Estimating Pasture Forage Dry Matter Intake of Grazing Dairy Cattle

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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. There are four different methods for estimating forage intake for dairy cows on pasture: clipping and weighing, a pasture plate, canopy height, and energy balance.

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 determined 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.

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, the amount of pasture intake required to provide the net energy differencebetween that from supplemental feeds and that exported in maintenance and milk could be calculated. Energy balance was used to calculate intake for 58 dates over the course of the study.

Results. 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 was done for the pasture plate. Intake estimates would be more realistic, but the high variability makes this method unreliable when used to estimate dry matter intake.

The other three methods agreed closely with each other on average but not within individual years. The clipping method and 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, particularly when reported as a percentage of the average. These values were 34% for clipping and 24% for the plate compared with 15% for the energy method. In 2004 and 2005 the variability associated with these two methods was even greater. Even when considering the three year averages this variability was significant. For example, the use of the pasture plate estimated a three year average of 20.1; however, the variability associated with this figure means that, statistically, it could be as low as 16.4 or as high as 23.8. 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 be used with caution.

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. On average the variability was only 7.3%. While this method requires more information to use, it also provides the most accurate estimates of a cow's actual dry matter intake.

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

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

Estimating Dry Matter Intake with the Energy Balance Method

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.

Conclusion. These data have provided some important information in regard to dry matter intake 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 and thus 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.