

HARVESTING SILAGE CORN AT THE OPTIMUM TIME

Roger Vinande¹

ABSTRACT

Corn silage and how it is harvested can have a significant impact on the profitability of the main partners involved in the enterprise. Dairy producers, silage growers and silage harvesters all have a financial interest in when a particular field should be harvested. This paper gives some suggestions for deciding when to harvest corn silage and some background on the ramifications of corn silage maturity on silage nutritional value.

INTRODUCTION

Many observers relate that the “first truck loads are the heaviest.” Historically, silage harvest starts earlier than may be necessary and finishes too late. This results in corn silage that may be too wet with low grain content at the beginning and too dry with large amounts of grain at the end. The final objective of a corn plant is to fill its kernels. Once grain fill begins there are essentially no changes in the amount of stover (all the green parts of the plant). Although the nutritional quality of the stover may decline with advancing maturity, this is overshadowed by the impact of increasing grain content in the plant. As a consequence the dry matter yields and nutritional quality increase with advancing maturity.

METHODS USED TO SCHEDULE CORN SILAGE HARVEST

1. **CALENDAR DAYS FROM PLANTING.** Corn development progresses according to heat unit accumulation. So the calendar days from planting to harvest maturity will vary from location to location, year to year and date of planting because of air temperature differences which influence heat unit accumulation. A “110 Day” hybrid in Visalia will be a “115 Day” hybrid in Modesto because of higher daily temperatures in the Visalia area. Calendar days from planting to harvest maturity can vary from year to year in a given location because of growing season heat unit differences. For example July 2005 was much hotter than July 2004 – in Modesto a “115 day” hybrid planted on May 15th could be chopped at the same maturity five days earlier in 2005 than in 2004.
2. **KERNEL MILK LINE.** For most storage structures in the western United States, the ideal moisture is between 65 and 70%. In most cases, this would correspond to plant maturity of between 1/2 to 2/3 starch line in the kernel. Two reasons to manage for target moisture between 65% and 70% are:

¹ R. Vinande, Ph.D., Agronomist, Pioneer Hi-Bred International, Inc., Modesto, CA; Email: Roger.Vinande@pioneer.com **In:** Proceedings, California Alfalfa and Forage Symposium, 12-14 December, 2005, Visalia, CA, UC Cooperative Extension, Agronomy Research and Extension Center, Plant Sciences Department, University of California, Davis 95616. (See <http://alfalfa.ucdavis.edu> for this and other proceedings.)

- Ease of excluding oxygen from the structure.
- Near maximum starch fill in kernels.

One field indicator for determining when corn silage is at the proper stage of maturity for harvest is using the kernel starch line method. The best procedure to follow for this method is:

- a) In several locations in your field pick 10 or more typical ears.
- b) Break the ears in the middle and look at the tip end of the ear. (It is more difficult to see the starch line on the butt end of the ear.)
- c) If starch deposition has been initiated, you should see a visible line. This is the starch line.
- d) Starch is deposited from the top of the kernel, towards the cob. The closer the starch is to the cob, the more advanced the maturity of the plant.
- e) Although starch line is usually visible, the most accurate way to determine starch line is to cut the kernel lengthwise and observe the starch deposited in the kernel. The actual starch line is often advanced beyond the visible starch line.
- f) You may also use the “bite-test.” Begin biting the kernel from where it attaches to the cob and slowly work your way up. As you begin, the kernel contents should be milky. At some point you will notice a firmer texture. The amount of kernel above the firm layer indicates starch line.

While visible dent is often used as an indicator of silage maturity, differences between hybrids and types of hybrids limit this techniques reliable use. Hybrids showing visible dent can range from 1/8 starch line to full physiological maturity. Some genotypes of hybrids do not show visible dent during starch deposition.

Kernel milk line is not always a good indicator of whole plant moisture. Some hybrids will mature grain at a faster rate than their stover matures. Growing conditions further complicate the reliability of totally relying on kernel milk line to schedule corn silage harvest. My suggestion is to use the kernel milk stage as a “trigger” to start checking moisture.

3. ***HEAT UNIT ACCUMULATION.*** Consistent, high quality corn silage is achieved when corn is harvested at the same moisture and grain maturity. Long-term heat unit or Growing Degree Unit (GDU) data will help silage growers reach consistency goals at harvest. Although corn maturity is determined genetically, air temperature is the primary factor that influences rate of growth. All hybrid corn maturity rating systems are related to air temperature. A corn plant requires a certain amount of heat to reach maturity and that total quantity of heat is relatively constant for a given hybrid. A numerical value is assigned for the amount of heat accumulated each day by using the GDU system. The heat unit formula for corn is:

$$\frac{\text{Daily High} + \text{Daily Low}}{2} - 50 = \text{Daily GDU Accumulation}$$

Both the daily high and low in the formula have restrictions. Corn stops growing at temperatures below 50 degrees F and the historical formula limits the daily high to 86 degrees F. In California where we have sunny days, low humidity, full irrigation and fertile soils I prefer to cap the maximum temperature at 95 degrees F. Observations at our Woodland, CA research station have verified my observations. Thus, when the daily high exceeds 95 degrees F, use 95 in the formula. When the daily low is below 50 degrees F, use 50 in the formula.

Example:

Daily High	97 °F (use 95 in formula)
Daily Low	59 °F (use 59 in formula)
$[(95+59) \div 2] - 50 = 27$ GDUs	

You can gain access to GDU data through the Internet. Table 1 shows some Internet sites to find GDU data for California and Arizona. Other sites or more current addresses can be obtained via search engine or state agriculture departments.

Table 1. GDU Data Available on the Internet

State	Internet Address
Arizona	http://ag.arizona.edu/azmet/.html
California	http://www.ipm.ucdavis.edu/WEATHER/ddretrieve.html

One means of describing maturity for a hybrid is silage Comparative Relative Maturity (silage CRM). Since we know the approximate GDUs it takes for a hybrid of a given silage CRM to reach maturity, Table 2 shows the approximate GDUs to 1/2 milk line for hybrids in increments of five silage CRMs.

Table 2.

Silage CRM	Approximate GDUs to 1/2 Starch Line
120	2,650
115	2,550
110	2,450
105	2,350
100	2,250
95	2,150
90	2,050
85	1,950
80	1,850
75	1,750

- CORN SILAGE MOISTURE TESTING.** Accurate moisture testing of corn silage is critical. Because of the nature of corn silage and the fact that 100 gram samples are

frequently used, it is recommended that triplicate samples be dried and the values averaged to determine moisture content. There are several methods to accurately test forages for their moisture content and all require forages be dried to zero percent moisture. These include drying ovens, microwave ovens and Koster testers. The key to an accurate test is taking a true representative sample and utilizing consistent techniques when handling and weighing samples.

Small errors in moisture testing can have significant impact on adjusted yields. A 2% mistake in moisture determination translates to more than 2% difference in yield. If actual yields were 34 tons at 30% dry matter (70% moisture), the actual dry matter yield would be 10.2 tons. If through poor sampling procedures or poor moisture determination techniques we obtain an erroneous value of 28% dry matter, this incorrect value would lead us to calculate we harvested only 9.5 tons of dry matter. In this example, our 2 percentage unit error in dry matter determination represents a 6.8% error in yield.

	Actual	2-Unit Error	4-Unit Error	6-Unit Error
Moisture	70%	72%	74%	76%
Wet Yield (Tons)	34	34	34	34
DM Yield	10.2	9.5	8.8	8.2
Adjusted Yield (70%)	34	31.7	29.5	27.2

An accurate scale is the most important piece of equipment to determine moisture content of corn silage. It is easiest to work in grams so an accurate gram scale is the best. Be sure to calibrate the scale frequently to ensure its accuracy. The best scales to use are electronic scales or balances. Electronic digital gram scales are widely available. Make sure that the sensitivity is 0.1 gram or greater at 100 grams.

In the three methods below, remember to weigh, dry and average triplicate samples.

Using a Microwave:

- Weigh out 100 grams of silage and place in the microwave on a paper plate.
- Place a cup of water in the microwave to prevent damage from excessive heat buildup during the drying process.
- Heat the sample on high for four minutes.
- Remove the sample from the microwave, weigh and record the weight. Stir the sample on the plate and replace in the microwave. Heat for one minute on high.
- Repeat the procedure using only 30 second intervals until the weight of the sample does not change for three consecutive intervals.
- Be careful not to overheat the sample to the point where it chars. This may give inaccurate results.
- Since power outputs of microwaves vary, adjustments to the recommended time intervals may be necessary.
- To calculate the moisture percentage, subtract the last weight from the original weight. This is the moisture content of the sample. If you used a sample weight different than 100 grams, use this formula:

$$\{(Initial\ Weight - Final\ Weight) \div Initial\ Weight\} \times 100 = \% \text{ Moisture}$$

Using a Koster Tester:

- To use a Koster tester weigh 100 grams of silage and place it in the tester.
- Turn tester on for 20 minutes and reweigh sample.
- Record weight and place sample in tester for another five minutes.
- Weigh and record.
- Repeat the procedure until the weights are the same two times in a row.
- Use the above formula to determine moisture percentage.

Using an Electric Conventional Oven:

- Use the same procedures as the microwave oven, except use a noncombustible container for the sample.
- Place the samples in the oven at the lowest setting (around 150 degrees F) with the door open slightly. Make sure the oven racks are far enough away from the heating elements to prevent areas of overheating and charring.
- Depending on the number of samples, it may take four to eight hours to dry. Once the samples appear dry, begin weighing and recording weights every 30 minutes until the weights are the same two times in a row.
- Do not add wet samples to an oven with partially dry samples.

5. *WHEN BUYER SAYS IT IS READY TO CHOP.* Some dairies buying the corn silage dictate when it should be chopped.

6. *WHEN CUSTOM CHOPPER CAN GET THERE.* This isn't very scientific, but it was reality this year, in the southern San Joaquin Valley. Because of an unusually wet, cool spring many corn silage fields were planted in a narrow time frame when the rain stopped. Because many fields were ready to chop at the same time, custom harvesters had a difficult time chopping every field at its optimum maturity.

SUMMARY

There is no one "right" way of determining the optimum time to harvest silage. Utilizing some of the suggestions outlined in this paper should take some of the guesswork out of the process.