

Estimating Dry Matter Intake of Grazing Dairy Cattle

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Introduction

Knowing forage dry matter intake of lactating dairy cattle is critical for meaningful ration formulation. Determining this for cattle in a conventional system is a relatively easy task of simply weighing feeds. For dairy cattle on pasture it is much more difficult to measure. Recently, a study was conducted in Wisconsin to compare four different methods for estimating forage intake for dairy cows on pasture: clipping and weighing, a pasture plate, canopy height, and energy balance.

Study Design

Seven farms were sampled in each of 2003, 2004 and 2005. Yield was estimated using clippings, a pasture plate, and canopy height prior to and just after a grazing event. Intake could then be determined by subtracting the yield after grazing from the yield prior to grazing. Methods for determining pasture yield are described below.

Clipping and Weighing

Five 1.5 x 1.5 ft areas were clipped dried and weighed prior to a grazing event and again just after a grazing event. Sampling was increased to 10 in 2005. Total sample dates for the clipping method over the three years was 60.

Pasture Plate

The compressed height was measured with a pasture plate prior to each clipping. This allowed us to determine pounds of dry matter per inch for each clipping, which was used as a calibration for the pasture plate. Following that the plate was used to measure compressed height in 20 areas of the pasture prior to a grazing event and again after a grazing event. The compressed height was then multiplied by the average pounds of dry matter per acre per inch for that sampling to estimate pasture yield. Total sample dates for the plate method over the three years was 63.

Height

Non-compressed height was measured and multiplied by a constant 350 lbs dry matter per acre per inch. This value has been suggested as the average yield of a mixed pasture in good condition. Total sample dates for the height method over the three years was 65.

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Energy Balance

Intakes were estimated by a net energy balance where net energy intake from supplemental feed was known. Total energy output for maintenance and milk was also known. The difference was net energy provided from pasture intake. As net energy concentration of pasture was also known, we were able to calculate the amount of pasture intake required to provide the net energy difference between that from supplemental feeds and that exported in maintenance and milk. Energy balance was used to calculate intake for 58 dates over the course of the study.

How did the different methods compare?

A comparison of dry matter intakes estimated by each method is shown in Table 1. Using uncompressed height to estimate dry matter intake consistently produced the highest estimates and showed the greatest variability. These intake estimates are unrealistic and likely due to this method's failure to account for pasture density. This method could be improved by calibrating the ruler with clippings as we did for the pasture plate and/or by using different values for lbs of dry matter/acre/inch for residual measurements. Intake estimates would be more realistic, but the high variability makes this method the most unreliable.

The clipping method and the use of the pasture plate resulted in dry matter intake estimates that agreed closely with each other but showed significant variability both within and between years. In 2003 the clipping and plate methods estimated significantly lower DMI than the energy method. In addition the variability was much greater. In 2004 and 2005 the variability associated with these two methods was even greater. For example, in 2004 both the clipping method predicted a dry matter intake of 26.3 pounds however the variation associated with this method (± 6.7 lbs) means the actual value could be anywhere between 19.9 lb/day and 33 lbs/day. The values for the plate method were similar. This type of variability in forage dry matter intake estimates is too great to accurately balance dairy rations, and these two methods, while more accurate than height alone, should still be used with caution.

Table 1. Estimate of pasture forage dry matter intake by four different methods.

Method	2003	2004	2005
-----lbs/cow/day-----			
Clipping	12.0 \pm 4.1	26.3 \pm 6.7	15.5 \pm 8.6
Plate	13.4 \pm 3.2	27.2 \pm 6.9	16.2 \pm 5.0
Height	33.3 \pm 8.8	59.0 \pm 10.3	40.9 \pm 19.4
Energy	20.9 \pm 3.1	20.5 \pm 2.4	20.0 \pm 2.8

Which method was the most accurate?

The energy balance method provided the most consistent estimates between years and also showed the least variability. The estimates over the three years of the study varied by less than a pound. The 2004 dry matter intake prediction was 20.5 \pm 2.4 or between 18.1 lbs/day and 22.9 lbs/day, a much more acceptable range than the other methods compared. While this method requires more information to use, it also provides the most accurate estimates of a cow's actual dry matter intake.

What is involved in using the energy balance system?

To calculate pasture forage dry matter intake, the following measurements or estimates must be recorded and plugged into the energy balance equation:

1. The wet or as-fed weight of each stored and supplemental feed fed per cow daily.
2. The dry matter content of each stored/supplemental feed.
3. The NEL content of each stored/supplemental feed.
4. The average body weight of each cow grazing each day.
5. The average amount of milk produced per cow per day.
6. The average composition of the milk produced.

The first three items are used to calculate the amount of energy consumed per cow per day from feeds OTHER THAN pasture forage. The fourth item is needed to estimate the energy output per cow for maintaining her body weight. The fifth and sixth items are needed to calculate the energy output per cow in the form of milk. The more accurately these measurements are taken, the more accurate will be the estimate of forage dry matter consumed per cow per day.

The energy balance method described herein is simple enough to use by grazers, yet accurate enough to produce useful, reliable results. Further refinements in this method are possible in the future, if such refinements can improve accuracy without sacrificing practical application. The spread sheet used to estimate pasture intake with this method is located at www.uwrf.edu/grazing.

Estimating Utilization Percentage

Another useful offshoot of this study was the ability to use the before and after yield estimates to calculate a utilization percentage. This data is shown in Table 2. There were no significant differences between the three methods (energy balance method was not used as there is no before and after measurements). There was much less variability between methods and years than with the intake values. The average utilization percentage over all years and methods was 44.3%. As the height method is the easiest and quickest to use this data suggest this is a good method to determine the utilization levels of grazed pastures.

Table 2. Estimate of forage utilization by four different methods.

Method	2003	2004	2005
-----% Utilization-----			
Clipping	45.1	45.6	43.1
Plate	50.0	42.0	48.0
Height	43.0	42.0	42.0

Conclusion

This data has provided some important information in regard to dry matter intakes of dairy cows on pasture. Measuring height alone is not a reliable estimator of dry matter availability in pastures due to inflated values and high variability. Clipping and the use of pasture plates provided more realistic figures but variability is still high. While these methods may be useful in determining stocking rates or estimating grazing durations they are of limited usefulness in ration balancing. Utilization of the energy balance method provided consistent values with low variability. Thus this would be the preferred method for ration formulation. Any of the methods investigated except the energy balance method were useful in measuring percent utilization.