USING A RISING PLATE METER

to Measure Pasture Mass

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EXTENSION

No matter what business or process one is managing, the success of that management depends on regularly measuring and monitoring performance. Pasture management is no different. Employing the "three Ms" of the management cycle (Figure 1) —measure, monitor, and manage—is crucial to success in management-intensive grazing systems. Increasingly, management-intensive grazing systems are being employed in the Southeast U.S. by livestock producers who are focused on being more efficient with their forage production. One of the most important management needs for these producers is the regular measurement of their pasture growth.

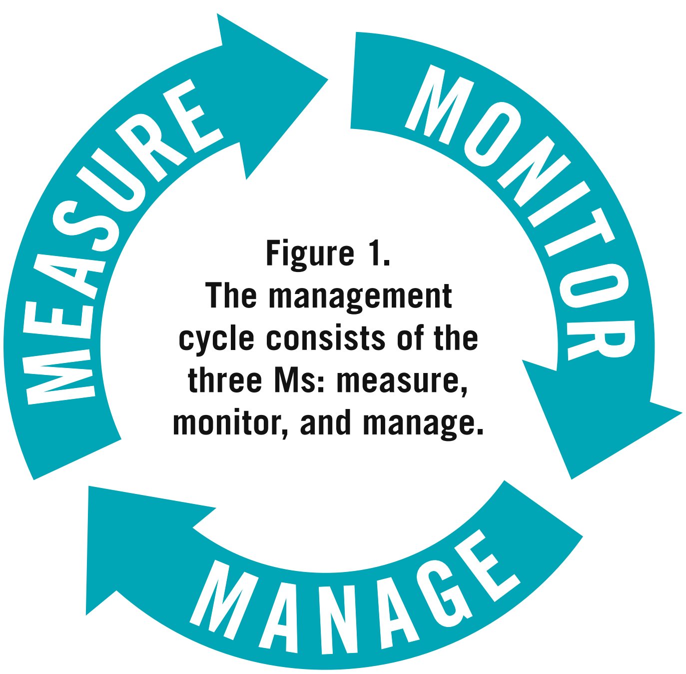

Figure 1. The management cycle consists of the three Ms: measure, monitor, and manage.

The goal of this publication is to introduce and provide real-world calibration sets for the rising plate meter (RPM), a tool used for measuring pasture mass (Figure 2). Using the RPM on a walk through one's pasture can provide a measurement of forage mass within each paddock. Regularly doing so will provide a database that enables one to monitor the forage growth in the short term and, over the long term, identify forage production patterns at the farm level and within individual paddocks.

Figure 2. An electronic rising plate meter (left) can be used to measure pasture mass (right).

How does a rising plate meter work?

Forage mass (or yield) is related to the height of the standing forage. However, research has shown that simply measuring the height of the canopy and multiplying the height by a species-specific constant may not give an accurate and reliable estimate for forage mass. Researchers and engineers sought to find a better way to estimate forage mass and developed the RPM, which measures the height of a slightly compressed forage.

The RPM consists of three basic elements: a plate of a standard weight and size, a shaft that slides up and down through the plate, and a device that measures the movement of the shaft through the plate (Figure 3). When a measurement, or "plonk," is taken, the plate is placed on top of the forage mass. The weight of the plate slightly compresses the forage but is suspended above the ground level by the forage mass underneath. As a result of this slight compression, the measurement is influenced by the density of the forage mass as well as the height of the canopy.

Figure 3. A description of some of the key parts on an electronic rising plate meter (RPM). Manual rising plate meters are very similar except there is a number dial in place of the digital interface.

The digital interface reports the number of "plonks," or measurements made; the average reading; and the pasture mass, if programmed with the proper calibration equation. Some models can record this data for each paddock, allowing producers to download the data to a computer using pasture management software.

Grooves in the shaft fit a geared electronic counter fixed to the back of the data recorder and digital interface. As the rod moves down, a measurement of that travel is recorded. Manual RPMs contain a continuous counter where the user can record the beginning and ending measurement and divide by the number of "plonks," or measurements taken from each paddock.

The metal or plastic plate is held up by the forage as the shaft penetrates the canopy to the soil surface. The distance between the shaft's end at the soil surface and the rise of the plate is the measurement being used to measure forage mass.

The metal or plastic plate is threaded onto the sheath that allows the shaft to move up and down. For easy storage, the plate can be removed.

While the plate is suspended, however, the shaft that slides through the plate can penetrate to the canopy floor (i.e., soil surface). On most RPMs, the shaft is grooved so that as the shaft slides through the plate, the number of grooves that passes the plate is counted by a geared electronic counter. The grooves on most RPMs are 0.5 cm apart. Thus, the counter records how high the plate is suspended above the canopy floor (i.e., the distance between the height of the plate and the end of the shaft). This value can then be used to calculate the forage mass in the measured area.

To get an accurate measurement of forage mass, at least 50 to 100 measurements (or plonks) should be obtained throughout the paddock. Like soil sampling, it is important to take numerous RPM measurements because there is likely to be tremendous variability across the paddock. Walking a zigzag pattern across the paddock and taking a measurement with every other step is an effective and time efficient way to get an accurate estimate.

Calibration equations for selected forage systems

Like any measurement device, the RPM must be properly calibrated to the forage system that is being measured. In New Zealand, the RPM has been well-developed and researched for use on perennial ryegrass. Prior to 2010, calibration equations had not been developed for the major forage systems used in Georgia and the rest of the Southeast U.S. From 2007–10, University of Georgia researchers collected RPM measurements and clipped forage mass data on intensively managed grazing systems. From those data, researchers developed calibration equations for annual ryegrass, small grains, winter annual mixtures, 'TifQuik' bahiagrass, and 'Tifton 85' bermudagrass. The equations for these systems are summarized in Table 1 and the data are presented in Figures 4 through 9.

Table 1. Equations to be used calibrate RPM measurements to forage mass for selected forage systems.

Forage system	Forage species or varieties	Time period	Forage mass (FM) in lb DM/acre*	
			Calibration equation	Equation syntax for use in a spreadsheet
Annual ryegrass	All varieties	Prior to April 1	$FM=\frac{3840}{1+e^{-\frac{(x-20.7)}{4.21}}}$	=3840/(1+EXP(-(*x*-20.7)/4.21))
Annual ryegrass	All varieties	April 1 and thereafter	*FM*=79.5*x*-289	=(79.5* *x*)-289
Bahiagrass	'TifQuik'	June through September	*FM*=65.5*x*-905	=(65.5* *x*)-905
Bermudagrass	'Tifton 85'	June through September	*FM*=60.8*x*-680	=(60.8* *x*)-680
Small grains	All small grain species and varieties	Prior to April 1	*FM*=99.1*x*-639	=(99.1* *x*)-639
Small grains	All small grain species and varieties	April 1 and thereafter	*FM*=79.5*x*-289	=(79.5* *x*)-289
Winter annual mixtures	Any combination of small grains and/or ryegrass and/or winter annual clover	Prior to April 1	*FM*=159*x*-1420	=(159* *x*)-1420
Winter annual mixtures	Any combination of small grains and/or ryegrass and/or winter annual clover	April 1 and thereafter	*FM*=79.5*x*-289	=(79.5* *x*)-289

*x = the average reading of how high the plate was suspended above the canopy floor, which, when plugged into the appropriate equation, can calculate the forage mass in the measured area.

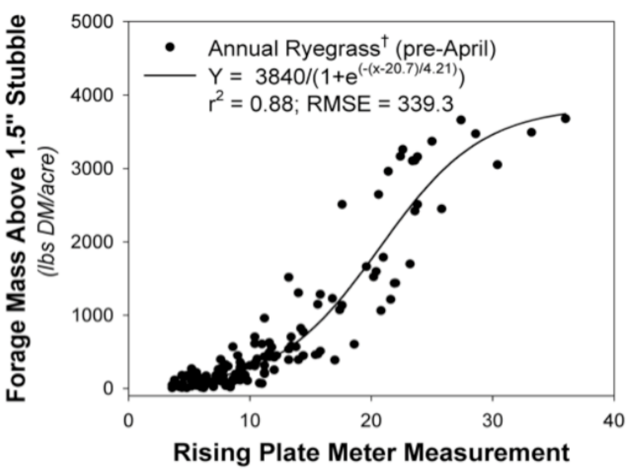

Figure 4. The relationship between the rising plate meter measurement and forage mass above a 1.5-inch stubble height‡ for annual ryegrass prior to April 1. The equation represents the best fit for the data.

† Includes data from the following varieties: 'Big Boss' (2009–2010), 'Feast II' (2007–2008 and 2009–2010), 'Hercules' (2007–2008), 'Jumbo' (2007–2008), 'Marshall' (2007–2008 and 2009–2010), and 'Oregro' '(2007–2008 and 2009–2010). Variety differences did not result in calibration equations that were significantly different.

‡ This 1.5-in. stubble height was used simply to provide a consistent height across all forage species that would reflect total available forage. This does not reflect an appropriate residual height.

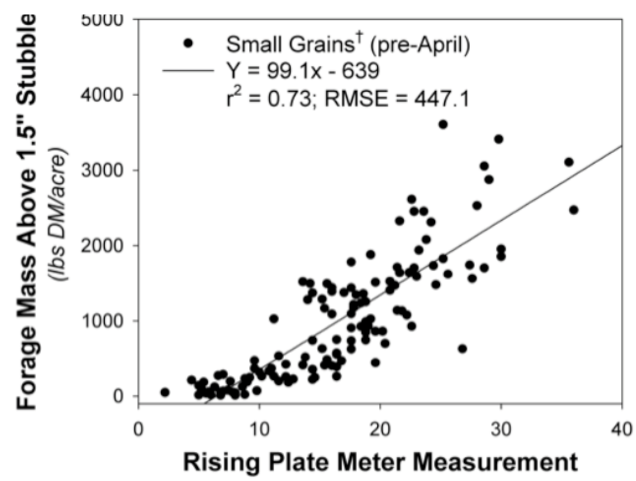

Figure 5. The relationship between the rising plate meter measurement and forage mass above a 1.5-inch stubble height‡ for small grains prior to April 1. The equation represents the best fit for the data.

† Includes data from i) 'Harrison' oats (2009–2010); ii) the following varieties of cereal rye: 'Wrens Abruzzi' (2007–2008 and 2009–2010), 'FL 401' (2007–08 and 2009–2010), and 'Wintergrazer 70' (2007–2008 and 2009–2010); iii) 'Trical 342' triticale (2007–2008); and iv) 'USG3592' wheat (2007–2008 and 2009–2010). Species and variety differences did not result in calibration equations that were significantly different.

‡ This 1.5-in. stubble height was used simply to provide a consistent height across all forage species that would reflect total available forage. This does not reflect an appropriate residual height.

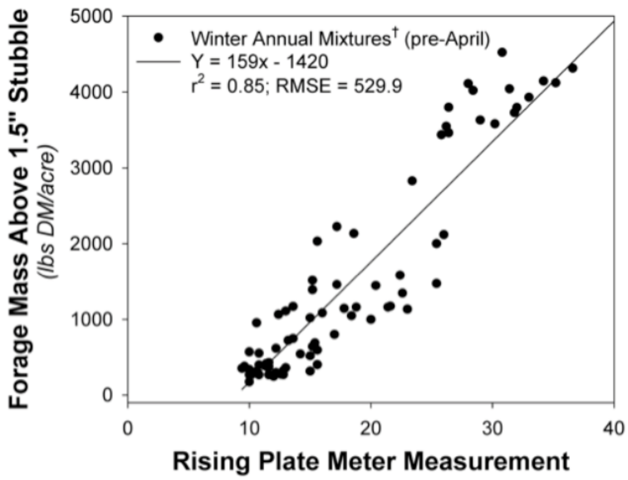

Figure 6. The relationship between the rising plate meter measurement and forage mass above a 1.5-in. stubble height‡ for winter annual mixtures prior to April 1. The equation represents the best fit for the data.

† Includes data from the following mixtures of winter annual forages in the 2009–2010 growing season: rye + ryegrass + crimson clover, rye + ryegrass + arrowleaf clover + crimson clover, rye + oats, rye + wheat, and rye + wheat + oats. Different forage mixtures did not result in calibration equations that were significantly different.

‡ This 1.5-in. stubble height was used simply to provide a consistent height across all forage species that would reflect total available forage. This does not reflect an appropriate residual height.

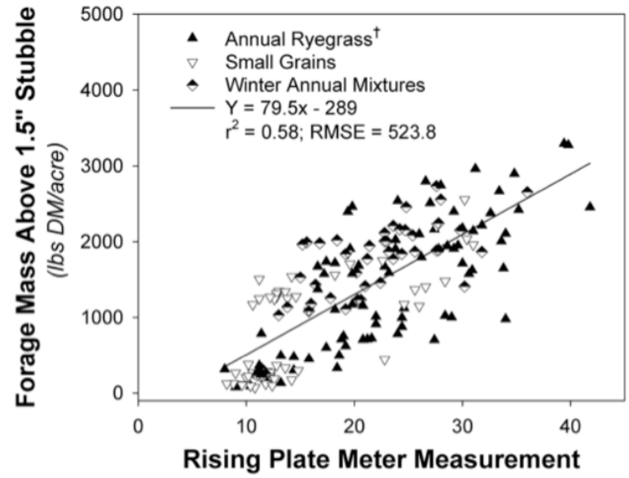

Figure 7. The relationship between the rising plate meter measurement and forage mass above a 1.5-in. stubble height‡ for all winter annual forage systems after April 1. The equation represents the best fit for the data.

† Includes data from the annual ryegrass varieties, small grains varieties, and winter annual mixtures identified in Figures 4 through 6. Species, variety, and mixture differences did not result in calibration equations that were significantly different.

‡ This 1.5-in. stubble height was used simply to provide a consistent height across all forage species that would reflect total available forage. This does not reflect an appropriate residual height.

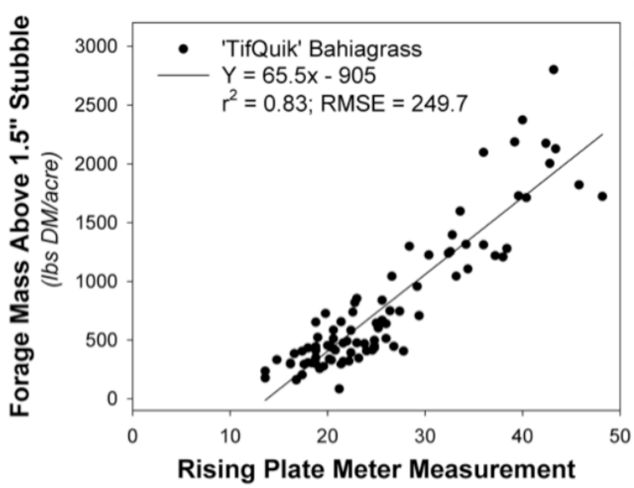

Figure 8. The relationship between the rising plate meter measurement and forage mass above a 1.5-in. stubble height† for 'TifQuik' bahiagrass. The equation represents the best-fit for the data collected June through September 2010.

† This 1.5-in. stubble height was used simply to provide a consistent height across all forage species that would reflect total available forage. This does not reflect an appropriate residual height.

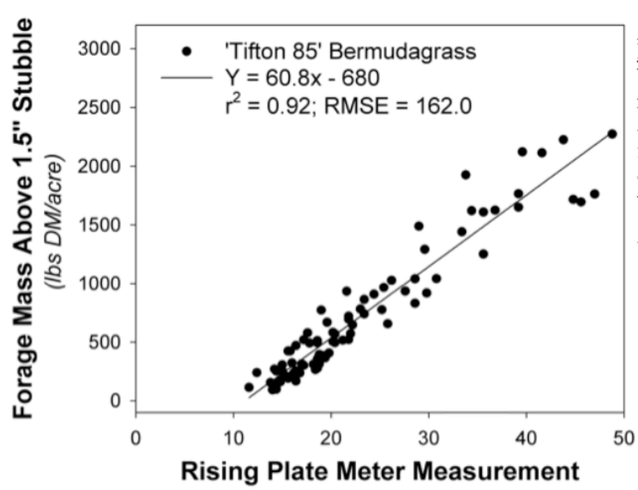

Figure 9. The relationship between the rising plate meter measurement and forage mass above a 1.5-in. stubble height† for 'Tifton 85' bermudagrass. The equation represents the best-fit for the data collected June through September 2010.

† This 1.5-in. stubble height was used simply to provide a consistent height across all forage species that would reflect total available forage. This does not reflect an appropriate residual height.

Since the RPM measures both a resistance to the weight of the plate and the height of the compressed sward (expanse of grass), it should be expected that each species will have a slightly different calibration. Each of the forage systems listed in Table 1 have structural differences (e.g., sod forming versus bunchgrass, influences of reproductive tillers, etc.) that could affect the accuracy of the RPM. For example, once winter annual mixtures transition to more reproductive growth, the calibration changes. Further, mixtures of winter annual species generally grow and perform differently than when grown alone. Thus, it is important to choose the calibration that fits the forage system and time period being assessed.

It should be noted that the data presented in Figures 4 through 9 were obtained by clipping the available forage down to a 1.5-in. stubble height. This is not a recommended grazing height. The value of 1.5 in. was used simply to provide a consistent height across all forage species so that a consistent measure of total available forage mass could be obtained. With very rare exceptions, grazing managers should never let or force their livestock to graze the forage this close. Most of the commonly used forage species in Georgia should be grazed no shorter than 3 in. Native warm season grasses and many of our warm season annual species should not be grazed shorter than 8 to 10 in. In general, though, producers should manage their grazing such that they are leaving a substantial amount of the forage mass, as this allows maximum regrowth. As a general rule of thumb, grazing managers should allow grazing livestock to take no more than half to two-thirds (50%–67%) of the total available forage mass.

Summary

Measuring, monitoring, and managing forage requires one to regularly measure how much forage mass is present and how quickly that forage is growing. By using a rising plate meter, producers can assess the forage mass across several pastures quickly and reasonably accurately. Then, by comparing available forage in individual paddocks from one week to another, producers can determine the growth rate of the forage. In periods of poor growing conditions, management can be deployed to increase growth rates. In periods of rapid growth rate, decisions can be made to alter grazing sequences or harvest excess forage for hay or baleage. In short, the RPM helps producers to assess the current status of each pasture and then make better decisions to increase the efficient use of that forage.

We gratefully acknowledge the contributions of Dennis W. Hancock, formerly in the Department of Crop and Soil Sciences, to the original manuscript for this publication.

The permalink for this UGA Extension publication is extension.uga.edu/publications/detail.html?number=B1528

Bulletin 1528 **Reviewed June 2023**

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