Calibration of five rising plate meters in the Netherlands

Holshof G., Stienezen M.W.J. and Galama P.G.
Wageningen UR Livestock Research, P.O. Box 338, 6700 AH Wageningen, the Netherlands;
gertjan.holshof@wur.nl

Abstract

To obtain good grassland management, especially under grazing, requires accurate information about grass growth. In the Netherlands several methods have been introduced to estimate herbage mass. At present the rising plate meter is the most accessible tool for Dutch farmers; it is cheap and easy to use. However, the equations for translation of grass height, as measured with the rising plate meters, into measures of herbage mass, have been developed in the countries of origin of the meters. To check the equations for the situation in the Netherlands in 2014 five rising plate meters were calibrated. Grass height was estimated with the five rising plate meters on small plots on which the grass was then cut and dried to measure the dry matter (DM) yield. For each rising plate meter a calibration curve was estimated. DM yield was estimated from ground level and from 5 cm stubble. Information about the herbage mass in the stubble was also estimated by cutting the stubble to ground level. The results show that for three rising plate meters the same equation can be used. Two rising plate meters need a different equation. The rising plate meters are relatively reliable for a measured grass sward of 20-25 cm in height from ground level. This means that a good estimate of DM yield can be made for up to 2,500 kg DM ha^{-1} above 5-cm stubble height.

Keywords: grassland management, measurement, rising plate meter, grass growth

Introduction

For good grassland management actual information on herbage mass production and farm grass cover is necessary. The rising plate meter is a simple tool to measure growth and DM yield. The quality and applicability of these meters has been proven (Earl and McGowen, 1979; Michell and Large, 1983). The use of the plate meter has retreated into the background in the Netherlands. Nowadays grazing is an issue and farmers therefore have a need for support tools to manage their grazing. By measuring all the paddocks weekly (by walking the farm), the farmer will get actual information about growth and DM yields. To obtain the right information a good calibration of the rising plate meter is needed. In the Netherlands we use DM yield measured from stubble height. The rising plate meter, however, measures from ground level. New rising plate meters have been developed during recent years, so new calibrations for Dutch circumstances probably need to be made. The questions are: which calibration is suitable for which meter? are there differences between meters ? and how to deal with the DM yield in the stubble? In 2014 an experiment was carried out in the Netherlands to get answers to these questions.

Materials and methods

In 2014 five rising plate meters were tested within an existing cutting experiment (100% *Lolium perenne*). The tested rising plate meters were the Farmworks F400 (Farmworks Precision Farming Systems Ltd, New Zealand), EC10 and JenQuip (NZ Agriworks Ltd, New Zealand, diameter 36 cm, average pressure 0.47 g cm^{-2}), Grasshopper (developmental stage) and the Styrofoam plate meter (Eijkelkamp Agrisearch Equipment, the Netherlands, diameter 48.5 cm, pressure 0.2 g/cm^{-2}). Measurements took place at different stages of growth (generative stage, vegetative stage, different percentages of heading and differences in sod density) and for different cuts. Table 1 gives an overview of the data, location, cut number and number of plots and herbage mass in the stubble.

Table 1 Overview of experiments

Date	Location[1]	Cut no.	Stubble height (cm)	DM stubble (kg ha^{-1})	Total obs.
29-4-2014	Dwingeloo	1			100
20-5-2014	Venray	1	6.8	982	100
10-6-2014	Dwingeloo	2	6.4	688	100
26-6-2014	Venray	2	6.6	1,223	100
17-7-2014	Lelystad	3	6.8	1,036	125
25-8-2014	Dwingeloo	4	7.2	925	125
Average			6.8	972	650

[1] Dwingeloo and Venray= sandy soil; Lelystad = clay soil.

The area of each experimental plot was 10×1.5 m and on every plot five measurements were carried out. The percentage of ears and sod density were estimated. Also, the herbage mass conditions (standing lodging, heading) were estimated. The results were statistically analysed with linear regression ($y = ax + bx^2$) to estimate a calibration line for each meter relating meter reading (height × in cm) and herbage mass above stubble (6.8 cm, y). The effects of heading and sward density and differences in regression lines were also tested. The measured height as well as height^2 were used as fixed parameters.

Results and discussion

Sod density varied between 65% (one object) and 98%. In most objects density was over 90%. The percentage of ears was between 0% and 25% and were present only on 10 June and 17 July. DM yields measured by cutting ranged from 1,232 kg DM ha^{-1} to 3,864 kg DM ha^{-1}. There was no significant effect of sod density or percentage of ears (generative or generative stage) on the relation between sward height and DM yield. Therefore in a second step, all the data were pooled to estimate a regression that could be used over the whole season. A significant difference (P<0.001) in calibration lines was found between the Farmworks, EC10 and JenQuip on the one hand, and the Grasshopper and Styrofoam plate on the other hand. The statistical results are shown in Table 2.

Sward height as well as sward height^2 (P<0.001) were significant parameters for estimating DM yield. The overall declared variance was 70%. A higher yield gave a lower amount of DM per cm (so that height^2 is negative), but the Grasshopper and Styrofoam plate had higher yields at higher swards (height^2 is positive). Earl and McGowan (1979) and Michell and Large (1983) found a much higher declared variance (92-97%) and they used an intercept. In their experiment height^2 did not improve the calibration line. Measuring from ground level does not require an intercept, so in this calibration no intercept is used. Because of the great difference in the DM yield in the stubble (Table 1) and the fact that DM yield in the

Table 2. Regressions ($y = ax + bx^2$) relating herbage mass y (kg DM ha^{-1}) and measured height x (cm).[1,2]

Plate meter	a (height factor)	SE	b (height^2 factor)	SE	RSD	R^2	N obs.
EC 10	181.61 [a]	10.1	-1.57 [a]	0.516	483	64.6	150
Farmworks	177.42 [a]	9.15	-1.34 [a]	0.466	435	71.2	150
Grasshopper	64.4 [b]	17.9	4.37 [b]	1.10	290	77.3	50
JenQuip	174.65 [a]	9.18	-1.29 [a]	0.464	445	69.9	150
Styrofoam	95.27 [c]	8.57	1.24 [c]	0.372	399	75.8	150

[1] SE = standard deviation; RSD = relative standard deviation.

[2] Different letters means significant (P<0.001) differences.

stubble was not measured on every plot (by destructive methods) means that the calibration presented in this article is the line based on DM yields from a stubble height of 6.8 cm.

The highest sward height measured was 27 cm, probably due to the weight of the plate and the weight of the leaves (herbage on some plots was lodged). The measured DM yield showed much variation in the range from 18 to 27 cm. Therefore, a rising plate meter can be used for reasonable measurements up to 2,500 kg DM ha^{-1}. The total declared variance was only 70%. The difference in sod density and amount of DM in the stubble probably caused this relatively low figure. As there was too little difference in sod density and percentages of ears (vegetative or generative stage) at one moment of measurement combined with a relatively high yield (>2,700 kg DM ha^{-1}) no effects of these parameters were estimated. Including those parameters would probably lead to a more accurate estimation. Michell and Large (1983) made a distinction in two of three periods within a season. Nakagami and Itano (2013) also estimated seasonal effects. Further research is needed to get more information about the effects of sod density, DM yield in the stubble and percentage of ears. Probably because the Grasshopper and Styrofoam plate meters have different plate pressures, these meters need a different calibration.

Conclusions

Rising plate meters can be used to measure reliable DM yields in a range up to 2,500 kg DM ha^{-1} or about 20-25 cm of sward height. Not every meter has the same calibration. Additional research is needed to get more information about effects of different sward density and effect of ears and DM yield in the stubble in order to give substantiated equations for estimating DM yield of grasslands.

References

Earle D.F. and McGowan A.A. (1979) Evaluation and calibration of an automated rising plate meter for estimating dry matter yield of pasture. *Australian Journal of Experimental Agriculture and Animal Husbandry* 19, 337-343.

Michell P. and Large R.V. (1983) The estimation of herbage mass of perennial ryegrass swards: a comparative evaluation of a rising-plate meter and a single-probe capacitance calibrated at and above ground level. *Grass and Forage Science* 38, 295-299.

Nakagami K. and Itano S. (2013) Improving pooled calibration of a rising-plate meter for estimating herbage mass over a season in cool-season grass pasture. *Grass and Forage Science* 69, 717-723.