Assessing Needs and Feed Sources: How Much Forage Do I have?

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Why measure yield?

Pasture yield is the most important determinant of animal performance, yet is the most difficult to define and measure. Many of the important management decisions a livestock producer makes related to the management of the available forage resources. Knowing the forage dry matter yield of a given acreage is important in determining the productivity of the crop, purchasing or selling hay, making fertility and feeding recommendations, planning grazing schemes and adjusting stocking rates. It is important to take into consideration that the amount of forage produced per acre will vary significantly from one location to another. These variations are due to climatic changes, soil types, forage species, moisture, and management.

Is there enough forage growth to last for the remainder of the grazing season?

Pasture managers are always looking at alternatives that will allow extending the grazing season to improve livestock production. Accurate estimates of forage availability are often needed in determining carrying capacity, grazing intensity, and frequency. A number of methods have been used in determining available forage. Clipping and weighing of forage from a given area is the most accurate method but is time consuming, requiring drying and weighing of clipped forage. A falling plate meter has also has been used. The falling plate meter measures height of forage depressed with a weighted plate thereby taking density into account and improving accuracy. Measuring height of existing forage using calibrated rulers is usually an easy method but less reliable, because stand density can have an impact in biomass estimates.

Clipping, weighing, and drying method

This method is more accurate because a producer is measuring the dry matter in the pasture. Cut the forage from a known area (1 to 2 square ft.) at about 2 to 3 inches from the soil surface depending on forage species (**Fig. 1**). It is important to collect forage from several areas in the pasture to account for variation in vegetation. If the pasture is very uniform, three to four samples might be appropriate. In pastures with high variability in vegetation, it would be best to take eight to ten samples. Place each sample into a paper bag(s), weight it, and dry it in the paper bags in an oven at about 100-120 °F for one day or more. The dry weight will be used to determine the amount of forage dry matter per acre.

Using a conventional oven is time and energy consuming. It is recommended to use a microwave oven.

Figure 1. Clipping, weighing, and drying the forage biomass is the most accurate estimate of forage availability but not economical and time consuming.

Determining Forage Dry Matter Using a Microwave Oven

1. Weigh approximately 50 to 100 grams of chopped forage onto a microwave-safe dish or container. Heat the sample initially for two minutes, and then reweigh it.

2. If forage is not completely dry, reheat for 30 seconds and reweigh. Continue drying and weighing until back-to-back weights are constant. Be careful not to heat the forage to the point where it chars. If charring occurs, use the previous weight. Caution: Microwaves vary considerably in drying capacity. It is better to dry for short intervals and reweigh until the last two weights are constant than to run the risk of burning the forage and damaging the oven.

3. To calculate the moisture percentage, subtract the last dry weight from the original wet weight and divide this number by the wet weight. Now multiply by 100. This is the moisture content of the sample.

Example:

Original wet weight was 100 grams. Dry weight is 60 grams.
100 - 60 = 40
(40 ÷ 100) x 100 = 40.0% moisture and 60% Dry Matter (DM)

To determine the amount of forage based on dry matter percentage it is important to know the area of the square being used (1 or 2 square ft) and the total weight (in grams) of the sample collected in the square. Remember that a subsample will be used for determining the dry matter percentage.

Available Forage (lb/ac) = % DM * area * total sample weight (grams)

Available Forage using 1 ft^2,

Forage (lb/ac) = % DM * (43560/ac) * (total sample weight * 0.0022)

Forage using 2 ft^2,

Forage (lb/ac) = % DM * (21780/ac) * (total sample weight * 0.0022)

Example:
A forage sample was collected using a 1-ft^2 square and the weight of the sample was 200 grams. Fifty grams of the sample were dried and the dry weight was 32 grams. What is the amount of forage available?

First, calculate your moisture content = [(50 – 32)/50] *100 = 36% moisture. In this case the amount of dry matter is 64% (100 – 24).

Forage (lb/ac) = 0.64 * 43560 * (200 * 0.0022) = 12266.2 lb/ac or 6 ton/ac

Rapid pasture mass estimates

Producers need rapid methods for pasture mass estimation. These methods are less accurate, but their convenience far outweighs the reduced accuracy.

Falling plate meter:

There are different designs of plate meters that could be bought from manufacturers, but for a producer a falling plate meter could easily be constructed with materials that are available at the farm or could be readily purchased. Plate meters are generally made of sheet metal, plexiglas or acrylic plastic using a yard measuring stick. Some modifications have been made to the basic design to establish the effect of size and area weight on the performance of these meters.

The falling plate meter is made from 0.22-inch acrylic plastic sheeting cut in an 18-inch square. A 1.5-inch hole is cut in the center of the plate. A yardstick

is used for measuring the plate's height above the ground when it is set on the sward. In addition, 24 holes with 0.125-inch in diameter are drilled along five lines set at 3-inch intervals. Always start 3 inches from the plate's edge. Each hole is also spaced at 3-inch intervals along these lines. The yardstick is connected to the plate by using two or four of the small holes in the plate (**Fig. 2**) (Rayburn and Loizer, 2003).

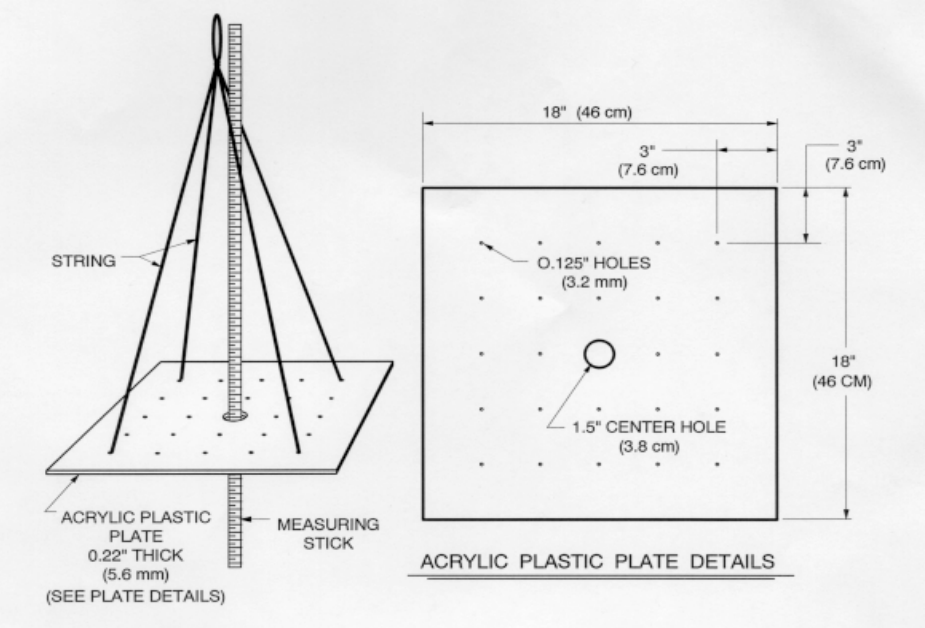

Figure 2. Falling plate meter schematic (Rayburn and Loizer, 2003).

Figure 3. Visual representation of using the falling/raising plate meter

To measure forage availability select random locations in the pasture where there is enough forage to support the plate. Measure the height of the plate's top above the ground (**Fig. 3**). Make sure that the plate is dropped from a constant height to reduce viability cause by the traveling velocity of the plate. Record the height of the pasture plate on the yardstick. It is important to measure several locations (at least 30) and obtain an average to get a good estimate of forage mass in the pasture. It is important that one person collects the data to avoid large variability. The following formula could be used to estimate dry matter yield (DMY) from pasture plate (Cosgrove and Undersander, 2001):

DMY (lb/ac) = 390 * Plate Height (in)

Plant height

Most producers usually do a visual evaluation and assume that the taller the pasture, the greater the yield. However, that is not always the case, because plant density also plays a major role in forage availability. Pasture height can be used to get a rough estimate of forage availability. It is commonly assumed that there is 200 lbs of dry matter yield per acre of inch of forage height. This rough estimate can vary approximately 50 lb/ac/in depending on the forage species and seasonality. **Table 1** gives an indication of some forage species productivity depending on stand condition.

Figure 4. Measuring canopy height.

Table 1. Average dry matter yields in pounds per acre (lb/ac) per inch for various forage species.

Forage Species	Yield (lb/ac/in)
Legumes	
Alfalfa	225
Annual Legumes	130
Arrowleaf Clover	200
Crimson Clover	200
Red Clover	220
Sericea Lespedeza	175
Cool Season Grasses	
Annual Ryegrass – Fall drilled	250
Annual Ryegrass – Fall broadcasted	170
Annual Ryegrass – Spring broadcasted	200
Orchardgrass	180
Orchardgrass - clover	200
Tall Fescue	210
Small Grains* – Fall drilled	150
Small Grains – Spring drilled	115
Warm Season Grasses	
Bahiagrass	285
Bermudagrass	260
Crabgrass	130
Dallisgrass	150
Native Warm Season Grasses	200
Mixed Pasture	180

*Small grains = rye, oats, wheat, barley, and triticale
Source: Noble Foundation Grazing School, 2007 (online); Ball et al., 2002

It is recommended not to graze pasture below 3 inches to allow a rapid recovery and reduce stand loss. If a pasture has 6 inches of growth, this means 3 inches are grazeable. It is estimated that there are 200 pounds (dry matter) of grass per acre-inch. On 50 acres, this represents 30,000 pounds of available forage per acre (50 acres times 3 inches times 200 lbs/acre/inch). It is safe to assume that harvest efficiency under continuous grazing is approximately 25 to 50%, but efficiency can increase in a rotational grazing system up to 75%. Thus, the livestock will consume only 15,000 pounds of forage. Estimated daily dry matter intake levels of various groups of livestock are shown in **Table 2**. Dairy cows require on average about 26 pounds of forage (dry matter) per day. Fifty cows eating 26 pounds of dry matter per day equals 1,300 pounds of total forage consumed daily. The available 15,000 pounds of forage to be consumed by 50 cows will last about 12 days (15,000 lbs. available in pasture / 1,500 lb. daily

consumption by herd). It is always recommended to use a management goal of 50%, meaning, “take half and leave half.”

The formula below calculates the approximate number of days that the pasture can support a specific group of animals:

$$\text{Days} = \frac{\text{Total Forage (lbs/ac) } \mathbf{X} \text{ \# Ac. } \mathbf{X} \text{ \% Grazing Efficiency}}{\text{Avg. Animal Wt. } \mathbf{X} \text{ Intake Rate (\% Body Weight) } \mathbf{X} \text{ Animal \#}}$$

Table 2. Estimated daily dry matter intake (DDMI) by various animals based on body weight.

Livestock	DDMI (lb)
Cattle	
Beef yearling steers – medium frame	21.6
Beef yearling steers – large frame	25.2
Beef yearling heifers – medium frame	21.6
Beef yearling heifers – large frame	25.2
Beef 2 yr heifers 800-1000 lb; mod milk	24.2
Beef 2 yr heifers 1000-1200 lb; mod milk	28.1
Beef 2 yr heifers 800-1000 lb; high milk	29.6
Beef 2 yr heifers 1000-1200 lb; high milk	32.8
Beef cows 900-1000 lb; moderate milk	26.0
Beef cows 1100-1300 lb; moderate milk	28.6
Beef cows 1300-1500 lb; moderate milk	31.0
Beef cows 900-1000 lb; high milk	28.6
Beef cows 1100-1300 lb; high milk	31.7
Beef cows 1300-1500 lb; high milk	34.8
Beef bulls	39.0
Dairy cows 1000 lb; 50% forage ration	20.0
Dairy cows 1300 lb; 50% forage ration	26.0
Dairy cows 1600 lb; 50% forage ration	32.0
Horses	
Horses – mature maintenance	24.3
Horses – mares mid-gestation	24.3
Horses – mares late-gestation	27.0
Horses – mares 1st 3 Mo. Lactation	32.4
Horses – mares late-lactation	29.7
Horses – weanlings 4-6 Mo.	13.5
Horses – weanlings 6-12 Mo.	18.9
Horses – Yearlings 12-18 Mo	21.6

Table 2. Cont.

Horses Cont.	
Horses – 18-24 Mo.	24.3
Horses – Light work	27.0
Horses – Moderate work	29.7
Horses – Heavy work	32.4
Horses – Stallions	29.7
Sheep	
Mature sheep – 150 lb	3.0
Ewes – winter lamb – 175 lb	5.5
Ewes – May lamb – 175 lb (140% lamp crop)	6.2
Ewes – May lamb – 175 lb (180% lamp crop)	6.8
Replacement ewe lambs – 80 lb	3.4
Replacement ewe lambs – 100 lb	4.4
Replacement ewe lambs – 120 lb	4.4
Mature Rams	4.0
Goats	
Mature doe with kids	5.9
Weaned kid to yearling	10.0
Mature buck	4.5
Donkey – 700 lb	21.0

Sources: Holechek et al., 2004; Banhart, 1998; and Sedivec, 1996.

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