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RESULTS WITH METHODS FOR MEASURING HERBAGE MASS IN SITU

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Abstract

Two indirect methods for estimating herbage mass in situ were investigated in a research programme. Electric capacitance and spectral reflectance measurements were made and estimated values were compared with cut herbage mass results. Vegetation indexes (VI) measured by spectroradiometer showed a high correlation with fresh herbage mass, but there was no correlation observed between VI and dry matter results. Equations installed in electric capacitance meter were not feasible for Hungarian conditions. The change of electric capacitance in the sward (CMR) gave no correlation with cut DM yields. The investigated indirect methods are not suitable for research or production use yet.

Keywords: herbage measurement, electric capacitance, and spectral reflectance

Introduction

Herbage measurements in situ are needed both in practice and research. There are direct and indirect methods for measuring herbage mass in situ known. Direct methods are based on different cutting techniques and sample areas. Indirect methods operate on various kinds of estimation technique. Advantages and disadvantages of herbage mass measurement methods were evaluated for research purposes by BGS (Frame 1981).

Up till recently, grassland research in Hungary used conventional cutting methods for measuring herbage mass. During the XVII IGC delegates of Hungary were shown electric capacitance equipment on display in the grassland exhibition. Demonstrations of application were organised by the producer. This experience initiated a research programme "Investigating objective methods for measuring grass herbage dynamics" at Debrecen Agricultural University.

In the research programme series of measurements with spectral reflectance (Nagy and Zilinyi 1993) were also included, as a potential indirect estimation technique.

This paper presents some results of in situ measurements of herbage mass gained by electric capacitance and spectral reflectance.

Material and methods

Two sites of pasture and meadow type grasslands were selected for series of direct and indirect measurements of grass herbage mass. Pasture type grasslands had denser swards consisting of *Poa pratensis* and *Festuce rubra* as main components. The commutative ground cover (GC) of the two species was 78% as a minimum. The meadow type grassland was less dense, having a population of *Festuca arundinacea* (GC minimum=35%), *Festuca pratensis* (GC minimum 22%), and *Festuca rubra*. GC % for the latter in these experimental years ere 30%, 22%, 5%, and present (+) respectively.

SM-2 spectroradiometer (Nagy and Zilinyi 1993) was used for spectral reflectance measurements.

A commercial electric capacitance meter imported from New Zealand was used for electric capacitance measurements. The meter recorded the change of electric capacitance (CMR) caused by herbage mass in the sensitivity area of the probe (maximum 5 cm). The meter was installed with 7 quadratic equations for calculating herbage mass in kg dry matter per ha for different grassland and weather conditions. The 8th equation was used to calculate CMR only.

Direct cuts of sub-sample areas of the grasslands were made with a self-propelled rotary mower, which was adjusted to collect clippings (cut grass). Dry matter (DM) content of the cut grass was determined by the standard laboratory method.

Sward height of the sample areas was each time measured with the ruler technique before the measurements of indirect and direct methods were started. Research results were statistically analysed with computer based methods (Excel).

During the experimental years, 9 series of investigations were made. One investigation series consisted of 3-6 occasions. On each occasion 15-sample area were measured with indirect and direct herbage mass methods.

Results

Our results indicate, that spectral reflectance can be seen as a reliable indirect method for estimating fresh herbage mass. As it was also found earlier (Nagy and Zilinyi 1993), the regression analysis presented a very strong correlation between measured VI and cut green mass (Figure 1). However, there was no correlation between measured VI and herbage mass in DM (R^2=0,1362). Because of these conflicting results, spectral reflectance seems to be of very limited use for predicting herbage mass in situ.

Cut herbage mass in DM and estimated herbage DM values of electric capacitance were compared for each occasion of measurements. Comparative data obtained from equal numbers of observations (n_1=n_2) presented significant difference for most occasions, and there were only a few occasions with no significant difference. It means that equations installed into the electric capacitance meter cannot be used under our conditions.

Finally, we made a regression analysis between CMR values and cut herbage DM mass for 39 occasions. This statistical analysis provided mostly a predominance of low correlation coefficient values (Table 1), indicating a poor correlation between the change of electric capacitance and herbage DM mass. These correlation coefficient values were lower than those found with electric capacitance by Toledo et al (1980), and the relationship between estimated and real herbage DM mass was much poorer than found by Vickery et al (1980).

In conclusion we have to say that the indirect methods we used in our measurements have not proven to be reliable for estimating herbage mass in situ, so they cannot be suggested for research or production purposes yet, which supports the findings for electric capacitance by Vidrih (1996) as well.

Acknowledgements

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Table 1 - Correlation coefficients between electric capacitance CMR values and cut DM yields

Site, year and season of series of measurements	Occasions per measurement series					
	1	2	3	4	5	6
Site 1						
1996 Spring	0,10	0,20	0,02	0,06	0,06	
1997 Spring	0,18	0,04	0,16	0,38	0,25	0,60
Site 2						
1996 Spring	0,03	0,01	0,02	0,20	0,40	
1996 Autumn	0,12	0,04	0,31	0,37	0,02	0,30
1997 Spring	0,20	0,30	0,06	0,01	0,07	0,24
1999 Spring	0,03	0,30	0,08	0,10	0,10	0,01
1999 Autumn	0,74	0,11	0,04	0,06	0,49	

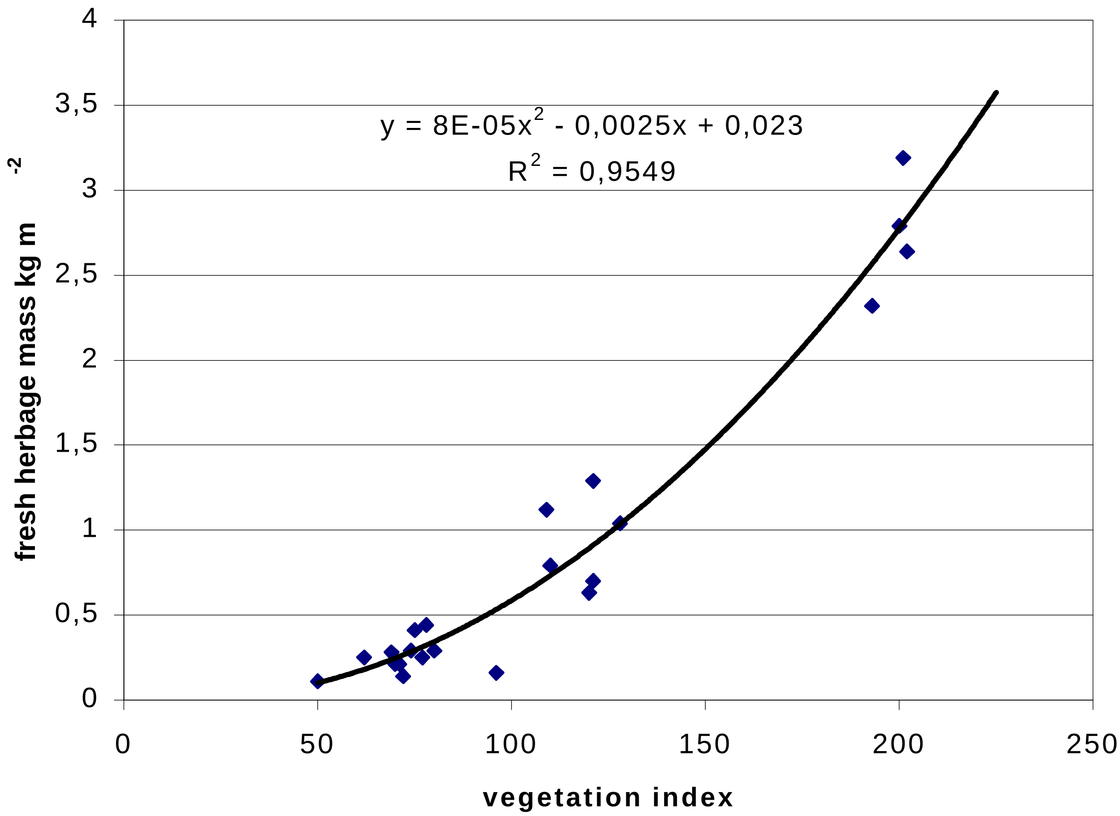

Figure 1 - Correlation between vegetation index and fresh herbage mass