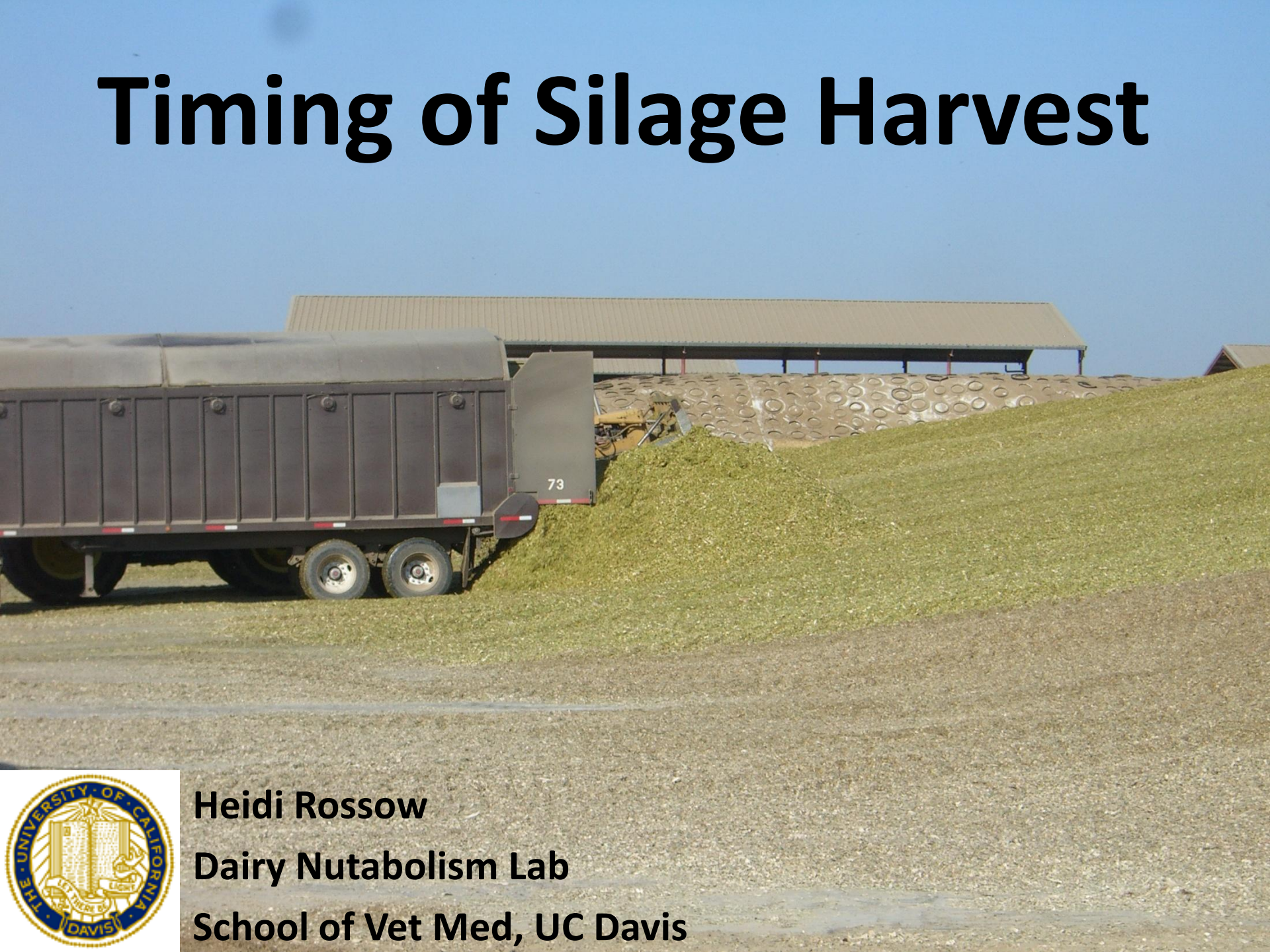
Timing of Silage Harvest



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1. Why?
2. When?
3. How?

1.Why?

Nutrient content
Digestibility
Silage quality

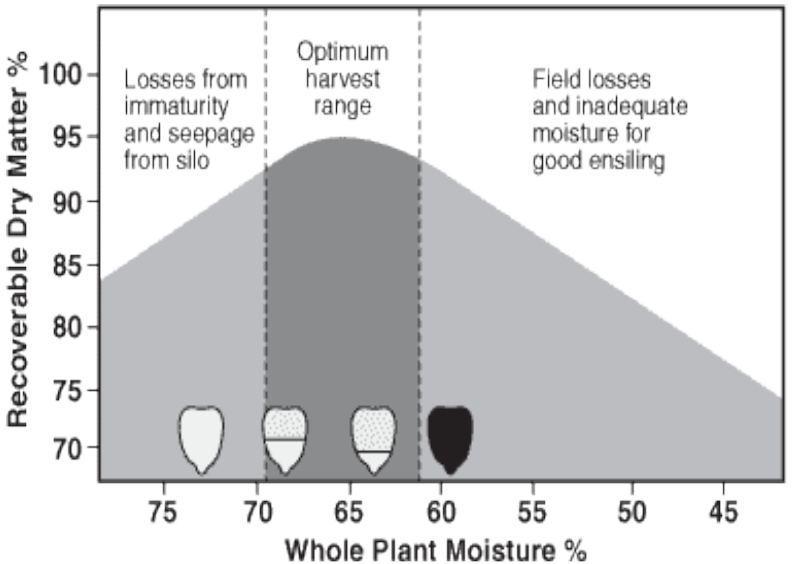
1.Why? Nutrients

Table 3. Plant composition and energy yield of whole plant corn silage harvested at three different stages of maturity.[1]

Maturity	Grain DM	Stover	Sugar	Starch	TDN/Acre[2]
	Percent, Dry Matter Basis				
1/3 milk line	32.4	59.1	9.8	22.2	7.2
2/3 milk line	41.8	50.2	7.1	28.4	7.8
black layer	46.1	45.8	6.6	31.0	7.7

[1] Average of six hybrids, two locations.

[2] Tons of total digestible energy per acre, dry matter basis.



1.Why? Nutrients

TABLE 1. Chemical composition and characteristics of corn silage as affected by maturity.

Item	Study[2]	Maturity[1]						
		Milk	ED	¼ ML	⅓ ML	½ ML	⅔ ML	BL
% DM Whole plant	1	. . .	30.1	32.4	. . .	. . .	35.1	42.0
	2	. . .	. . .	. . .	. . .	35.7	. . .	45.1
	3	. . .	. . .	. . .	31.7	. . .	39.1	45.4
	4	20.4	28.5	. . .	. . .	. . .	. . .	43.5
	5	20.3	28.9	. . .	. . .	. . .	. . .	45.1
% DM Kernels	2	. . .	. . .	. . .	. . .	55.4	. . .	61.4
CP, %DM	1	. . .	7.5	7.3	. . .	. . .	7.1	7.0
	2	. . .	. . .	. . .	. . .	8.4	. . .	8.9
	4	9.5	9.2	. . .	. . .	. . .	. . .	8.3
	5	9.2	7.6	. . .	. . .	. . .	. . .	6.9
NDF, %DM	1	. . .	52.0	44.4	. . .	. . .	40.5	41.3
	2	. . .	. . .	. . .	. . .	45.0	. . .	44.0
	3	. . .	. . .	. . .	46.3	. . .	43.8	44.5
	4	63.5	51.8	. . .	. . .	. . .	. . .	45.7
	5	65.1	54.6	. . .	. . .	. . .	. . .	51.7
ADF, %DM	1	. . .	32.0	27.1	. . .	. . .	23.9	24.2
	2	. . .	. . .	. . .	. . .	27.0	. . .	26.0
	3	. . .	. . .	. . .	27.0	. . .	25.3	25.5
	4	34.6	38.5	. . .	. . .	. . .	. . .	21.8
	5	36.7	29.4	. . .	. . .	. . .	. . .	28.3
Starch, %DM	1	. . .	18.2	28.7	. . .	. . .	37.2	37.4
	2	. . .	. . .	. . .	. . .	32.0	. . .	35.0
	3	. . .	. . .	. . .	22.2	. . .	28.4	31.0
Lignin, %DM	1	. . .	3.3	2.8	. . .	. . .	2.9	2.7
	2	. . .	. . .	. . .	. . .	3.6	. . .	4.9
	3	. . .	. . .	. . .	3.0	. . .	2.8	3.0
	4	5.7	4.4	. . .	. . .	. . .	. . .	3.1
	5	6.4	4.8	. . .	. . .	. . .	. . .	5.3

[1]ED = Early dent, ML = milkline, BL = blackline.

[2]Data for study 1, 2, 3, 4, and 5 were from Bal et al. (2), Harrison et al. (11), Hunt et al. (18), Xu et al.

1.Why? Nutrients

TABLE 2. Dry matter intake, milk production, milk component yield, and digestibility of nutrients as affected by maturity of corn silage.

		Maturity (% of Blackline response)[1]				
Item	Reference	ED	¼ ML	½ ML	⅔ ML	BL (kg or %)
DMI, kg	Bal et al. (2)	100	100	. . .	100	25.6
	Harrison et al. (11)	. . .	. . .	103	. . .	20.2
Milk, kg	Bal et al. (2)	99[b]	100[ab]	. . .	102[a]	32.7[ab]
	Harrison et al. (11)	. . .	. . .	107[c]	. . .	20.1[d]
Milk fat, %	Bal et al. (2)	102	101	. . .	97	3.52
	Harrison et al. (11)	. . .	. . .	94[g]	. . .	3.91[f]
Fat yield, kg	Bal et al. (2)	102	99	. . .	99	1.15
	Harrison et al. (11)	. . .	. . .	101	. . .	0.78
Milk protein, %	Bal et al. (2)	100	100	. . .	101	3.48
	Harrison et al. (11)	. . .	. . .	98	. . .	3.55
Protein yield, kg	Bal et al. (2)	99[d]	99[d]	. . .	104[c]	1.13[d]
	Harrison et al. (11)	. . .	. . .	106[h]	. . .	0.70[i]
Starch intake, kg	Bal et al. (2)	81	92	. . .	100	9.0
	Harrison et al. (11)	. . .	. . .	100	. . .	4.4
Total tract starch digestibility, %	Bal et al. (2)	107[e]	106[cd]	. . .	105[d]	88[e]
	Harrison et al. (11)	. . .	. . .	110[c]	. . .	87[d]

[a,b]Values within a row differ ($P < 0.07$).

[c,d,e]Values within a row differ ($P < 0.05$).

[f,g]Values within a row differ ($P < 0.01$).

1.Why? Digestibility

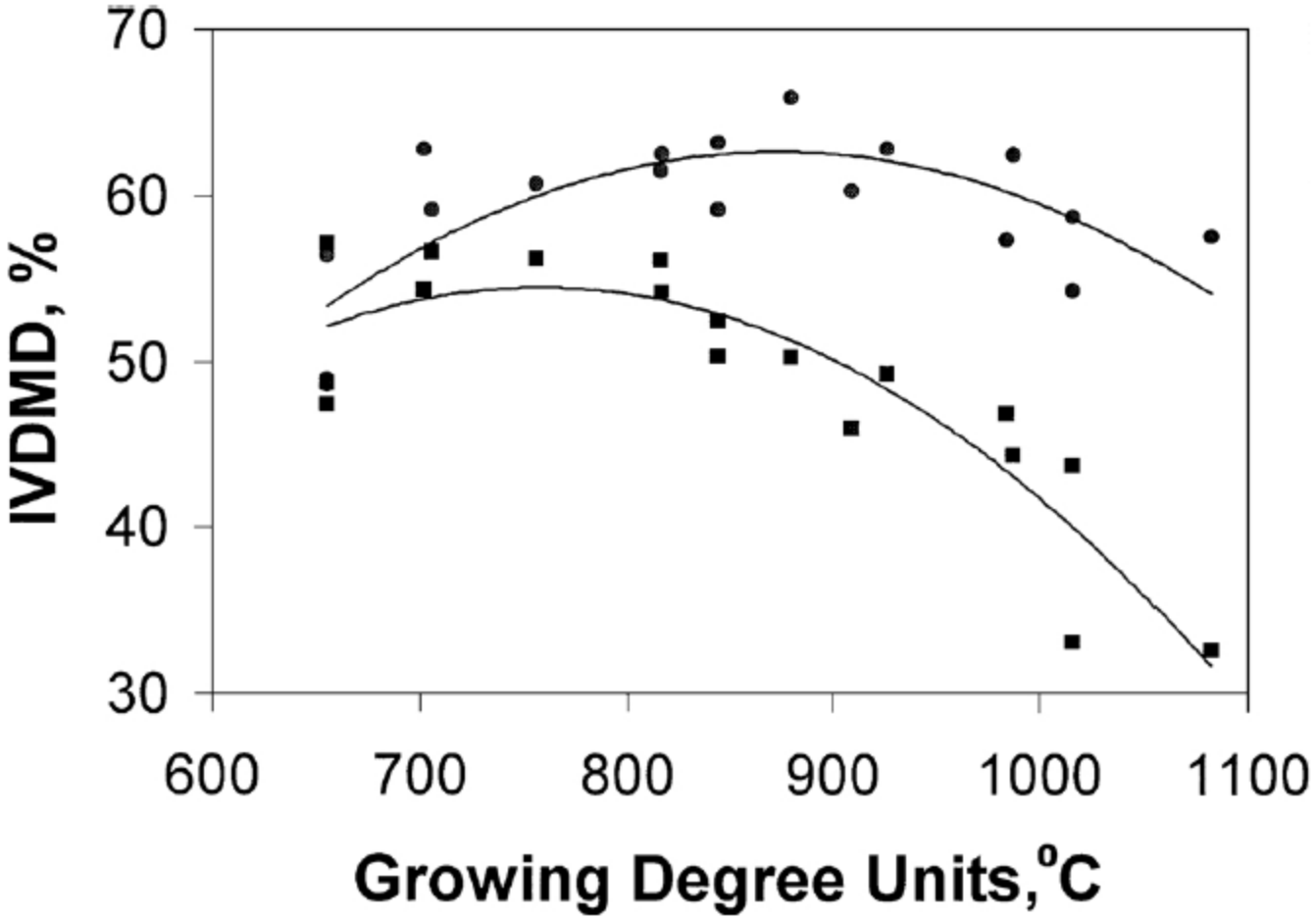


Figure 1. The effect of growing degree units on whole plant (●) and stover (■) in vitro DM digestibility. Whole plant, $Y = -0.0002x^2 + 0.3415x - 86.40$, $r^2 = 0.5621$. Stover, $Y = -0.0002x^2 + 0.3309x - 71.032$, $R^2 = 0.8055$. Adapted from Xu et al. (42).

1.Why? Digestibility

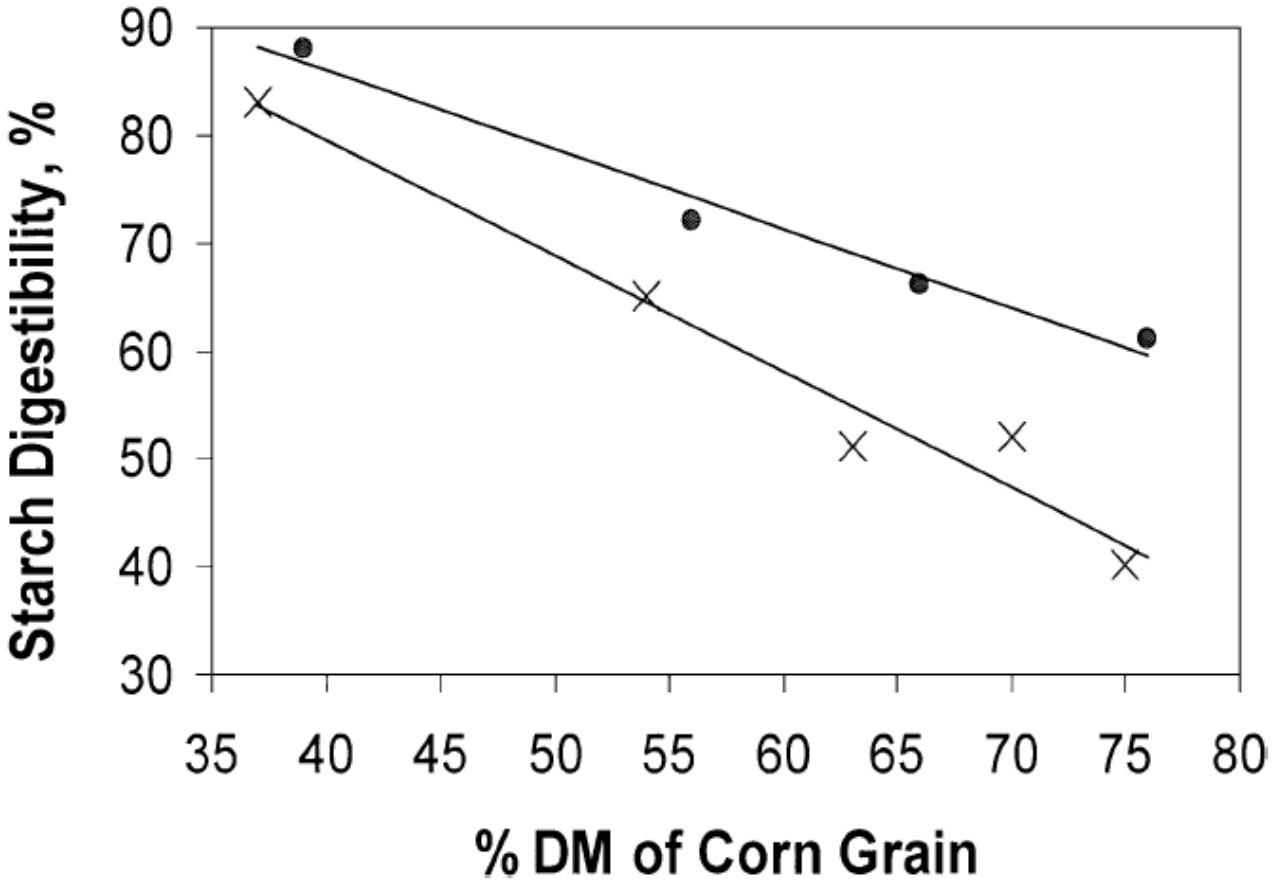


Figure 2. The effect of DM content of corn grain on in situ ruminal starch digestibility. Legend: Dent (●), and Flint (X). Equations: Dent, $Y = -0.7349x + 115.29$, $r^2 = 0.977$, Flint, $Y = -1.0768x + 122.59$, $r^2 = 0.9624$. Adapted from Philippeau and Michalet-Doreau (28).

1.Why? Digestibility

Table 4. Effect of harvest stage on yield and quality of corn silage.

Maturity stage	Moist	DM yield tons/Ac	CP %	NDF %	Digestibility %
Early dent	73	5.6	9.9	48.0	79.0
½ milkline	66	6.3	9.2	45.1	80.0
¾ milkline	63	6.4	8.9	47.3	79.6
No milkline	60	6.3	8.4	47.3	78.6

Source: Wiersma and Carter, University of Wisconsin, 1993.

1.Why? Silage quality

Target 30-35% DM

Too Early < 29%

Low starch
Acetic acid > 4%
Ferment acids >10%
Seepage

Too Late >36%

Starch Digestibility
Acid Production low
Yeast inhibition
Packing

2. When?

Squeezing
Milk line
Plant Growth
Dry Matter

2. When? Squeezing

?

2. When? Milk line

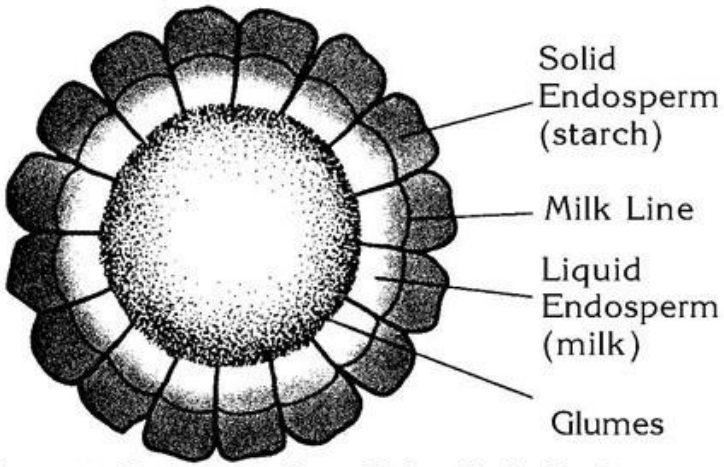
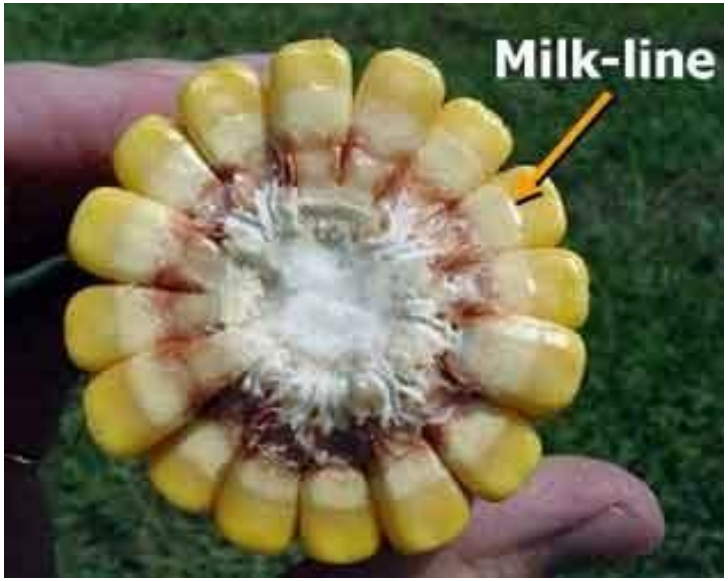
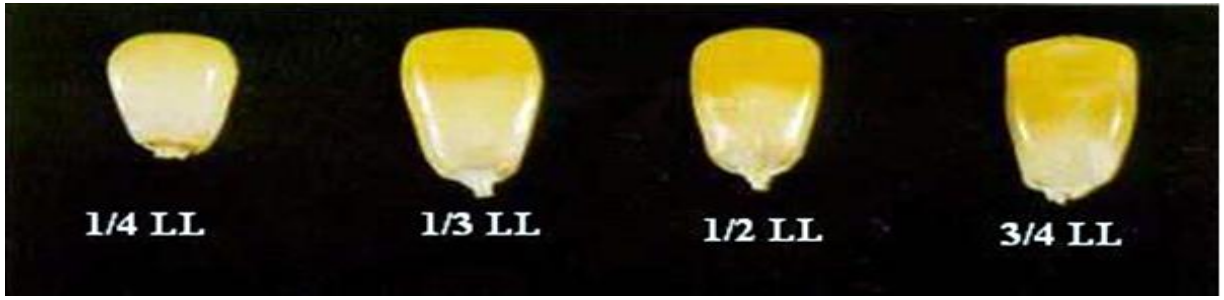
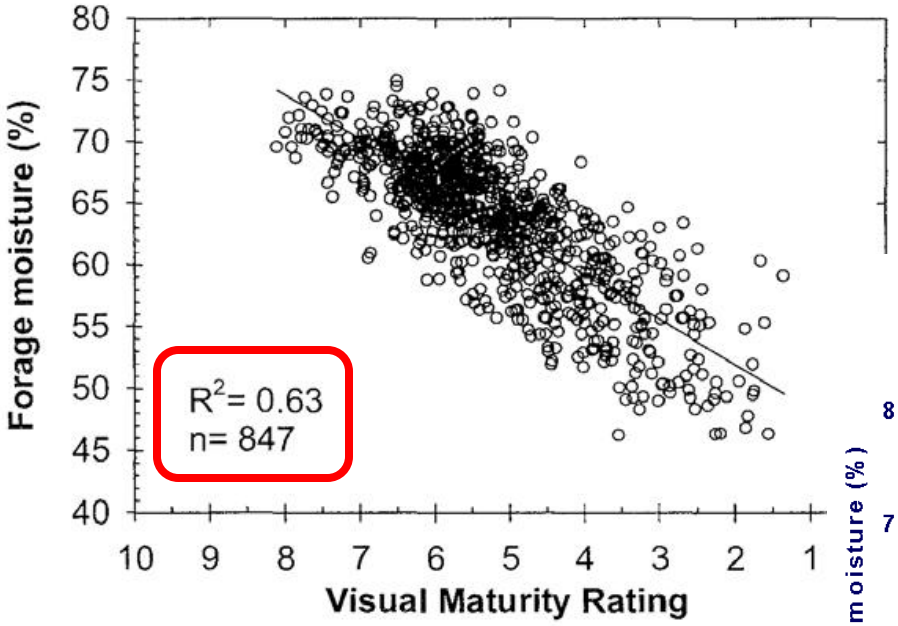


Figure 2. Cross section of the tip half of a corn cob showing milk line progression down the kernel.

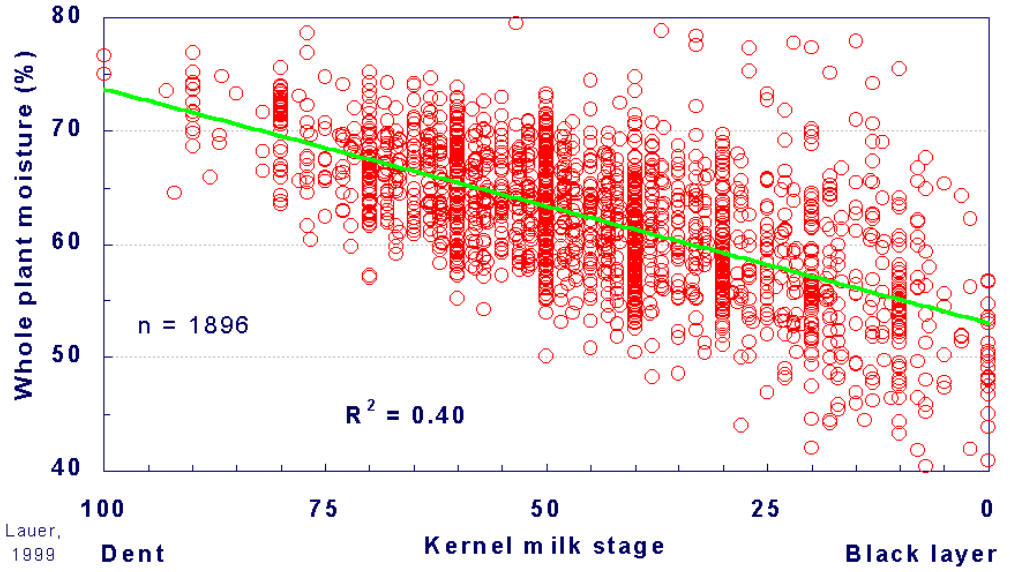




2. When? Milk line



Relationship between forage moisture and kernel milk stage (1990 - 1999)



Low correlation between milk line and Dry Matter Content (Lauer 1999, 2006).

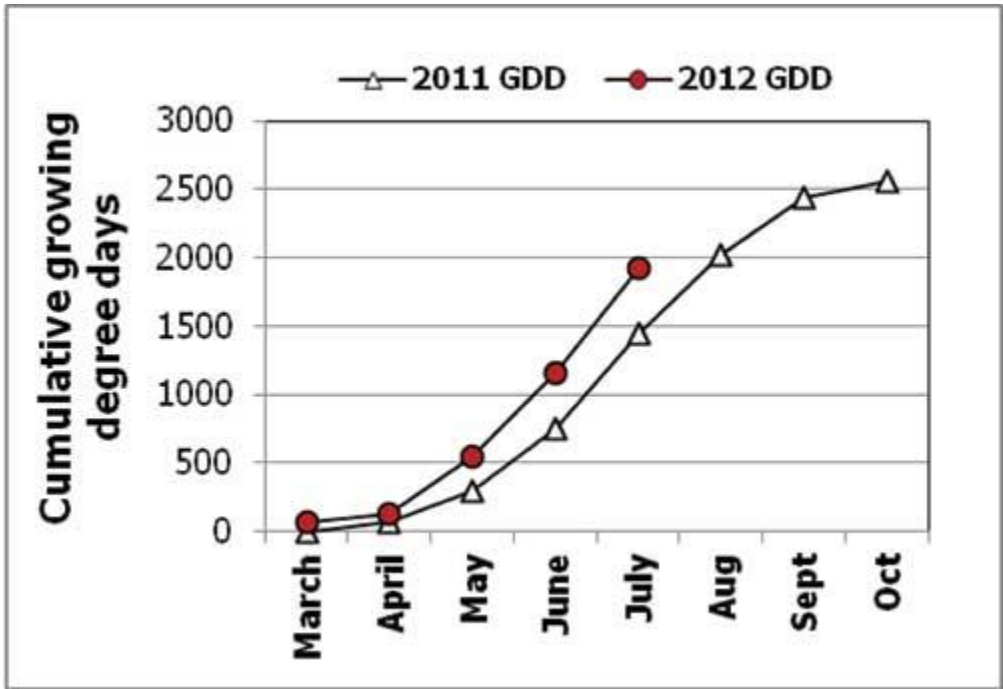
2. When? Plant Growth = days to tasseling, silking growing degree days

Harvest Guidelines:

- **Approximately 95-115 days after seeding**
- **After dent, dry down is 0.5-0.6% /d, above 40% DM dries faster**
- **Dent = 35-42 d after silking**

GDD = (Tmax-Tmin)/2- 50;
Tmax<86, Tmin>50

95-115 d = 2250-2500 GDD



2. When? Plant Growth

But still need to measure DM to time harvest

2. When? Dry Matter

	Harvest stage	%DM
Corn Silage	1/2-2/3 milk line	32-38
Bunker		33-35
Bags		33-37
Cereals	boot-dough	35-45
Grasses	boot	35-45
Alfalfa	bud-1/10 bloom	35-45

3. How? Sampling

(Thomas and William)

1)Take a representative sample, 10-20 plants per field

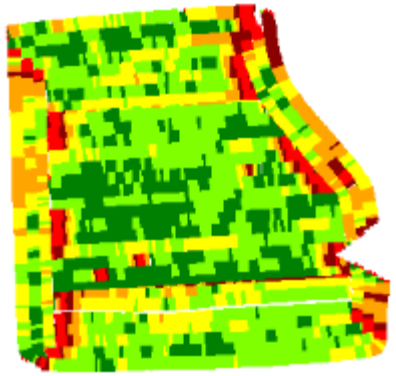
2)Hand feed the plant to a chopper, 3) Take a representative sample of the chopped material, keep cool

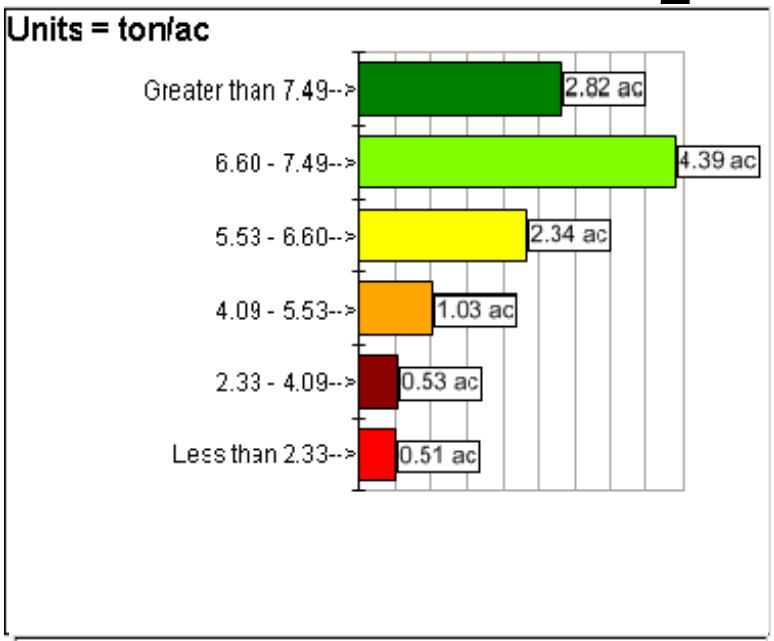
4)Use approximately 100 g for microwave oven for 40s or 200g for Koster tester Subtract 2%

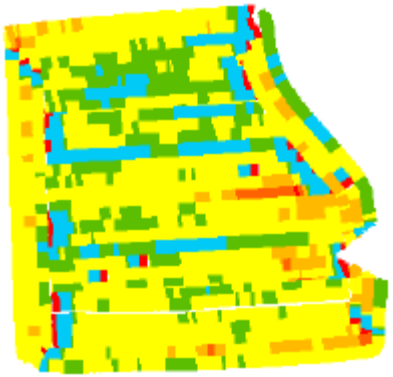
3. How? NIR Field Maps

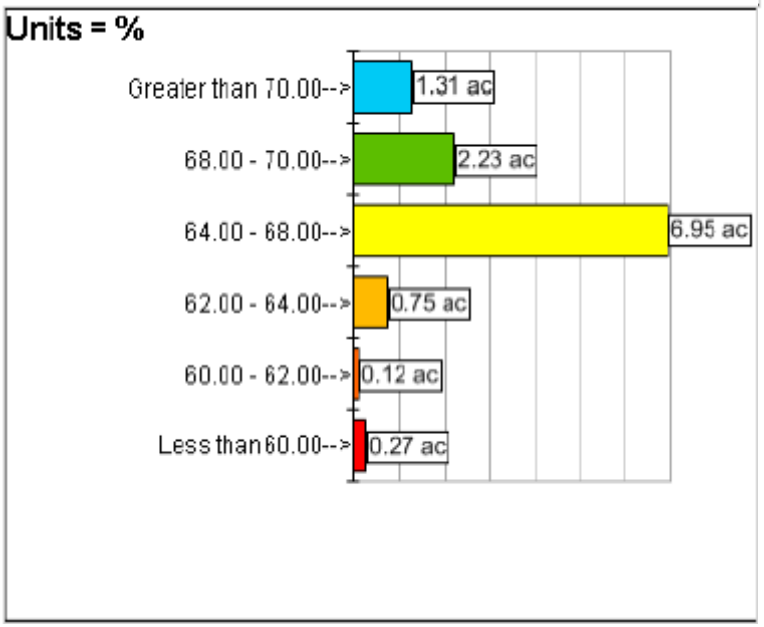
JOHN DEERE

HarvestLab









Why?

Balance nutrient content, digestibility, yield and fermentative capacity.

When?

Start DM measurements at milk, early dent, silk (40d to dent), GDD (silk 1300-1400, harvest ~800)

How?

Dry Matter!, representative sample