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New estimation possibilities the actual quality and value of grassland in Hungary

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ABSTRACT

The future way of grassland management is greatly affected by the new functions of the grasslands relative to the environment. The role of raising nutrition will be expanded by the role of keeping the natural resources. In the D-e-Meter grassland module we start the evaluation with the DM yield of the characteristic grass. This starting point is modified with the factors proper to the area. The measured and the estimated DM yield were compared to each other at 5 grasslands at Bőszénfa in Hungary. An important part of the sustainable developing is to find the adaptation to the local area and the nature. This aspect could be found in the multifunctional European Agricultural model and in the rural development too. The evaluation of grasslands in Hungary is not solved, the details we have are disused, so it is hard to plan the yields of the grasslands, we can estimate them a posteriori. To evolve an up-to-date evaluating system we analysed grasslands at the University of Kaposvár Deer Farm at Bőszénfa to find answers to the followings. Geological analysis of the humus, the N, P, K levels and the pH of the grasslands. Describe the botanical composition by the Balázs-method. The quality and the nutrition value of the grasslands. The yields of the grasslands, by annual. Analyzing of the results by the D-e-Meter system, and as a feedback to check the accuracy of the method.
(Keywords: D-e-Meter, grassland, evaluation, yields, nutritive content)

INTRODUCTION

Nowadays both the arable and the pasture land usage is controlled and has close connection to the environmental friendly farming. An important part of the possibilities of farm management is to know the actual quality and value of the fields. In the past several scientist try to build up method for the estimation to the quality and value of grassland. So the arable land evaluation and the controlled farming are important issues (*Várallyay,* 2003).

The important role of plant production and grassland management in Hungary has brought up the need to develop an informative system of arable evaluation. This method, which had been developing from the 1800's, was known as „aranykorona" value and was used till not long ago, in the 1990' by the arable lands privatization.

On the end of the 19th century one of the first classification of grasslands based on the botanical composition when Schröter and Stebler preformed the phyto-sociology, which analyzes the correlation between the local area and the plants. The best-known botanist of this method was *Braun-Blanquet* (1954). Authors (Türen, Knapp, Klapp, Könekamp, Köhnlein, Knoll, Petersen, Ellenberg, Stählin, Bocker) tried to harmonize the pure grassland qualification to the practice (*Petersen,* 1955).

In Hungary Thaisz started to examine the grasslands by the botanical composition, but the first modern phyto-sociological examination was made by *Soó* (1941, 1964,

1965) and his followers. Other scientists Máthé and his followers, Juhász and Prettenhoffer also turned their attention to the problem of the grassland evaluation (*Máté,* 2003). *Balázs* (1960) examined botanical and economical evaluation. His system is used nowadays, and it's called „Balázs quadrate method".

In the 1990's *Vinczeffy* (1995) created a grassland evaluation system, which characterizes the grasslands with three numbers. The problem with this method is that it doesn't deal with the geological and climate factors. So nowadays the correct evaluation of the grasslands is not solved, it is very difficult to plan the yields of the grasslands, the estimation is based on the routine.

An important part of sustainable development is to adapt to the local area and the nature. This aspect could be found in the multifunctional European Agricultural model and in the rural development as well. The "aranykorona" evaluation system is an obstacle for sustainability. Nowadays the evaluation of grasslands in Hungary is not solved, the data we have are dated, so it is hard to plan the yields of the grasslands. We have more than 1 million hectares of grasslands (more than 17% of the total agricultural area), so it is a very important question to find a well developed system to the estimation of the quality and value of grasslands.

During the last five years a new method was carried out in Hungary which hopefully will be suitable for the estimation of characteristics both the arable land and the grasslands. The name of the system is D-e-Meter method.

While the elaborated D-e-Meter method hopefully will be suitable for the arable farming, we have to aim to elaborate an up-to date method for the grasslands including the usable parts of the arable farming classification, and of course the special characteristics of the grasslands.

Classification of the grasslands can be solved in some ways. The most important from these are the followings: *Baskay-Tóth* (1966) separated the grasslands into 3 group according to the use: pasture, meadow and combined grasslands. *Horn and Stefler* (1990) classified the grasslands by the intensity of the usage of the grasslands separated them into three group (intensive, semi-intensive and extensive pasture). A new way of grassland classification was created by *Dér et al.* (2003), which was separated by the way of usage and the type of it (*Table 1*).

Table 1

Grassland classification by the type of the grassland usage

Designation of the grassland	Categories	Size 1.060 e ha	Productivity t/ha DM
Productive grassland	Unfertilized, or barely fertilized grasslands with medium productivity	54%	3–7
	Frequently fertilized grasslands with high productivity	3%	8–14
Area of outstanding natural beauty	Strictly sheltered grasslands	3%	No dates
	Non strictly sheltered, and other grasslands of outstanding area	15%	2–4
	Soil protecting grasslands	25%	1–2

The "Zöldmező" (Greenfield) society started the grassland evaluation at Keszthely in 1933. Later other county's grasslands were evaluated as well. The dates – after the

processing – were sent to the authority. During the 2nd World War the archives were lost, and after the end of the war the archives of the "Zöldmező" society were annihilated. After these happenings grasslands phyto-sociological composition was examined again. Hungary's arable land estate's potential fertility is high. The value of the arable lands is highly specified by the ecological factors. The bases of the productivity factors are the arable lands, so they must be in accord to each other. So man has to use very carefully the quantity, the composition, and the level of the resources.

The future way of grassland management is greatly affected by the new functions of the grasslands relative to the environment. This means that the role of raising nutrition will be expand by the role of keeping the natural resources.

As in other countries, the motivation to characterizing the arable lands was the increase of the taxes. By the end of the 18th century. II. Joseph enacted the cadastral survey of the arable lands. The works started in 1786, but the nobility balked the plan. After the fall of the 1848–49 revolution the taxes were assessed by the cadastre, which was the base of the arable land taxation till 1884. This base was measured in "korona" unit, which was the currency that time, but when the "korona" was not longer valuable, the unit was the "búza egyenérték" (wheat equivalence) which means that the value of it was equalized to the wheat's value. From 1924 we use "Aranykorona" unit.

When we say arable land evaluating, we often think about their classification by the productivity. In arable land evaluating people can use the income's capitalization methods as well. The market insists on the authentic and accurate qualifying of the arable lands. That is why the cadastre has to show the real quality number and fertility number of the arable land.

To evolve an up-to-date evaluating system we analyzed grasslands at the University of Kaposvár Deer Farm at Bőszénfa to find answers to the followings:

- pedologycal analysis of the humus, the N, P, K levels and the pH of the grasslands,
- describe the botanical composition by the Balázs-method,
- the quality and the nutrition value of the grasslands,
- the yields of the grasslands, by annual,
- analyzing of the results by the D-e-Meter system.

MATERIALS AND METHODS

The experiments were carried out from autumn of 2005 (by soil analyzing) till autumn of 2008 at the Deer Farm of the Kaposvár University, at Bőszénfa. The five grasslands were the followings: Baltacim (6 ha), Egyenestető (23 ha), Kuti III. (9 ha), Pacsirta (19 ha), Templom Dél (20 ha). The meteorological details were measured by the Hungarian Meteorological Service in the near of Kaposvár.

We measured three samples per year from 2006 to 2008. The dates (yyyy.mm.dd.) of the cuts were the following (*Table 2*).

We cut samples from the grasslands in four repetitions by a 50×50 cm frame. The samples were analyzed at the Kaposvár University, Department of Chemistry and Biochemistry. They measured the weight of the samples, the DM contents, and quantified the crude protein, crude fat, crude fiber, crude ash and N-free extract by Weendei-analysis.

The statistical analysis was done with SPSS for Windows software at 5% significance level ($P \leq 0.05$) by one-way anova. At the analysis of the results of the annual nutritive contents we used the weighted means of them. The weights were the DM yields of the three samples.

Evaluation system of the D-e-Meter grassland module

In the following part of our publication we will introduce the basic theoretical aims of the D-e-Meter method and the possibility of its utilization in the practice. At the grassland point calculation method of the D-e-Meter system is based on the general yield ability of the field and we use some quality and quantity factors which has affect to the yield and stocking capacity of the grasslands during the growing period which are the followings (*Table 3*).

Table 2

Time of sampling (date)

First growth (1)	Second growth (2)	Third growth (3)
2006.05.15–25.	2006.07.5–15.	2006.09.15–25.
2007.05.05–15.	2007.07.15–25.	2007.09.20–30.
2008.05.10–20.	2008.07.10–20.	2008.09.25–10.05.

Table 3

D-e-Meter method for grasslands

Starting point: Potential Dry Matter yield (t/ha) In Hungary as the result of the ecological factors there are several types of grasslands. Very often we don't have any actual measured dates concerning the yield ability of the field therefore in our system we use dates from the literature of the most common 36 type of grasslands (*Vinczeffy,* 1995). We can use the measured dates of course, if we have more than five year's dates. This starting point could be modified with the qualifying factors of the field as the following:	
Accumulation of water Grasses are one of the cultures which need a lot of water. Grass growing is frequently held up by the low level of rainfall and the frequency distribution of it. The roots of the grasses work down till 10–15 cm deep, so if the weather is droughty, the only help for the grasses can be the depot in this deep. In our system we created five factors for the level of the ground-water in nine categories of the soil quality.	0.5–1.0
Agro-ecological districts The 7 main agro-ecological districts and its 35 subdistricts of Hungary – which have great affects to the agricultural production – The factors of them are between 0.6 and 1.6 in the D-e-Meter system.	0.6–1.6
Gradient category At the grasslands of slopes by increasing the gradient the effect of the rainfall become smaller and the caution of the sheet erosion is higher.	0.6–1.6
Date of the sward establishment The establishment – the soil management and the fertilization before it, and the composition of the grasses – has great effect to the productivity of the grassland. In the year of the establishment the factor is 0.8 because the cover of the grassland is not 100% yet. After the first year we calculate the factors from 1.2–1.6.	In the first year 0.8 After the first year 1.2–1.6
Weathering of the year The categories are almost the same as in the arable farming method in the D-e-Meter system, but we classified five group, and the factors are between 0.8–1.2.	0.8–1.2

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Intensity of cultivation The categories in this section are the followings: intensive, semi-intensive and extensive. Intensive grasslands are well fertilized and used (grazing or cutting) frequently. Extensive grasslands are unfertilized and rarely used.	0.7–1.5
Quality factor Grasslands are a complex company of annual species like grasses and legumes and other plants. The nutritive values of them are different. The yields of the different type of grasses could be modified with the quality factors, and could give a more accurate figure to the real value of the grassland.	0.85–1.0

RESULTS AND DISCUSSION

By evaluating the results of the researches we used the botanical and the geological records to analyze the botanical and the geological records to analyze the fresh mass, the dry matter yield and the crude protein yield sorted by the areas. The yields of the grasslands were compared to each other by the fresh mass (t/ha), the DM yield (t/ha) and the crude protein yield (kg/ha) in the examination years (*Table 4*).

Table 4

Yields of the grasslands

Area	Year	Fresh mass (t/ha)	DM yield (t/ha)	Crude protein yield (kg/ha)
Baltacim	2006	16.5^{a}	5.4^{a}	631^{a}
	2007	14.3^{ab}	5.6^{a}	568^{a}
	2008	13.8^{b}	5.6^{a}	543^{a}
Egyenestető	2006	20.2^{a}	5.8^{a}	630^{a}
	2007	14.3^{b}	4.8^{b}	499^{b}
	2008	23.2^{c}	7.7^{c}	828^{c}
Kuti III.	2006	13.0^{a}	3.9^{a}	400^{a}
	2007	12.1^{a}	4.0^{a}	437^{a}
	2008	11.7^{a}	3.8^{a}	493^{a}
Pacsirta	2006	22.7^{a}	6.1^{a}	825^{a}
	2007	8.2^{b}	2.7^{b}	398^{b}
	2008	23.1^{a}	7.0^{c}	808^{a}
Templom Dél	2006	23.6^{a}	7.4^{a}	993^{a}
	2007	15.1^{b}	5.5^{b}	604^{b}
	2008	17.6^{c}	7.6^{a}	713^{b}

^{a,b,c} $P<0.05$

At Baltacim we couldn't find significant difference between 2006 and 2007 at the fresh mass product per hectare. The DM yield per hectare and the crude protein yield per hectare in the experimental years doesn't show significant difference. The drought of year 2007 had great effect to the arable land production, but in grassland production only in the 2nd cut, so the other two cuts could equalize the yields.

At Kuti III. we couldn't find any significant differences among the experimented yields. At Pacsirta the annual change of the weather has greater effect to the yields. In

2007 the unsuitable management had an effect too, so the differences were significant in all the measured parameters.

At Templom Dél the differences were significant in the fresh mass yield in the experimental years. The level of the yields were influenced by the weather and the land use management.

The D-e-Meter evaluation associates to the measured yields

At the examined areas we estimated the yields by the D-e-Meter system grassland method in the experimental years. The estimated and the measured DM yields were from the three cuts of the grasslands, and are showed on *Table 5*. The statistical evaluation was made by one sample T-test to compare the estimated and the measured DM yields.

Table 5

The D-e-Meter grassland evaluation associates the measured yields at Bőszénfa in 2006-2008

Area	Year	Estimated DM Yield t/ha	Measured DM Yield
Baltacim	2006	5.4[a]	5.4[a]
	2007	4.8[a]	5.6[b]
	2008	4.8[a]	5.6[a]
Egyenestető	2006	6.7[a]	5.8[b]
	2007	6.0[a]	4.8[b]
	2008	7.5[a]	7.7[a]
Kuti III.	2006	4.5[a]	3.9[b]
	2007	3.0[a]	4.0[b]
	2008	4.5[a]	3.8[b]
Pacsirta	2006	6.7[a]	6.1[a]
	2007	2.0[a]	2.6[b]
	2008	6.7[a]	7.0[b]
Templom Dél	2006	7.1[a]	7.4[a]
	2007	4.8[a]	5.5[b]
	2008	5.4[a]	7.6[b]

[a,b] $P<0.05$

Although there are significant differences between the estimated and the measured DM yields, the values show that the D-e-Mether method could give a good basic to plan the management. By improving this method with 0.2–0.4 t/hectare we can give estimation for the DM yield without significant differences.

CONCLUSIONS

We can draw the following conclusions from the experiments:

- Drought has the greatest effect to the botanical content, the cover of the plants and the DM content.
- In dry years the total number of the species can dramatically decrease, so this creates empty areas, and the number pioneer species (in the first place weeds) and the mass of them increases.

- The DM content of the grasslands increased caused by the drought year of 2007, but the crude protein per DM kilograms and the crude fiber per DM kilograms were almost the same. The yields of the grasslands are influenced to greater extent by the weather of the year (especially the rainfall) than the nutritive contents.
- By evaluating the yields we can say that grasslands with greater yields have greater effect by the changes of the weather than by the management.
- Grasslands can compensate the environmental effects, which have impact on one mow, compared to the field cropping species.
- The deviation between the estimated and measured DM yields is 0.05–1.2 t/ha, which shows high level of deviation, but greater margin of error is in the droughty year, so we have to correct this point of the method.
- Of course we must correct the accuracy of the method by further dates of the production, but in all the results certify the conduciveness of the D-e-Meter system in the near future.

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