TECHNICAL NOTES

A Simple Disc Meter for Measurement of Pasture Height and Forage Bulk

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Plot harvest (clipping) is the most commonly used technique to measure phytomass in range and pasture studies. Clipping, while generally considered the most accurate technique, is laborious and destroys a portion of the sward sampled. Much effort has been devoted to development of rapidly measured, nondestructive parameters from which phytomass may be predicted without the necessity of clipping plots. Both pasture height (Bakhuis 1960, Michalk and Herbert 1977, Whitney 1974) and forage bulk (Bransby et al. 1977, Powell 1974) have been employed successfully as predictors of pasture phytomass.

Pasture height is often measured with a ruler (Heady 1957) or a graduated reference board (Michalk and Herbert 1977) which is inserted into the sward. Whitney (1974), however, suggested that acceptable etimates of sward height could be obtained from a plastic lense which was lowered from above the stand until the leaf tips contacted the bottom of the lense. He reported that 94% of the variation in yield from each of two tropical grass pastures examined was explained by sward height.

Forage bulk refers to the volume of forage compressed beneath a plate of known weight (Bransby et al. 1977). It is measured by dropping a plate from a predetermined height above the soil surface, then measuring the height at which the plate comes to rest. The relationship between forage bulk and pasture phytomass yield generally has been strong. Correlation coefficients greater than 0.90 often have been reported (Alexander et al. 1962, Bransby et al. 1977, Castle 1976, Powell 1974, Santillan et al. 1979, Shrivastava et al. 1969). Because forage bulk is a measure of "compressed volume" of forage, it integrates both sward height and density into a single, three-dimensional quantity. This is believed to explain its value as a predictor of phytomass yield (Alexander et al. 1962, Michalk and Herbert 1977).

Apparatus used to measure forage bulk have ranged from cardboard boxes (Shrivastava et al. 1969) and pieces of plywood (Alexander et al. 1962) to elaborate mechanisms which employ counters and gears to automatically determine and record the resting height of a metal plate (Earle and McGowan 1979). Most numerous of all, however, are "disc meters" employing circular plates constructed from wood (Baker et al. 1981) or metal (Castle 1976, Powell 1974, Santillan et al. 1979). These devices, while generally useful to determine forage bulk, may not be used to measure sward height.

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The purpose of this paper is to describe a simple, inexpensive disc meter which measures both forage bulk and sward height for prediction of phytomass yield.

Disc Construction

The forage disc meter was constructed entirely of clear acrylic plastic material. Acrylic plastic was chosen for its weight, optical clarity, durability, availability, and the ease with which it could be worked. A 3.8-cm hole was drilled in the center of a 50-cm diame

ter, 5-mm thick acrylic plastic disc. A 15-cm section of tube with a 3-mm wall thickness served as a handle (Figure 1). The handle was inserted into the disc and glued flush with the bottom edge. A 5.5-cm × 6-mm thick square with a 3.8-cm hole drilled in its center was slipped over the handle and glued to the disc to strengthen the handle. The finished disc was 0.2 m^2 in area and weighed 1.1 kg. Its weight/area, 5.5 kg/m^2, was similar to the 5.9, 4.6, and 5.0 kg/m^2 of plates successfully used by Santillan et al. (1979), Baker et al. (1981), and Earle and McGowan (1979), respectively. Fabrication can be completed in approximately two hours. Current cost of materials is about $15.00.

Measurement Procedure

Sward canopy height and forage bulk are measured by use of a meter stick inserted into the handle of the disc meter (Figure 1). Canopy height is determined by lowering the disc along the meter stick until the uppermost leaves of the canopy are contacted by the disc. Height can then be read directly off the meter stick. To measure forage bulk, the disc is raised until the top of the handle is flush with the end of the meter stick. The disc is then released and its resting height read from the meter stick. For convenience, resting height may be read from the top of the handle rather than from the bottom of the plate and the reading adjusted accordingly. Calibration of the disc meter is accomplished by harvesting all forage within a 0.2 m^2 circular plot which is placed over the disc once height and/or forage bulk have been recorded. Least squares regression procedures are used to develop a predictive equation relating height or forage bulk to the yield of harvested plots. I determined new predictive equations for each pasture type and sampling date. However, several authors (Earle and McGowan 1979, Michell 1982) have observed that disc calibration is quite stable over time, suggesting that less frequent calibration is required.

The forage disc meter described here has been routinely used for pasture measurements in western Oregon since 1978. No maintenance has been required. Once calibrated, measurements of sward canopy height or forage bulk may be obtained using the disc in approximately 15 seconds compared to the 6 minutes generally required to clip a 0.2-m^2 plot. Coefficients of determination between either forage bulk or sward height and sward phytomass yield generally ranged between 0.70 and 0.90 (Table 1). Where considerable soil surface micro-relief occurred, however, the meter gave eratic readings. Reliable estimates of phytomass were not obtained when this occurred on swards which were low in height. This proved to be especially problematic on annual grass pastures during the winter when both sward height and phytomass were relatively low.

Table 1. Coefficients of determination (r^2) between sward phytomass yield and sward height or forage bulk obtained from examination of n 0.2 m^2 areas for three pastures.

Date	Pasture type	n	r^2 Height	r^2 Forage bulk
5 Dec. '78	Grass-subclover[1]	20	0.90	0.79
9 May '80	Grass-subclover[1]	30	0.72	0.70
29 May '80	Oat field[2]	30	0.86	0.91

[1]Primarily *Agrostis tenuis, Lolium perenne,* and *Trifolium subterraneum.*
[2]Commercial oats *(Avena sativa)* in the soft dought phenological stage.

Literature Cited

Alexander, C.W., J.T. Sullivan, and D.E. McCloud. 1962. A method for estimating forage yields. Agron. J. 54:468-469.

Bakhuis, J.A. 1960. Estimating pasture production by use of grass length and sward density. Neth. J. Agr. Sci. 8:211-224.

Baker, B.S., T.V. Eynden, and N. Boggess. 1981. Hay yield determinations of mixed swards using a disc meter. Agron. J. 73:67-69.

Bransby, D.I., A.G. Matches, and G.F. Krause. 1977. Disc meter for rapid estimation of herbage yield in grazing trials. Agron. J. 69-393-396.

Castle, M.E. 1976. A simple disc instrument for estimating herbage yield. J. Brit. Grassld. Soc. 31:37-40.

Earle, D.F., and A.A. McGowan. 1979. Evaluation and calibration of an automated rising plate meter for estimating dry matter yield of pasture. Aust. J. Exp. Agr. Anim. Husb. 19:337-343.

Heady, H.F. 1957. The measurement and value of plant height in the study of herbaceous vegetation. Ecology 38:313-320.

Michalk, D.L., and P.K. Herbert. 1977. Assessment of four techniques for estimating yield on dryland pastures. Agron. J. 69:864-868.

Michell, P. 1982. Value of a rising-plate meter for estimating herbage mass of grazed perennial ryegrass-white clover swards. Grass and Forage Sci. 37:81-87.

Powell, T.L. 1974. Evaluation of weighted disc meter for pasture yield estimation in intensively stocked dairy pasture. N.Z. J. Exp. Agr. 2:237-241.

Santillan, R.A., W.R. Ocumpaugh, and G.O. Mott. 1979. Estimating forage yield with a disc meter. Agron. J. 71:71-74.

Shrivastava, J.P., D.A. Miller, and J.A. Jackobs. 1969. Estimating alfalfa yields. Agron. J. 61:649-651.

Whitney, A.S. 1974. Measurement of foliage height and its relationship to yields of two tropical forage grasses. Agron. J. 66:334-336.