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

Why Measure Yield?

Pasture yield is the most important influence on animal performance but is the most difficult to define and measure. Many of the decisions a livestock producer makes are related to the management of the available forage resources. Knowing the forage dry matter yield of your acreage is important when you make decisions about crop productivity, purchasing or selling hay, fertility and feeding, grazing schemes, and stocking rates. Remember that the amount of forage produced per acre will vary significantly from one location to another. These variations are due to climate changes, soil types, forage species, moisture, and management.

Ways to Measure Yield

Pasture managers are always looking for ways to extend the grazing season to improve livestock production. You need accurate estimates of forage availability to make decisions about carrying capacity, grazing intensity, and frequency. There are several methods to determine available forage. Clipping and weighing the forage in a given area is the most accurate method but requires you to dry and weigh clipped forage. Therefore, this method is time consuming. You can also use a falling plate meter. The falling plate meter measures the height of forage while it is depressed with a weighted plate. It takes density into account and is therefore more accurate than measuring the height. Measuring the height of existing forage using calibrated rulers is usually an easy method but is less reliable because it does not take stand density into account.

Clipping, Weighing, and Drying Method

This method is more accurate because you are measuring the dry matter in the pasture. Cut the forage from a measured area (1 or 2 square feet) about 2 to 3 inches into the soil surface depending on forage species (Figure 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, weigh it, and dry it. You can dry the sample in the paper bag in a 100–120°F oven for one day or more. However, oven drying is time- and energy-consuming; microwave drying is recommended. (See next page for details.) The dry weight will be used to determine the amount of forage dry matter per acre.

Figure 1. Clipping, weighing, and drying the forage biomass is the most accurate estimate of forage availability, but it is 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 for two minutes at full power. Reweigh it.
2. If forage does not feel completely dry, reheat it for 30 seconds. Reweigh it. 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 risk burning the forage and damaging the microwave.

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.

   moisture percentage =
   [(wet weight – dry weight) ÷ wet weight] × 100

Example:
Original wet weight was 100 grams.
Dry weight is 60 grams.
100 – 60 = 40
(40 ÷ 100) × 100 =
40% moisture and 60% dry matter (DM)

To determine the amount of forage based on dry matter percentage, you need to know the size of the collection area (1 or 2 ft^2) 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 × (43,560/ac) × (total sample weight × 0.0022)

Available forage using 2 ft^2:
Forage (lb/ac) =
% DM × (21,780/ac) × (total sample weight × 0.0022)

Example:
A forage sample was collected in a 1-foot square. The weight of the sample was 200 grams. Fifty grams of the sample were dried. The dry weight was 32 grams. What is the amount of forage available?

First, calculate your moisture percentage:
[(50 – 32) ÷ 50] × 100 = 36% moisture.
The percentage of dry matter is 64% (100% – 36%).

Forage (lb/ac) =
0.64 × 43560 × (200 × 0.0022) =
12266.2 lb/ac or 6 tons/ac

Rapid Pasture Mass Estimates

Producers need rapid methods for pasture mass estimation. These methods are less accurate but far more convenient.

Falling Plate Meter

There are different types of plate meters available for purchase, but you can make a falling plate meter from materials that are easy to find. Plate meters are generally made of a yardstick and sheet metal, plexiglass, or acrylic plastic. 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 in the figure below is made from 0.22-inch thick acrylic plastic cut into 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 turf. In addition, 24 holes with 0.125-inch diameters 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 using string attached to the holes in the corners of the plate (Figure 2).

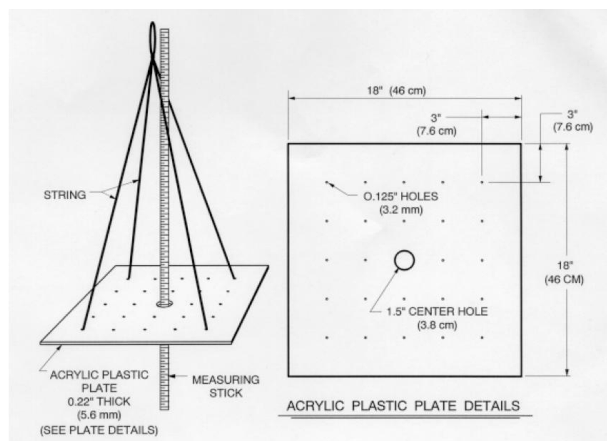

Figure 2. Falling plate meter schematic (Rayburn and Lozier, 2003.)

Figure 3. The falling/rising plate meter for estimating available forage in a pasture.

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 Drill	250
Annual Ryegrass: Fall Broadcast	170
Annual Ryegrass: Spring Broadcast	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

Sources: Noble Foundation Grazing School, 2007 (online); Ball et al., 2002

Figure 4. Measuring canopy height.

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
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.

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 (Figure 3). Make sure that the plate is dropped from the same height each time to reduce variability caused by the speed of the plate as it falls. Record the height of the pasture plate on the yardstick. It is important to measure several locations within the pasture (at least 30) and obtain an average to get a good estimate of forage mass in the pasture. It is important that the same person collect all 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 do a visual evaluation and assume that the taller the pasture, the greater the yield. However, that is not always the case; 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 pounds 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.

To allow a rapid recovery and reduce stand loss, do not graze pasture below 3 inches. This means that if a pasture has 6 inches of growth, 3 inches are grazeable. Assuming 200 pounds (dry matter) of grass per acre-inch, a pasture of 50 acres would give 30,000 pounds of total available forage (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 up to 75% in a rotational grazing system. Thus, the livestock will consume only 15,000 pounds of forage. You can find an estimate of the amount of dry matter different types of livestock eat per day on Table 2. Dairy cows require 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 15,000 pounds of forage available on the 50 acre pasture above would be consumed by 50 cows in about 12 days (15,000 lb available in pasture ÷ 1,300 lb daily consumption by herd). An ideal management goal is 50%: take half and leave half.

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

Days =
[total forage (lb/ac) × # acres × % grazing efficiency] ÷
[avg. animal wt. × intake rate (% body weight) × # animals]

References

Ball, D.M., C.S. Hoveland, and G.D. Lacefield. 2002. Southern Forages (3rd ed). Lawrenceville, GA: Graphic Communications Corp.

Banhart, S.K. 1998. Guide for year-round forage supply. Iowa State Univ. Coop. Ext. Service. PM 1771.

Cosgrove, D. and D. Undersander. 2001. Evaluation of a simple method for measuring pasture yield. Univ. of Wisconsin Coop. Ext. Serv.

Grazing Stick Instruction Manual. 2007. The Samuel Roberts Nobel Foundation. https://www.nrcs.usda.gov/wps/portal/nrcs/ia/technical/landuse/pasture/how+to+use+a+grazing+stick/

Holechek, J.L., R.D. Pieper, and C.H. Herbel. 2004. Range Management: Principles and Practices. Upper Saddle River, NJ: Pearson Prentice Hall.

Rayburn, E. and J. Lozier. 2003. A falling plate meter for estimating forage mass. West Virginia Univ. Coop. Ext. Serv.

Sedivec, K. 1996. Determining pasture rental rates. North Dakota State Univ. Coop. Ext. Serv. R-1092. http://www.ag.ndsu.edu/pubs/plantsci/hay/r1092w.htm.

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