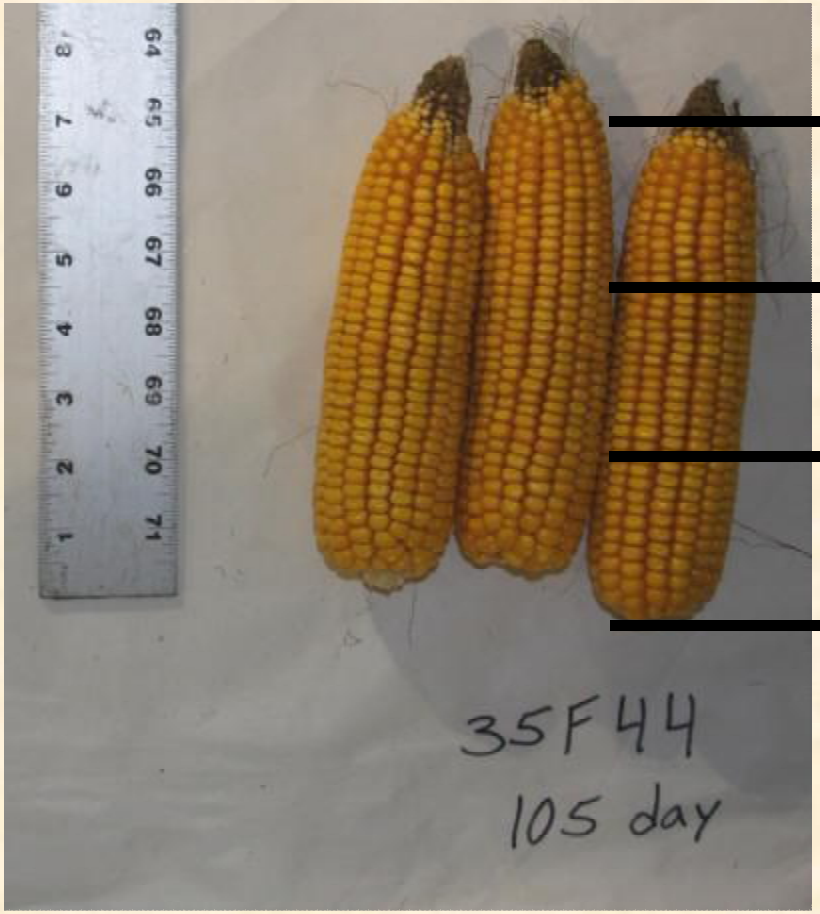
Lamberton & Waseca, MN: 2009



Lamberton & Waseca, MN: 2009



Where is the grain fill occurring?



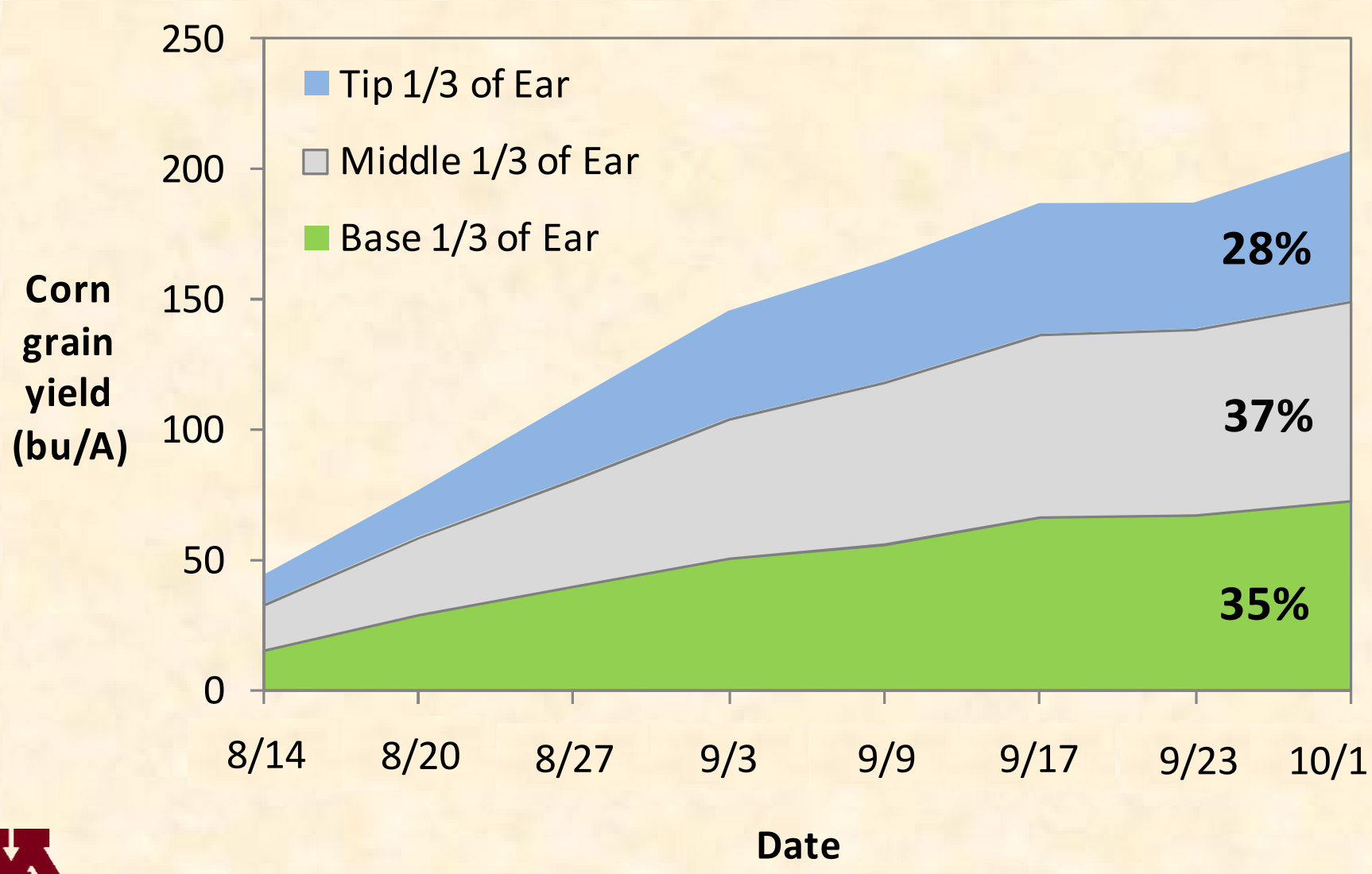
Tip 1/3

Middle 1/3

Base 1/3

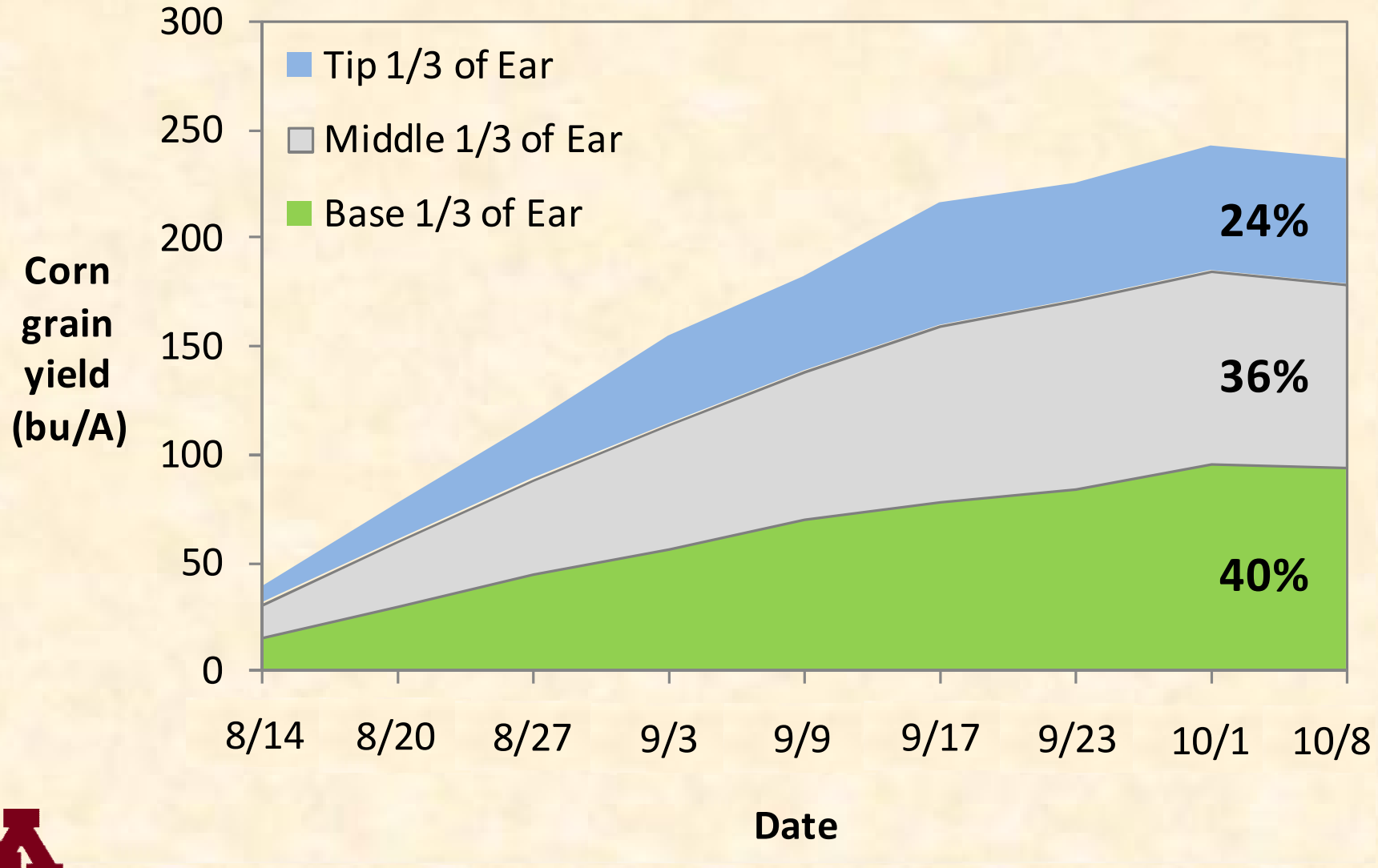
95-Day Hybrid

(Waseca & Lamberton, MN - 2009)



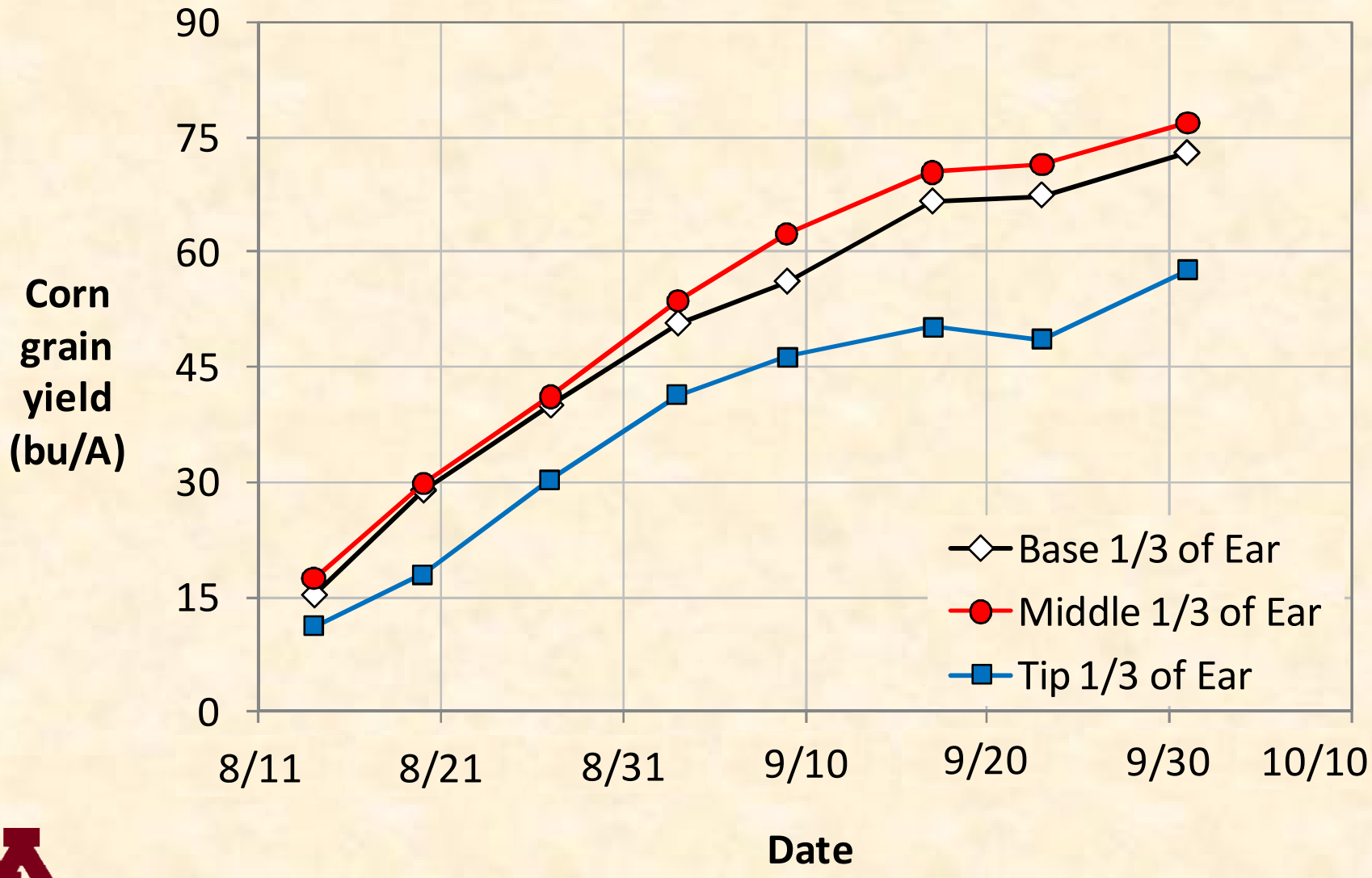
105-Day Hybrid

(Waseca & Lamberton, MN - 2009)



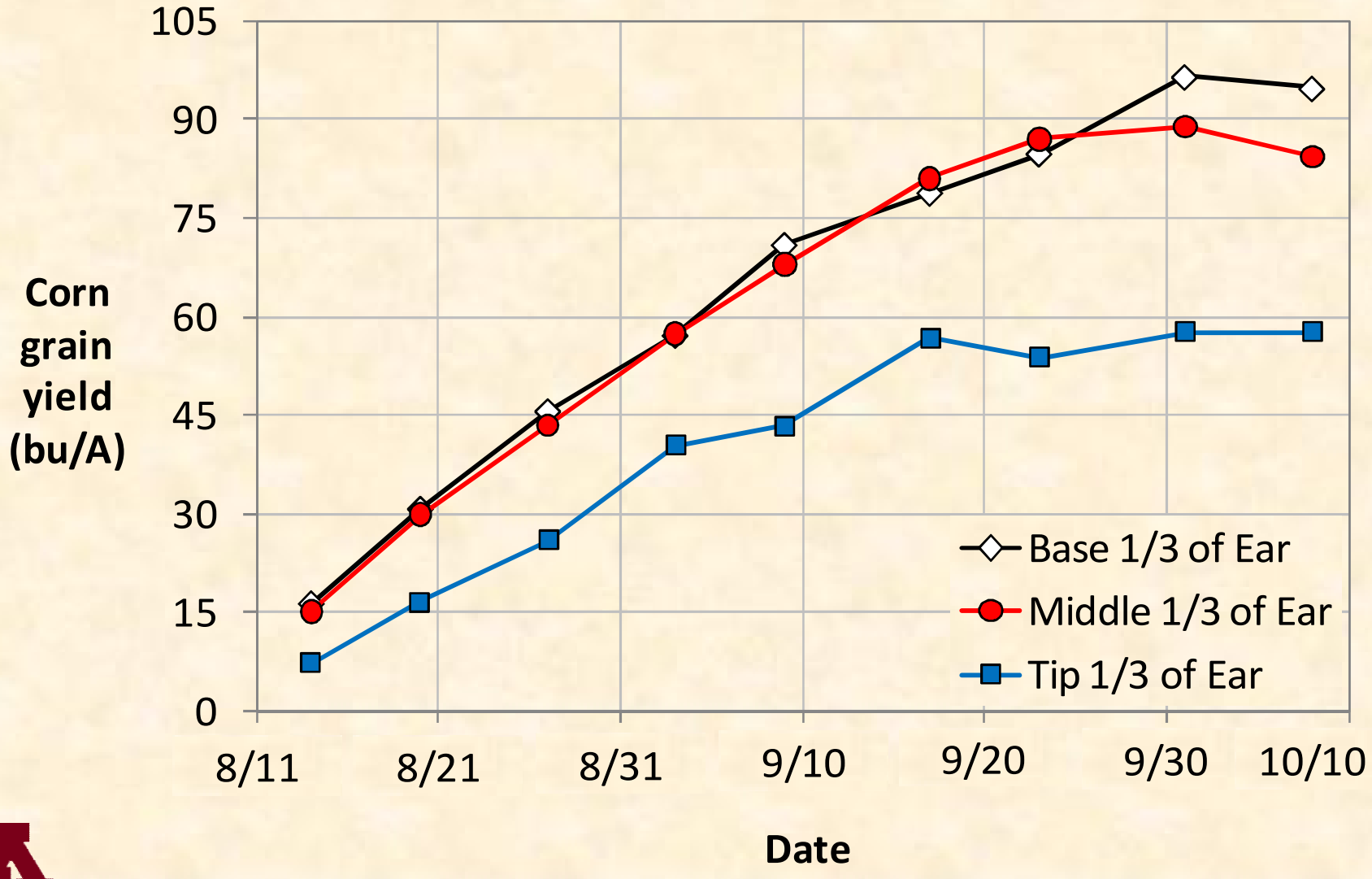
95-Day Hybrid

(Waseca & Lamberton, MN - 2009)



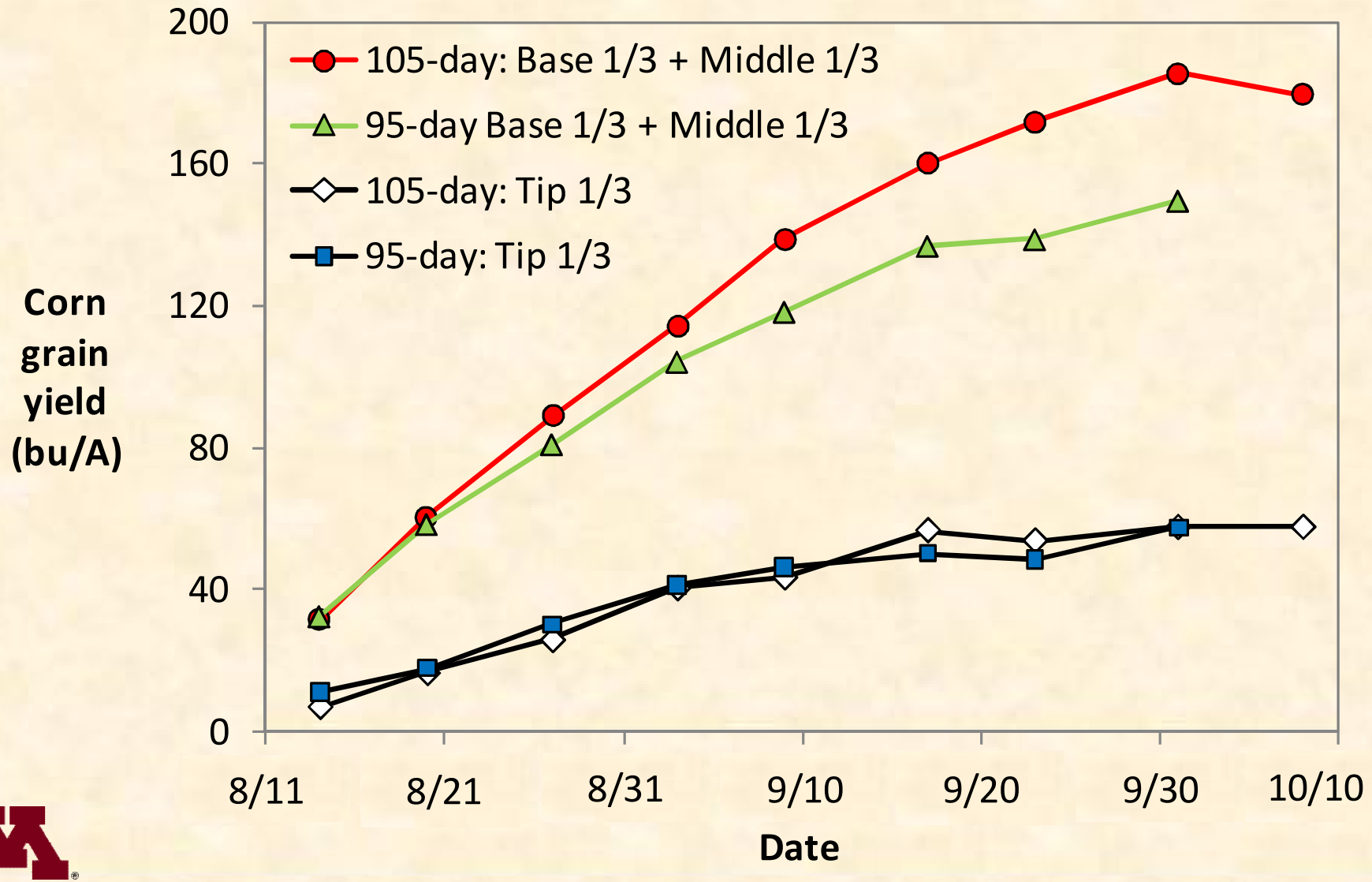
105-Day Hybrid

(Waseca & Lamberton, MN - 2009)



95- vs. 105-Day Hybrid

(Waseca & Lamberton, MN - 2009)



Grain Filling Rate by Ear Portion

(Waseca & Lamberton, MN - 2009)

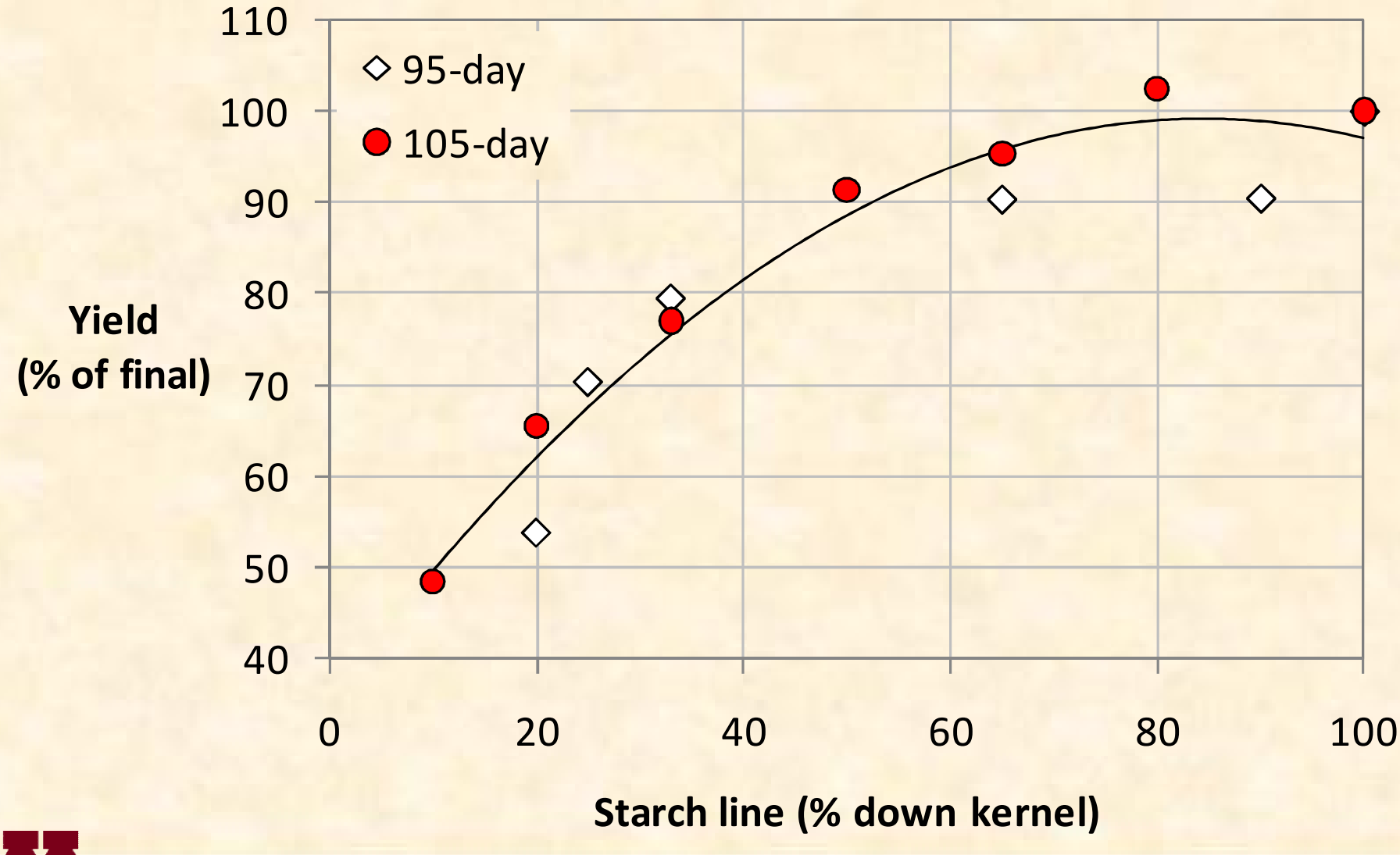
Sampling dates	Crop stages	Base + middle 2/3		Tip 1/3	
		105-day	95-day	105-day	95-day
		---------- Rate of fill (bu/A/day) ----------			
8/14 - 9/9 (26 days)	R3 - R5	4.1	3.3	1.5	1.4
9/9 - 9/17 (8 days)	R5 - R5.5	2.6	2.3	1.7	0.5
9/17 - 10/1 (15 days)	R5.5 - R6	1.8	0.9	0.1	0.6

Starch Line Location vs. Grain Yield

Starch line 20% down on August 3

Starch line 50% down on August 17

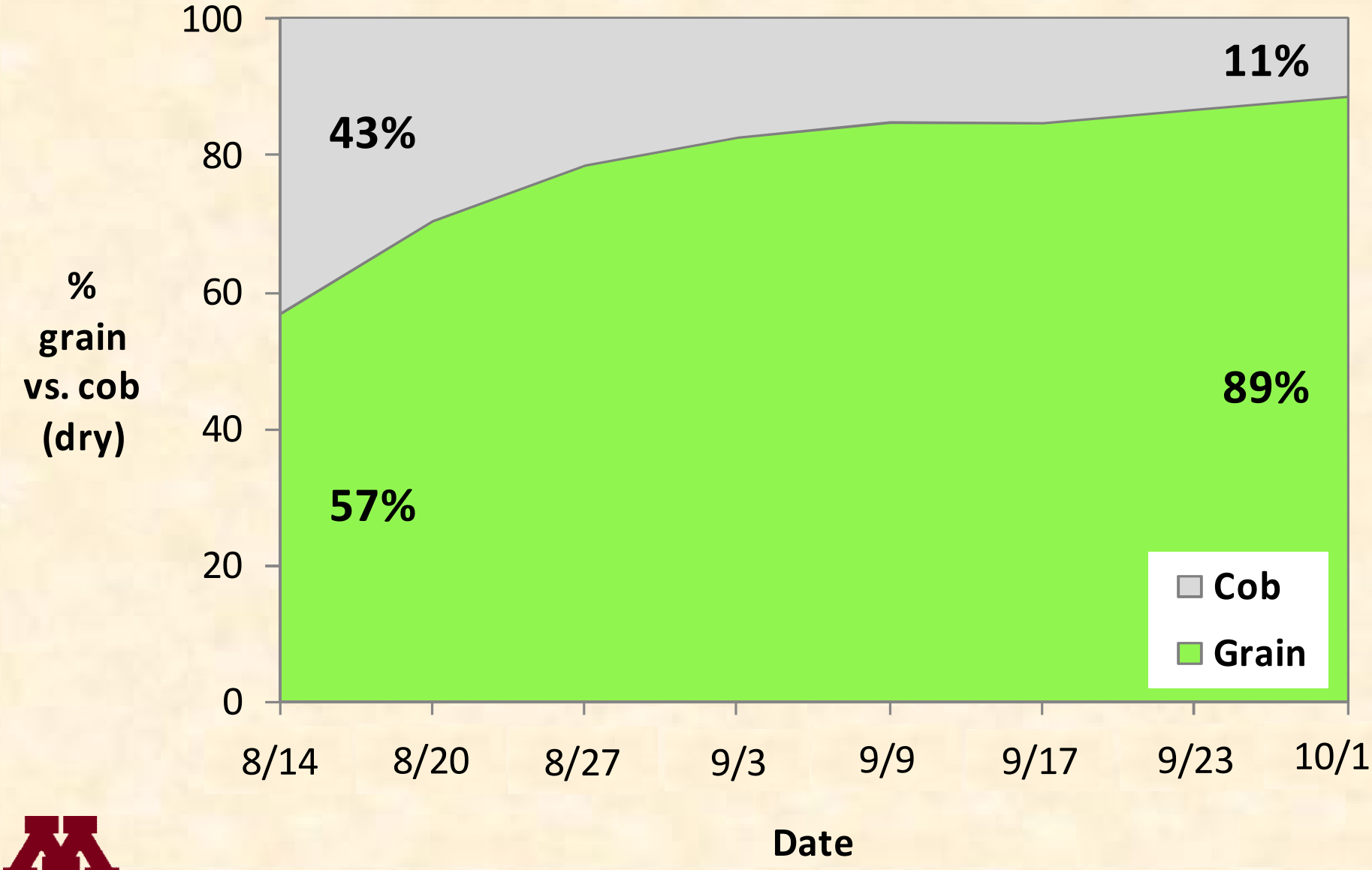
Starch Line Location vs. Grain Yield



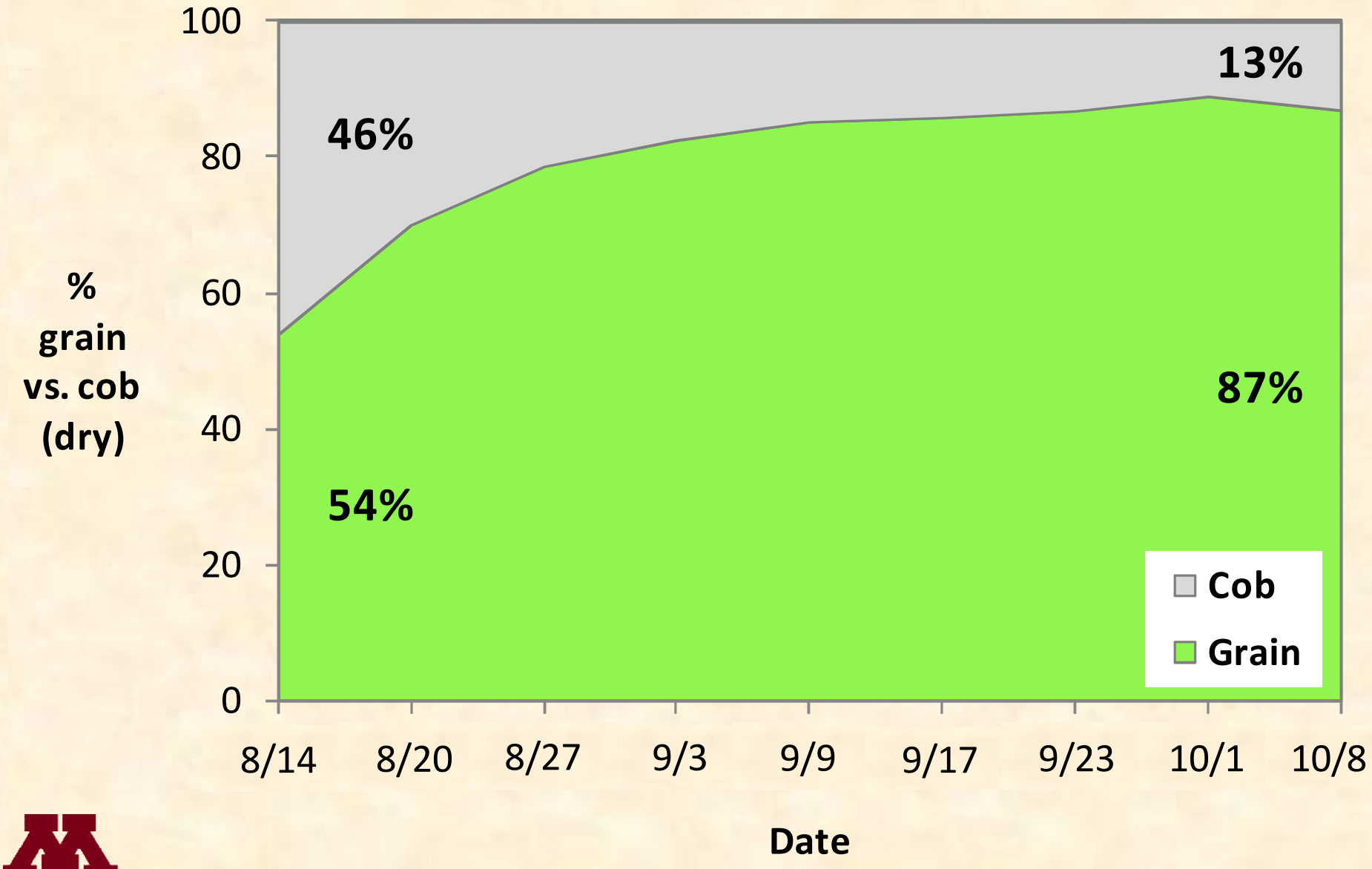
Starch Line Location vs. Yield Loss

Starch line (% down kernel)	Yield loss (%)
20	38
30	27
40	18
50	11
60	6
70	3
80	1

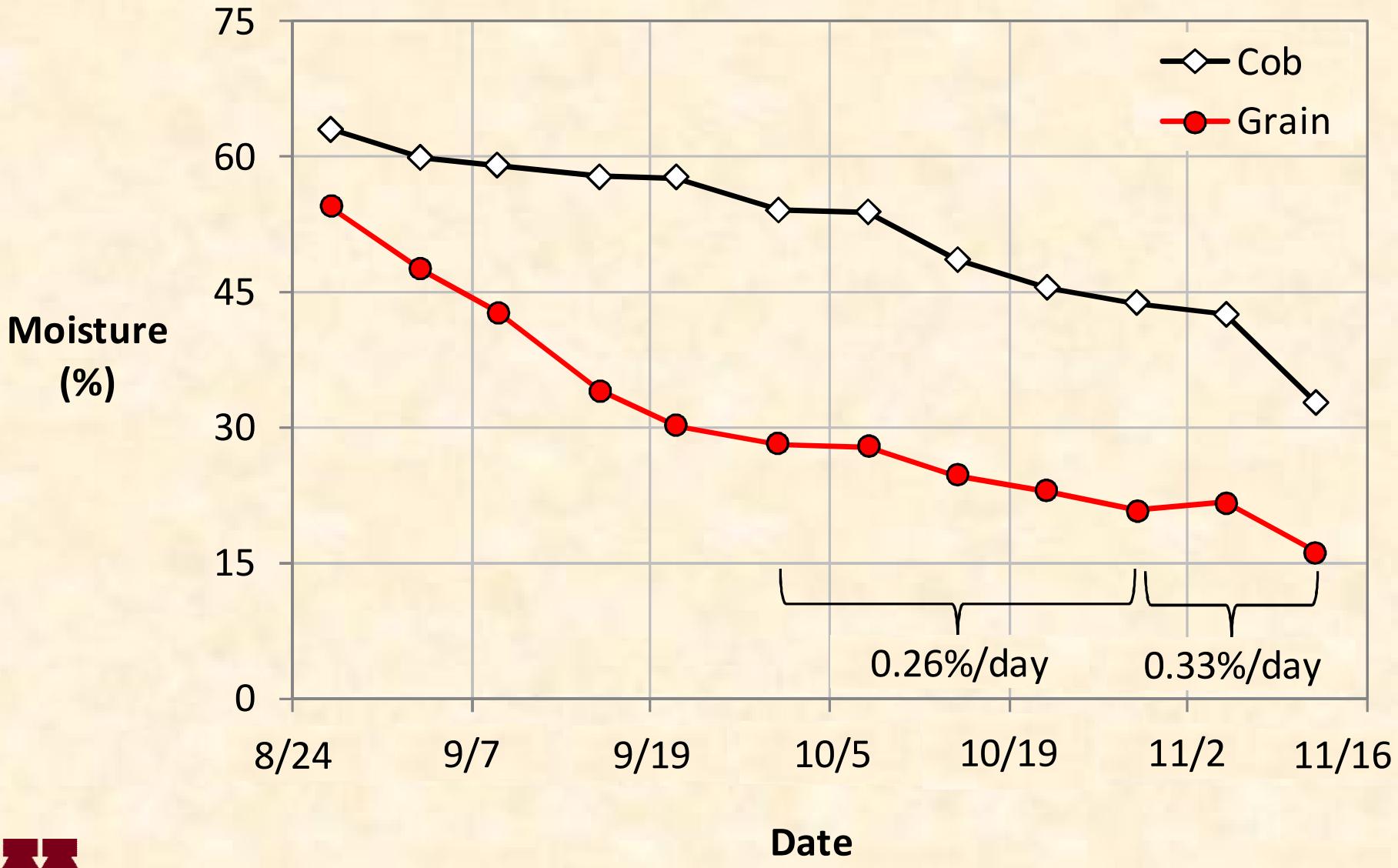
Cob vs. Grain (95-Day Hybrid)



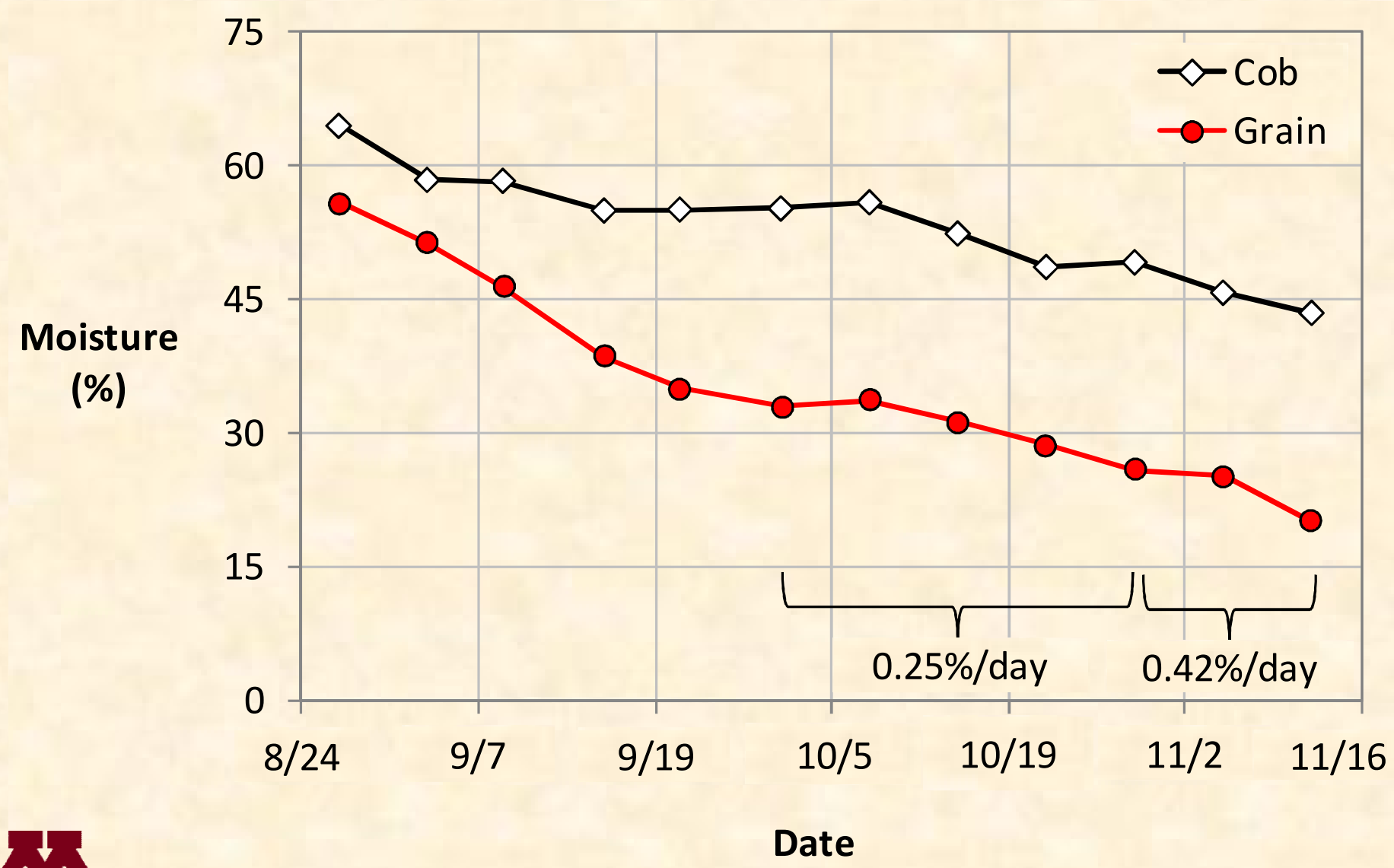
Cob vs. Grain (105-Day Hybrid)



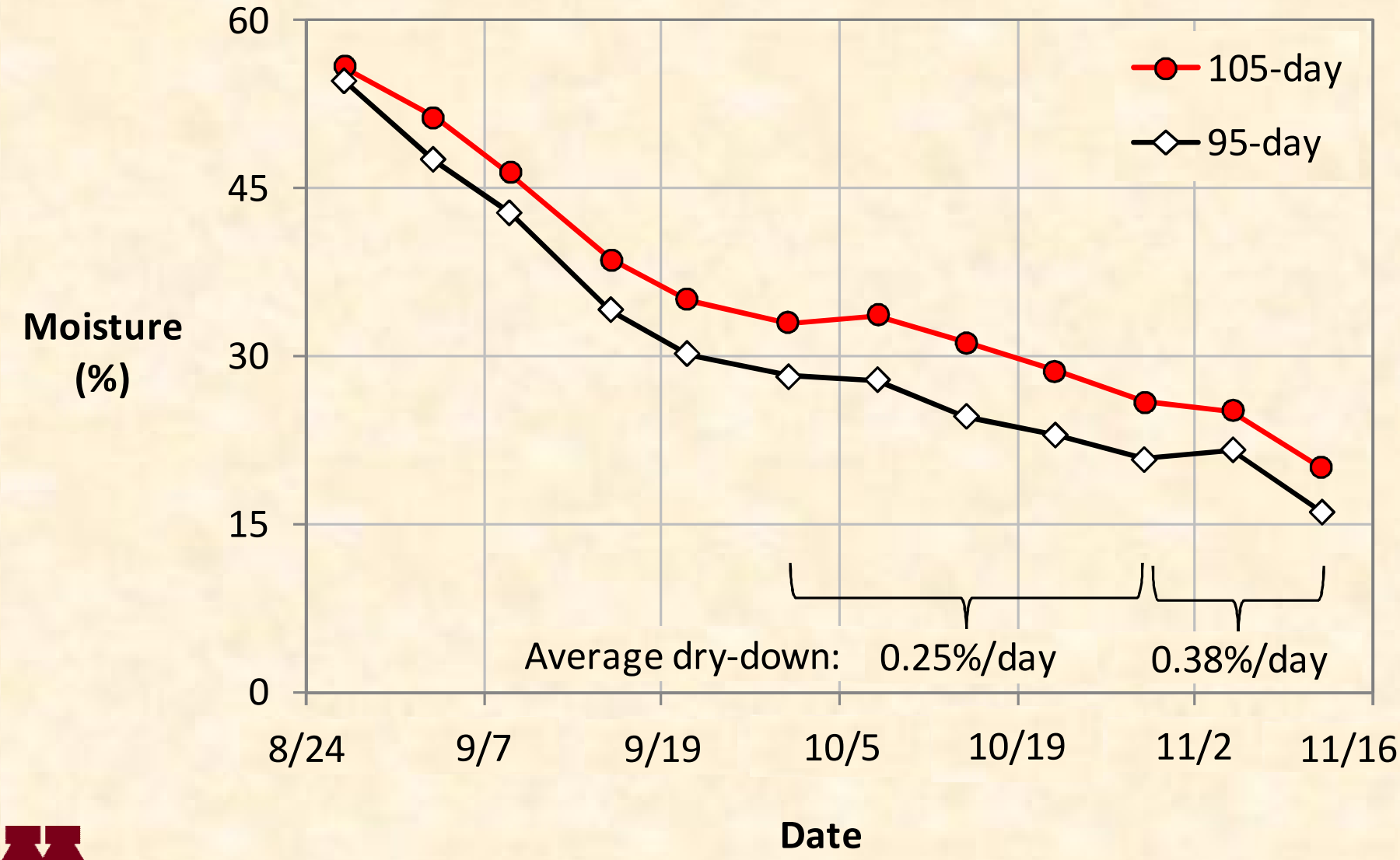
Cob & Grain Moisture (95-Day Hybrid)



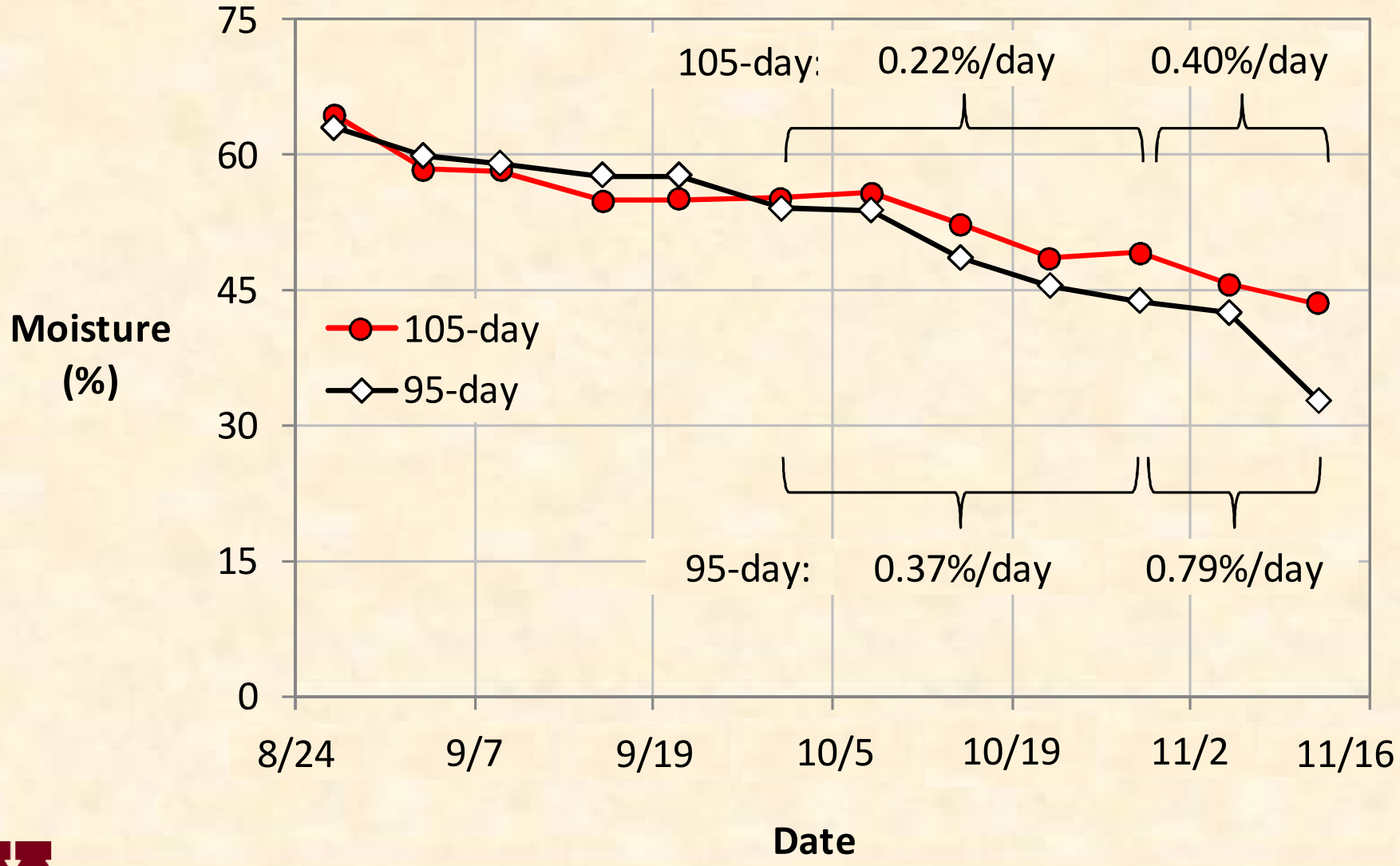
Cob & Grain Moisture (105-Day Hybrid)



Grain Dry-Down (95- vs. 105-Day Hybrids)



Cob Dry-Down (95- vs. 105-Day Hybrids)



Conclusions from Corn Grain Filling Study

- Grain filling conditions were good in southern MN in 2009.
- The 105-day hybrid yielded 14% more than the 95-day hybrid.
  - Due to more rapid grain fill at the base & middle ear portions from…
    - Mid-August to early September
    - Mid-September to October

Conclusions from Corn Grain Filling Study

- The base & middle ear portions make up 75% of total yield.
- All portions of the ear fill grain at a similar rate.
- Kernel starch line correlates well with yield accumulation.
  - This was consistent among hybrids.
  - 11% yield loss with freeze at 50% starch line.

Conclusions from Corn Grain Filling Study

- Cobs dry slower than grain until the grain reaches maturity.
- Cobs are 2/3 times wetter than grain, and thus can slow grain drying and promote mold if corn is froze before mature.
- Starting in mid-September…
  1) Grain from 95- and 105-day hybrids dried at a similar rate.
  2) Cobs from the 95-day hybrid dried a little faster.





Thanks!

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