Using the Plate Meters for Estimating Dry Forage Yield

April 2018

Priyanka A. Manjunatha
Doctorate Student

Alex Rocateli
Forage Systems Extension Specialist

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
facts.okstate.edu

Adequate fertilization, weed control and proper stocking rate are the three management pillars that set the foundation for a healthy pasture that will be productive for years to come. However, proper stocking rate is the foundation pillar that is neglected most of the time. There are some cases where forage managers invest in the best fertilizers and herbicides available in the market, believing that those products will turn their pastures highly productive overnight. In fact, those products will improve tame pastures' yield and quality, but only if the target forage can take advantage of those inputs. Overgrazed pastures due to high stocking rates deplete forage plants energy reserves, restricting new roots and shoot growth. Without a good rooting system, forages will not take up most of the applied fertilizes. Without good canopy growth, forages will not take over before the end of the effect of the herbicides. This is an aggravating scenario because from this point forward, weeds will start to grow aggressively taking up the applied fertilizers, and consequently, more herbicides need to be applied to control those mistakenly fertilized weeds. This unfortunate scenario would be avoided by simply using a proper stocking rate that allows forage plants to accumulate enough energy reserves for a vigorous root and canopy regrowth after grazing.

Proper stocking rates can be calculated using formulas that are available in the factsheet PSS-2871, "Stocking Rate: The Key to Successful Livestock Production." Taking a closer look at those formulas, one can realize that pasture dry forage yield is key for calculating stocking rate. There are several methods to estimate dry forage yield. The least labor-demanding method to estimate dry forage yield is via web-soil survey; however, this method is also the least accurate. The publication CR-2597, "Assessing Potential Forage Production" using the NRCS web soil survey shows how to estimate forage availability step by step in the comfort of your office. On the other hand, the direct method where pasture sections are clipped, dried and weighed is the most labor-demanding method, but this method has the highest accuracy of all. In between those two extreme methods, there are two indirect methods, such as the grazing stick and the plate meter, which are intermediate in labor demanding and accuracy. Those two methods are highly recommended due to simplicity and fair accuracy. The grazing stick method is fully described in the fact sheet PSS-2594, "Plan Grazing Management Using the Oklahoma Grazing Stick," and the smartphone GrazeOK available at App Store and Google Play can facilitate the grazing stick use. The plate meter method is the main topic of this fact sheet and the goals are:

- to describe in detail how the plate meter works,
- to demonstrate the proper way to take readings and
- to show how to estimate forage dry yield based on plate meter readings.

How does a plate meter work?

It may sound obvious, but a *plate meter* is mainly composed of a rounded *plate* which is most often metallic, and a *meter* stick which is inserted in the middle of the plate. When taking readings in a pasture, the plate lies on the top of the forage canopy gently compressing the leaves and stems to a height that supports the plate weight. This compressed height, i.e., where the plate crosses the meter stick, is our reading. This reading is converted to forage yield, based on mathematical correlations previously developed for different forage types. The estimated forage yield is then used for estimating proper stocking rate. The advantage of this measuring system is that the compressed height integrates forage height and canopy density into one reading. ***That saves time!*** Producers who use the grazing stick know that for accurate forage yield estimations it is necessary to measure not only the forage height, but also the laborious canopy cover. The plate meters already combine both of them in one reading.

Example: when taking compressed height readings with a plate meter in a spring oats pasture that has a consistent standing height of 8 inches, the compressed height readings will drop to 4 inches when the canopy cover is sparse, e.g., 50 percent. This reading variation occurs because there are fewer leaves and stems to support the plate's weight in sparse vegetation.

Types of plate meters

There are two types of plate meters:

The rise plate meter: plate will elevate from the mark zero from the measuring stick when inserted into the forage canopy.

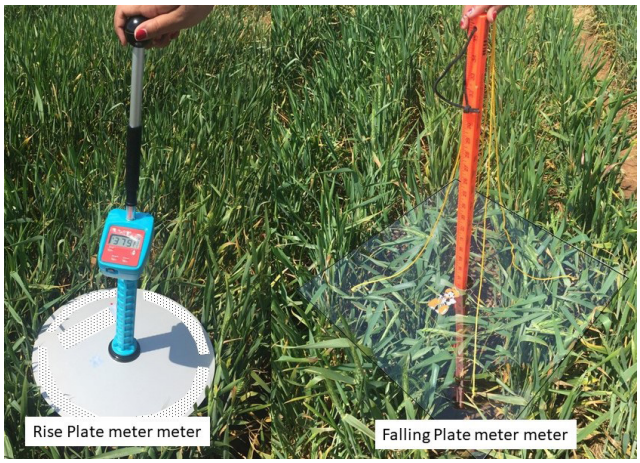

Figure 1. Rise and Falling plate meters.

The falling plate meter: plate will freely fall from a standard height hitting the forage canopy after that the measuring stick is vertically positioned into the canopy.

All existing plate meters fall into one of those two categories. Most of the "build it yourself" plate meters are the falling plate meter variety, thanks to it's simplistic mechanism of hanging the plate to the measuring stick. However, most of the commercial plate meters are rising types that require a little more engineering to make the readings fast. There are different plate meters to suit each person's pocket. The prices will increase, according to the number of add-ons, such as digital compressed height display, automatic data logging and built-in GPS.

Keep in mind

All plate meters follow the same principle, i.e., measuring compressed height. Therefore, types and brands can have the same accuracy level if properly handled. More add-ons will speed up reading collection time, saving labor.

Different plate meter brands may have different plate sizes and weight resulting in different compressed height and forage yield relationships. Always follow the tables, directions and conversion rates.

Collecting plate meter readings

Accuracy or number of add-ons do not matter if the equipment is not properly used. Improper use will result in inaccurate dry forage yield estimation. Know how to achieve accurate values:

1. ***The measured area needs to be somewhat uniform:*** Calling an area as "my pasture" does not mean that the area has the same forage all over. A good practice is to divide the pasture into sub-pastures (or paddocks) that contain the same forage species regardless of size. This practice is important because the plate meter conversion values are forage-specific. There is a conversion value for each forage type.
2. ***The plate meter readings must represent the measured area*:** Do not choose the reading spots. Never select the highest- or lowest-yielding spots because it leads to under- or overestimations. The main objective is to take enough readings from random locations that cover the whole pasture variability. It is recommended to take 20 to 30 compressed height readings per area. The higher the variability, the higher the number of readings. To achieve representative readings, take readings in a zig-zag (or W-pattern) fashion. Walk in-line and take readings at a regular pace – about every 50 or 100 steps, depending on the pasture size.

What if there is a water puddle at the 50th step?
Answer: Simply take the reading at 51st or 52nd step. Right before taking any reading, make sure that the selected spot represents the area. Water puddles, animal trails, dung, anthills or shaded areas are good examples of areas to be avoided. However, low or high productive spots are not. There is a "blurred line" between excluding unrepresentative spots and choosing preferential spots when taking readings.

3. ***Handle the plate meter properly*:** Come to a complete stop, hold the plate meter stick vertical to the soil, and allow the plate to lay freely at the top of the forage canopy. If using a commercial plate meter, refer to the manual for specific directions.

Common mistakes while doing readings are:
Taking the reading while still walking. This mistake is made frequently with commercial plate meters that automatically log the readings. Come to a complete stop, allowing the plate enough time to lay at the top of the canopy properly.
Holding the device handle bending forward. Tilting the stick will push the plate upward, resulting in forage overestimation. (Figure 2) illustrates this issue. Always keep the stick vertical to the soil.

Estimating forage availability from compressed heights

The compressed height readings are meaningless without proper conversion to forage yield. The conversion is made based on regression analysis of plate meter readings and forage samples collected at the same spot. Unfortunately, the conversions for the most common forages, such as bermudagrass are not currently available. The Oklahoma Forage System Program is currently working on this issue. For now, it is recommended to use the standard equations that come with any commercial plate meter. A study developed in the Southern Great Plains concluded that commercial rise plate meters could estimate cereal forages with fair accuracy (R^2 = 0.73, Mofey et al., 2012). If constructing your own plate meter, follow the instructions developed by Rayburn and Lozier (2003). The link is listed in the references section of this fact sheet. The average equation for estimating dry forage yield (DMY) using Rayburn and Lozier plate meter is:

DMY (lb./acre) = 432 x compressed height (inches)

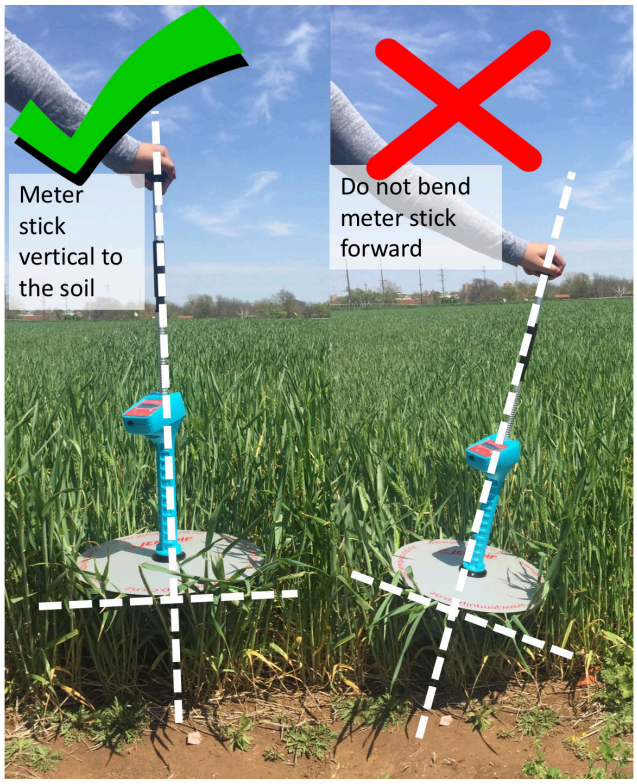

Figure 2. Right and wrong way of using plate meters.

Keep in mind that this equation is only valid for plate meters built following the specification described by Rayburn and Lozier. This equation is a one-fits-all type, but its accuracy should be good enough for a rough estimation. The hope is to have specifics and more accurate equations available to Oklahoma producers in the future.

References

Moffet C., R. Reuter, J. Rogers, J. Blanton. 2012. Using a plate meter to measure forage productivity. Accessed on April 22 2018. Available at https://www.noble.org/news/publications/ag-news-and-views/2012/june/using-a-plate-meter-to-measure-forage-productivity/.

Rayburn. E., J. Lozier. 2003. A falling plate meter for estimating pasture mass. . Accessed on April 22 2018. Available at https://ext.vt.edu/content/dam/ext_vt_edu/topics/agriculture/graze-300/Falling-Plate-Meter-For-Estimating-Pasture-Forage-Mass.pdf.

Case Study:

A producer opted for constructing his/her own plate meter following the Rayburn and Lozier specifications to estimate forage availability in his 60 acres pasture.

The first step was to assess the forage community in the pasture, the producer noted that the west side of the field was dominated by bermudagrass and the east side was populated by old world bluestem stands. Based on observations, he concluded that the pasture needed to be divided into two sub-pastures as illustrated in (Figure 3).

Figure 3. Forage community assessment.

The second step was to develop a reading collection plan for the east sub-pasture. Due to moderate variations in forage stands, he decided to take 25 readings every 75 steps in a zig-zag pattern. His reading plan collection is illustrated in (Figure 4).

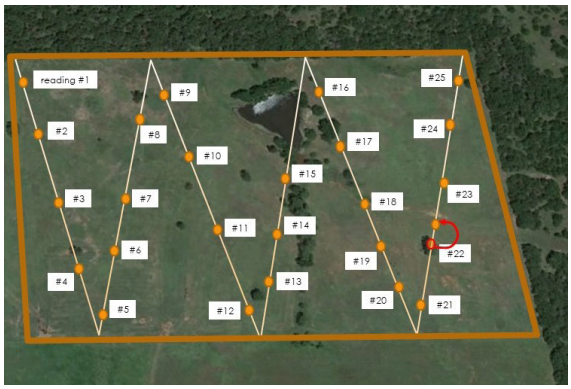

Figure 4. Reading collection plan.

The third step was to take each one of the 25 readings after a complete stop, holding the plate meter stick vertical to the soil, and allowing the plate lay freely at the top of the forage canopy. Reading #22 was spotted under a tree (shaded area), which is an unrepresentative spot; therefore the producer walked five steps forward and took the reading.

After all readings, the final step was to estimate the dry forage yield. The producer averaged all compressed heights readings resulting in 8.6 inches. Then, using the general Rayburn and Lozier equation (DMY = 432 x 8.6), he estimated 3,715 pounds of dry forage per acre which totaled 63.15 tons of forage available for the 34 acres. The following step could be the stocking rate calculation. For details on calculating stocking rates refer to factsheet PSS-2871, “Stocking Rate: The Key to Successful Livestock Production.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President for Agricultural Programs and has been prepared and distributed at a cost of 20 cents per copy. 0418 GH.