Forage feeding value of continuous grazed sward on organic permanent grassland

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Abstract

Continuous grazing provides low-cost forage with a high feeding value for milk and beef production and is a suitable pasture system in organic farming. To assess the forage feeding value of continuously grazed sward, a 3-field trial was carried out under harsh east Alpine conditions (680 m altitude, 7°C average temperature, 1000 mm annual precipitation). Forage contents of net energy (6.3-7.0 MJ NEL kg^{-1} DM) and crude protein (202-236 g kg^{-1} DM) varied on a high level during the vegetation period. Moreover, amounts of crude fibre (176-243 g kg^{-1} DM) and neutral detergent fibre (373-475 g kg^{-1} DM) were within the recommended range for ruminates. In conclusion, continuous grazing as a possible organic grassland use under harsh climate conditions can be recommended.

Keywords: organic farming, grazing, crude nutrients, structural carbohydrates

Introduction

Grazing, as the most animal-friendly means of husbandry, is regulated in organic farming and has still a very high priority in Alpine regions of Austria. Organic farms in Austria are very small-scale, in contrast to farms in European favourable areas. Austrian organic farms have an average size of 19 ha with 10 cows per farm (BMLFUW, 2009). Therefore, continuous grazing represents an interesting pasture system for these small-scale grassland farms, if smooth and gently sloped areas are available. Previous investigations (Münger, 2003) attested to high forage feeding value of continuously grazed swards. To assess this for the East Alpine area, a three-year (2007-2009) field trial was carried out at the organic grassland and dairy farm of the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein. The hypothesis of this investigation was that the harsh climate of the Eastern Alps influences the forage feeding value of continuously grazed swards and decreases the nutrient content in contrast to favourable grassland regions.

Materials and methods

The trial was carried out on an organically managed, continuously grazed area (latitude 47° 31‘03“N, longitude: 14°04‘26“E, 680 m altitude, 7°C average temperature, 1014 mm precipitation per year) as a randomized block design with three replicates. To sample the continuously grazed variants (4 different reseeding mixtures) a part of the plots was fenced out from grazing. Seven times per year the fenced area of the plots was harvested with a motor mower (cutting level 5 cm). The sampling date started in the first week of May and ended in the last week of October (7th sampling date). Between the sampling dates, a period of 4-6 weeks elapsed, depending on sward height (target height 15 cm, measured with a ruler). The sample cutting area on the continuous grazing variant was changed between two harvest times. One part of the continuous grazing variant was grazed 50% of the time by dairy cows. A detailed description of the biomass yield as well as the botanical composition is presented in Starz *et al*. (2010). After harvest, a part of the sward sample was dried at 50°C, for further content analyses. In the laboratory of AREC Raumberg-Gumpenstein, the crude nutrients (crude ash CA, crude protein CP, ether extract EE and crude fibre CF) were determined via Proximate Analysis. Furthermore, contents of structural carbohydrates (neutral detergent fibre NDF, acid detergent fibre ADF and acid detergent lignin ADL) were also assessed. Regarding the MJ net energy lactation (NEL) and MJ metabolic energy (ME), the calculation was based on a regression equation considering crude nutrients (GfE, 1998).

Data were checked for adherence to the normal distribution and homoscedasticity using analysis of variance via visual testing of the fit diagnostics in SAS 9.2. Statistical analysis was implemented with PROC mixed of SAS 9.2 with a *P*-value below 0.05 (n = 252). The main factors were replication, variant, sampling date (7 times per year) and year. Beside these factors, the sward height (differing on a small scale) at the sampling date was used as covariate in the model. The results of this analysis were displayed as LS-means (LSMEANS), standard error (SEM) and residual standard error (se). Test of pairwise differences were arranged with Tukey-Kramer and significant differences between LS-means are shown with different lower-case letters.

Table 1. Crude nutrients, structural carbohydrates and energy contents of continuously grazed swards at the 7 sampling dates in the vegetation period.

Para-meter	Unit	1 LSMEAN	SEM	2 LSMEAN	SEM	3 LSMEAN	SEM	4 LSMEAN	SEM	5 LSMEAN	SEM	6 LSMEAN	SEM	7 LSMEAN	SEM	*P*-value	s_e
CA	g kg^{-1} DM	93^{a}	2.2	88^{a}	2.4	109^{bc}	2.2	110^{bc}	2.2	104^{b}	2.4	114^{c}	2.2	122^{d}	2.7	<0,0001	10.4
CP	g kg^{-1} DM	202^{b}	1.9	175^{a}	2.2	224^{c}	2.0	203^{b}	1.9	218^{c}	2.2	236^{d}	1.9	228^{cd}	2.5	<0,0001	11.5
CP	g kg^{-1} OM	223^{b}	2.2	192^{a}	2.5	251^{cd}	2.2	228^{b}	2.2	243^{c}	2.5	266^{e}	2.2	260^{e}	2.9	<0,0001	13.1
EE	g kg^{-1} DM	31^{e}	0.3	26^{a}	0.3	28^{c}	0.3	30^{d}	0.3	28^{bc}	0.3	27^{ab}	0.3	26^{ab}	0.4	<0,0001	1.5
EE	g kg^{-1} OM	34^{c}	0.3	29^{a}	0.4	31^{b}	0.4	33^{c}	0.3	31^{b}	0.4	30^{ab}	0.3	30^{ab}	0.4	<0,0001	1.7
CF	g kg^{-1} DM	194^{b}	2.5	243^{f}	2.8	223^{de}	2.6	231^{e}	2.5	218^{d}	2.9	206^{c}	2.6	176^{a}	3.2	<0,0001	12.4
CF	g kg^{-1} OM	213^{b}	2.8	266^{f}	3.1	251^{de}	2.9	259^{ef}	2.8	243^{cd}	3.1	233^{c}	2.8	200^{a}	3.5	<0,0001	13.6
NDF	g kg^{-1} DM	381^{a}	6.5	475^{c}	6.9	431^{ab}	6.5	439^{a}	6.5	423^{bc}	6.9	409^{bc}	6.5	373^{a}	7.3	<0,0001	22.6
NDF	g kg^{-1} OM	420^{a}	7.5	521^{e}	7.9	483^{cd}	7.5	493^{d}	7.5	473^{bc}	7.9	462^{b}	7.5	424^{a}	8.4	<0,0001	24.8
ADF	g kg^{-1} DM	222^{a}	2.4	282^{c}	2.6	268^{c}	2.4	282^{ab}	2.3	266^{c}	2.7	242^{c}	2.4	215^{bc}	3.0	<0,0001	12.0
ADF	g kg^{-1} OM	245^{a}	2.8	309^{cd}	3.1	301^{cd}	2.8	317^{ab}	2.8	297^{bc}	3.1	273^{d}	2.8	245^{cd}	3.4	<0,0001	13.3
ADL	g kg^{-1} DM	26^{a}	0.7	35^{cd}	0.7	36^{c}	0.7	33^{ab}	0.7	36^{bc}	0.7	31^{d}	0.7	27^{cd}	0.8	<0,0001	3.1
ADL	g kg^{-1} OM	29^{a}	0.7	38^{bc}	0.8	40^{c}	0.8	37^{b}	0.7	40^{c}	0.8	35^{b}	0.7	31^{a}	0.9	<0,0001	3.4
ME	MJ kg^{-1} DM	11.48^{e}	0.04	10.71^{d}	0.04	10.52^{bc}	0.04	10.41^{ab}	0.04	10.63^{cd}	0.04	10.72^{d}	0.04	10.46^{a}	0.05	<0,0001	0.19
ME	MJ kg^{-1} OM	12.65^{d}	0.04	11.74^{ab}	0.04	11.81^{ab}	0.04	11.69^{a}	0.04	11.87^{b}	0.04	12.11^{c}	0.04	11.91^{b}	0.05	<0,0001	0.20
CP ME^{-1}	g MJ^{-1}	17.6^{b}	0.2	16.3^{a}	0.2	21.3^{e}	0.2	19.5^{c}	0.2	20.5^{d}	0.2	22.0^{f}	0.2	21.8^{ef}	0.2	<0,0001	0.9
NEL	MJ kg^{-1} DM	7.03^{d}	0.03	6.45^{bc}	0.04	6.34^{ab}	0.03	6.25^{a}	0.03	6.39^{bc}	0.04	6.50^{c}	0.03	6.47^{c}	0.04	<0,0001	0.14
NEL	MJ kg^{-1} OM	7.75^{c}	0.03	7.07^{a}	0.04	7.11^{a}	0.03	7.02^{a}	0.03	7.14^{a}	0.04	7.34^{b}	0.03	7.37^{b}	0.04	<0,0001	0.16
CP NEL^{-1}	g MJ^{-1}	28.7^{b}	0.3	27.0^{a}	0.3	35.4^{e}	0.3	32.5^{c}	0.3	34.1^{d}	0.3	36.3^{e}	0.3	35.3^{de}	0.3	<0,0001	1.5

PEQ: protein energy quotient

Results and discussion

In Table 1 the results from continuously grazed swards, contents in dry matter (DM) and organic matter (OM), under organic and East Alpine conditions are listed. The table shows the chronological sequence, from each sampling date with the forage feeding value during the vegetation period (2007-2009). Crude protein content decreased significantly, at a high level, from first (202 g kg^{-1} DM) to the second (175 g kg^{-1} in DM) sampling date but increased by the end of the vegetation period (228 g kg^{-1} DM). This observation is in accordance with results from Norway (Johansen,

2010) and Switzerland (Münger, 2003). Variability in crude protein contents (see Figure 1) of grazed swards were also found in investigations in north-east Germany (Braun, 2006) and may be caused by weather conditions. Similar to crude protein, the energy content decreased at the beginning (7.0 MJ NEL kg^{-1} DM), and stabilised at 6.5 MJ NEL kg^{-1} DM towards the end of the vegetation period (Figure 1). The generally high energy content underlines the high forage feeding value with continuous grazing. Similar NEL contents of 7.1 kg^{-1} DM (Schori, 2009) for rotational grazed swards were measured in a West Alpine area under organic conditions. Beside CP and NEL, the structural carbohydrates play an important role for fulfilment of fibre requirements of ruminants, which is a main focus for organic feed. NRC (2001) characterise the minimum NDF content for high performance dairy cows between 250 and 330 g kg^{-1} DM in the whole ration. This recommended range for ruminates was fulfilled at every sampling date and demonstrates the suitability of this type of fodder for seasonal pasture-based systems. In such systems grazed grass present the bulk of the daily ration and fibre supply is important for rumination. Regarding the content of NDF concentrate feeding is limited in pasture-based systems.

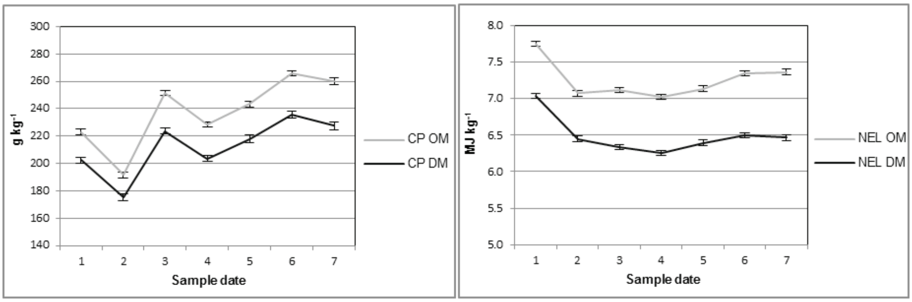

Figure 1. Chronological sequence of crude protein (left) and net energy lactation (right) and displayed standard error bar.

Conclusion

Continuous grazing provides fodder with high forage feeding value. The high contents, especially of energy and crude protein, are also reachable under the harsh climatic conditions of the Eastern Alps and with organic farming. In this case, continuous grazing in disadvantaged regions keeps up with favourable European grassland regions and could be a suitable system for small-scale organic grassland farms in Austria.

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