Management system and mineral nitrogen rate impact on the barley grain composition and its nutritional value for ruminants

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ABSTRACT

Many factors, most notably climate, soil, genotype and fertilising, can influence barley grain composition and its nutritive value. The aim of the research was to evaluate the impact of mineral N rate in different management systems in the static long-term experiment with three years field rotation of grain maize, wheat and barley on the chemical composition of winter barley and its nutritive value for ruminants. Crude protein content and metabolizable crude protein content were increasing with increased mineral N rates. Higher yield meant lower crude protein and metabolizable crude protein content in all mineral N rates. The average crude protein content of barley grain, presented in DLG tables (1997), which is 12.4%, was in MM and SM reached by fertilising rate 110 kg N.ha^{-1}. A significant impact of mineral N fertilising on crude ash, ether extract and crude fibre content could not be confirmed, nitrogen-free extract content was decreasing with increased mineral N rates. A significant impact of the management system on the Weende analysis parameters, net energy for lactation, metabolizable energy and metabolizable crude protein could not be confirmed. At both analyses a significant impact of the season was confirmed on crude protein content and nitrogen-free extract content. Although the protein content was increasing with increased mineral N rate from 9.2–14.2% (for 35%) ME content and NEL content did not significantly differ considering mineral N rate; ME.ha^{-1} and NEL.ha^{-1} increasing with increased mineral N rates was the result of the yield increasing with increased mineral N rates.

Keywords: winter barley; nutritional value; ruminants; Weende analysis; chemical composition; protein content

Barley (*Hordeum vulgare* L.) has always been a popular grain in the feeding of farm animals. In many parts of the world, it forms the main concentrate in the diets for pigs and ruminants (McDonald et al. 1995). Many factors, most notably climate, soil, genotype and fertilising, can influence its composition and nutritive value (Stekar and Stibilj 1989, Metayer et al. 1993, Valaja et al. 1997). As a result of variation in chemical composition, barley varies widely in bioavailable energy values (Zhang et al. 1994). In spite of the fact that cereal grain is mainly energetic feed, its protein content is an important source of amino acids in animal nutrition (Pirman and Orešnik 1999).

As with all cereal grains barley protein is of low quality, being particularly deficient in the amino acid lysine (McDonald et al. 1995, Jorgensen et al. 1999). Nitrogen (N) fertiliser supply increased the crude protein content of grain respectively digestible crude protein content of barley and lowered the lysine content in the protein in the experiments of Valaja et al. (1997), Fuller et al. (1989), Thomke (1970, 1976) and others. However, usually the reduced amount of lysine in protein is so slight that the total content of lysine in grain increases due to higher protein content (Thomke 1970). Negative correlation was detected between crude protein and crude fibre content (Horaczydski et al. 1981, cit. Jacyno 1995).

Metayer et al. (1993) found a big variability in Weende analysis parameters of different varieties, Stekar and Stibilj (1991) confirmed significant differences between years and a big influence of variety on the Weende analysis parameters. Between winter varieties, significant differences were confirmed in the contents of crude protein, crude fibre, nitrogen-free extract, starch and crude ash (Stekar and Stibilj 1988). However, the results of Weende analysis and minerals and amino acids composition analyses showed a relatively small degree of variability in these parameters among barley varieties grown at the same location under the same agrotechnique in Central Slovenia in 1997 (Pirman and Orešnik 1999).

Static long-term experiments were found as a good method to examine effectiveness of organic fertilisers in the combination with mineral fertilisers (Rauhe 1990, Boguslawski 1995). Over years, actual condition of the soil can be established and results really depend on the examined factors. The influence of different agrotechnique prior to the experiment is lessened over the years (Asmus 1995, Schulz 1997).

The aim of the research was to evaluate the impact of mineral N rate in different management systems in the static long-term experiment with three years field rotation of grain maize, wheat and barley on the chemical composition of winter barley and its nutritive value for ruminants.

MATERIAL AND METHODS

The experiment was conducted in 1993 in Murska Sobota (north-east Slovenia, 46°38’ northern latitude, 14°11’ eastern longitude, 184 m above sea level) as a part of European project IOSDV (long term static experiment

Table 1. Fertilising combinations, timing and mineral N rates to barley

	Fertilising combination	Average mineral N rates in circling per year (kg.ha^{-1})	Mineral N rates to barley (kg.ha^{-1})
N0 A	no fertilising	–	–
N3 A	mineral fertilising only	220	165 (70 EC 21/22, 70 EC 31/32, 25 EC 45/50)
N0 M	animal manure	50	–
N1 M	combinations of mineral fertilisers and animal manure	123	55 (55 EC 21/22)
N2 M		197	110 (55 EC 21/22, 40 EC 31/32, 15 EC 45/50)
N3 M		270	165 (70 EC 21/22, 70 EC 31/32, 25 EC 45/50)
N0 S	straw ploughing in and green manure	–	–
N1 S	mineral fertilising, straw ploughing in and green manure	73	55 (55 EC 21/22)
N2 S		147	110 (55 EC 21/22, 40 EC 31/32, 15 EC 45/50)
N3 S		220	165 (70 EC 21/22, 70 EC 31/32, 25 EC 45/50)

with three years filed rotation of grain maize, wheat and barley in a way that each crop is sown every year) on loamy sand soil (14.7% clay, 31.2% loam, 54.1% sand), classified as gleyic aerosol. Climate is semiarid (Pannonic) with an average of 810 mm precipitation and temperature of 9.4°C. The depth of water table is 2.5 m. The experimental layout are three blocks (three replications) with 10 fertilising combinations, which can be combined in 6 ways of management considering soil organic matter conserving and intensity of farming (mineral N rate) (Table 1). Plots are 30 m^2 (6 m × 5 m); each is treated the same way from the beginning (A – no organic fertilising, M – 30 t.ha^{-1} animal manure before maize, S – straw, maize straw ploughing in and green manure, N0, N1, N2, N3 – different mineral N rates KAN). Plots within system of management with straw get in average additional 20 kg.ha^{-1} mineral N yearly for straw mineralisation. All the other treatments in terms of ploughing, cultivation, seeding rate, sowing method and PK fertilisers are the same for all plots. Phosphorus and potassium are applied at rates equivalent to 133 kg K.ha^{-1} and 33 kg P.ha^{-1} yearly. Plots are harvested with a combine.

Samples of winter barley cv. Rex were taken at harvest in 2000 and 2001 from each plot. In 1999, sowing was on September 27, in 2000 on September 28 at seed rate of 250 kg.ha^{-1}. Weeds were controlled with a post-emergence herbicide (triasulfuron + clortoluron). The harvest was on June 15 in 2000 and June 26 in 2001. Average temperatures and monthly precipitation in 1999/2000, 2000/2001 seasons and long-term average for Murska Sobota are presented in Table 2.

Weende analysis parameters were estimated according to standard methods (Naumann and Bassler 1976). Dry matter was estimated by drying at 105°C for 3 hours, nitrogen content was estimated by the Kjeldahl method and multiply by factor 6.25 to convert nitrogen to crude protein content (CP). Crude fibre content (CF) is determined as a part of the sample, which remains after 30 minutes cooking in 1.25% sulphuric acid and afterwards for 30 minutes in 1.25% potassium hydroxid. Ether extract (EE) is the part of the sample soluble in ether and was estimated by ether extraction in Soxhlet apparatus. Total ash (CA) was determined gravimetrically by weighing the remains of the sample left after burning at 550°C. Nitrogen-free extract (NFE) was estimated as the part of the sample left after all the other parameters were deducted. Digestibility coefficients were used as presented in DLG tables (DLG 1997). Calculations of net energy for lactation (NEL), metabolizable energy for ruminants (ME) and metabolizable crude protein (MCP) were calculated according to DLG tables.

Analyses of variance were done for three-factors trial (fertilising combinations, management systems, years). The impact of mineral N fertilising on the Weende analysis parameters and nutritional value of barley was examined in two ways:

Table 2. Precipitation (P) and average temperatures (T) by month in growing seasons 1999/2000 and 2000/2001 and long-term average in Murska Sobota, NE Slovenia (AGROMET 1997–1999)

Month	9.	10.	11.	12.	1.	2.	3.	4.	5.	6.	7.	8.
T 1999/2000 (°C)	17.3	10.8	2.5	–0.2	–3.5	3.7	6.5	13.7	16.9	20.3	19.4	22.0
T 2000/2001 (°C)	15.4	12.3	8.3	2.5	1.3	3.6	8.5	9.5	17.2	17.7		
T long-term average (°C)	14.9	9.4	4.2	–0.5	–2	0.5	5	9.8	14.6	17.8	19.5	18.6
P 1999/2000 (mm)	21	59	57	70	5	20	41	37	58	46	88	13
P 2000/2001 (mm)	90	89	90	74	38	1	73	68	32	101		
P long-term average (mm)	76	70	73	47	34	36	47	58	71	98	100	100

Table 3. Significance of differences between factors and their interactions in MM and SM when four mineral nitrogen rates (N0, N1, N2, N3) were included

	CA	CP	EE	CF	NFE	ME	NEL	Yield	ME.ha^{-1}	NEL.ha^{-1}	MCP	MCP.ha^{-1}
System	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Rate	NS	***	NS	NS	***	NS	NS	***	***	***	***	***
Year	NS	***	**	NS	***	*	NS	NS	NS	NS	NS	NS
Interactions												
System × rate	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
System × year	NS	NS	NS	**	NS	NS	NS	NS	NS	*	NS	*
Rate × year	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
System × rate × year	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS = not significant, * significant at $p < 0.05$, ** significant at $p < 0.01$, *** significant at $p < 0.001$

- within two management systems with organic fertilising: management of cattle raising farms where cattle manure (MM) is used and management where organic matter in the soil is maintained with straw, maize straw ploughing and with green manure (SM); four mineral N fertilising rates were included in both systems (N0, N1, N2, N3)
- within three management systems: MM, SM and system without organic fertilising (AM – mineral fertilising only); two mineral N fertilising rates were included in each system (N0 and N3)

Differences among main factors were detected by an ANOVA protected Duncan multiple test at $p < 0.05$. For significantly different factors standard errors of average differences and appertain critical values were calculated ($p < 0.05$). Relationships between certain parameters were examined by regression analysis.

RESULTS AND DISCUSSION

Chemical composition by Weende analysis

Differences between factors and their interactions in MM and SM when four mineral nitrogen (N) rates were included are presented in Table 3, differences between factors and their interactions in MM, SM and AM when two mineral N rates were included are presented in Table 4.

Crude protein content

There was in the average 115 g CP per kg of dry matter of the examined barley grain samples. Mineral N fertilising increased CP content within management systems with organic fertilising (MM and SM) (Table 3). Even more, each mineral N rate significantly increased CP content (Table 5). The same results were obtained in the experiment of Čeh Brežnik and Tajnšek (2000), Peers and Taylor (1977), and by many others authors, in the experiment of Valaja et al. (1997) higher mineral N rate caused higher CP content. Although the protein content was increasing with increased mineral N rate from 9.2–14.2% (Table 5) (by 35%) ME content and NEL content did not differ considering mineral N rate (Table 3). In the first examined season (2000) the CP content was significantly lower when compared to the next one (2001). A significant impact of the management system on the CP content could not be confirmed.

CP content decreased with yield increase. Yield, higher by one tone, meant decrease in CP content by 4.9 g.kg^{-1}

Table 4. Significance of differences between factors and their interactions in MM, SM and AM when two mineral N rates (N0, N3) were included

	CA	CP	EE	CF	NFE	ME	NEL	Yield	ME.ha^{-1}	NEL.ha^{-1}	MCP	MCP.ha^{-1}
System	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Rate	NS	***	NS	NS	***	NS	NS	***	***	***	***	***
Year	NS	***	NS	*	***	NS	NS	**	**	**	NS	**
Interactions												
System × rate	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
System × year	NS	NS	NS	*	NS	NS	NS	*	*	*	NS	*
Rate × year	NS	*	NS	*	NS	NS	NS	*	*	*	NS	*
System × rate × year	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Legend see Table 3

Table 5. Significance of differences in crude protein content (g.kg^{-1} DM) in MM and SM when four mineral nitrogen rates (N0, N1, N2, N3) were included; $p < 0.05$ according to Duncan test

	2000	2001	Average
N0	88	96	92 a
N1	96	109	103 b
N2	124	126	125 c
N3	140	144	142 d
Average	112	119	

Table 6. CP and MCP decrease (g.kg^{-1} DM) with one tone yield increase

N rates	CP decrease/t yield increase	MCP decrease/t yield increase
N0	8.7	2.3
N1	8.3	2.9
N2	5.1	0.8
N3	4.9	1.2
Average	(R^2 = 95%)	(R^2 = 90%)

DM (at N3) to 8.7 (at N0) g.kg^{-1} DM considering mineral N rate (dilution effect) (Table 6); absolute value of decrease was decreasing with increased mineral N rates (there was more available N in the soil with higher mineral N rates).

Comparing MM, SM, AM when two mineral N rates were included (N0 and N3) showed that there was significantly higher CP content in 2001 in comparison with previous season (2000) in N0 rate, but there was no difference between seasons in N3 mineral N fertilising rate (Tables 4 and 7). In both years, there was higher CP content in N3 in comparison with N0 mineral N fertilising rate. The impact of management system on the CP content could not be confirmed.

Pirman and Orešnik (1999) found that the CP content of barley grown in Slovenia is lower while comparing values presented in nutritional tables, which should be considered when composing feed mixtures. The average CP content of 690 barley samples, presented in DLG tables (1997), which is 124 g.kg^{-1}, was reached by N2 fertilising rate in MM and SM in our experiment, in N3 it was even higher (Table 5). Considering results of our experiment there should not be problems if 110 kg.ha^{-1} mineral N or more is given to barley.

Crude fibre content

There was in the average 51 g CF per kg dry matter of barley grain. Mineral N fertilising did not have a significant impact on the CF content when comparing MM and SM (Table 3). Significant was only the interaction between management system and year. The systems differed in the CF content in the second examined year (2001), but not in the first (2000) (Table 8). CF content was in SM higher in the second examined season; in MM it did not differ considering season.

Comparing MM, SM, AM when N0 and N3 mineral N rates were included showed significant difference between years. In the second examined year (2001) the CF content was higher by 3 g when compared with previous year (2000); significant differences between years were in SM but not in MM and AM. In the second year, there was higher CF content in SM compared with MM (Table 9). A significant impact of management system and mineral N rate on the CF content could not be confirmed. Management system and mineral N rate impacted on the CF content differently considering season. In the second examined year differences in CF content could not be confirmed, in the previous year lower CF content was caused by higher mineral N rate (Table 10). In the experiment of Peers and Taylor (1977) CF content was decreasing with increased mineral N rate till 120 kg N ha^{-1}, but with the next N fertilising rate (180 kg N ha^{-1}) it was increased. At N0 rate CF content was the same in both seasons, at N3 rate it varied more than it varied between mineral N rates within years (Tables 9 and 10).

While Horaczydski et al. (1981, cit. Jacyno 1995) found negative correlation between CP and CF content no such correlation was found in our experiment.

Ether extract content

There was on average 28 g EE per kg dry matter of barley grain. While in the experiment of Peers and Taylor (1977) EE was higher at 60 kg N.ha^{-1} fertilising rate com-

Table 7. Significance of differences in crude protein content (g.kg^{-1} DM) in MM, SM and AM when two mineral N rates (N0, N3) were included; $p < 0.05$ according to Duncan test

	2000	2001	Difference (2000–2001)	Average
N0	87	97	10*	92 a
N3	141	144	3	142 b
Difference	54*	47*		
Average	114 a	120 b		

* significant at $p < 0.05$

Table 8. Significance of differences in crude fibre content (g.kg^{-1} DM) in MM and SM when four mineral N rates (N0, N1, N2, N3) were included

	MM	SM	Difference (2000–2001)	Average
2000	51	48	3	49
2001	49	54	5*	52
Difference	2	6*		
Average	50	51		

* significant at $p < 0.05$

Table 9. Significance of differences in crude fibre content (g.kg^{-1} DM) in MM, SM and AM when two mineral N rates (N0, N3) were included; $p < 0.05$; the values in a row indicated with the same letter are not significantly different

	AM	MM	SM	Average
2000	49 a	52 a	48 a	50
2001	53 ab	49 a	56 b	53
Difference	4	3	8*	
Average	51	50	52	

* significant at $p < 0.05$

Table 10. Significance of differences in crude fibre content (g.kg^{-1} DM) in MM, SM and AM when two mineral N rates (N0, N3) were included

	N0	N3	Difference (2000–2001)	Average
2000	52	47	5*	50
2001	52	54	2	53
Difference	0	7*		
Average	52	51		

* significant at $p < 0.05$

pared with control, afterwards it was decreasing, a significant impact of mineral N fertilising on this parameter could not be confirmed in our experiment as was not the significant impact of management system with organic fertilising (MM and SM) (Table 3). There was higher content of EE in the second examined year (for 12 g.kg^{-1}).

Comparing MM, SM and AM when N0 and N3 mineral N fertilising rates were included no differences in EE content could be confirmed (Table 4).

Ash content

There was on average 27 g ash per kg dry matter of barley grain. No significant differences in CA considering management system, years and mineral N fertilising could be confirmed (Tables 3 and 4). This is similar with results of Peers and Taylor (1977) and Valaja et al. (1997), but not with findings of Jřrgensen et al. (1999) who found significant decrease in the CA content with increased mineral N rates.

Nitrogen-free extract content

There was on average 779 g NFE per kg dry matter of barley grain. Comparing MM and SM when four mineral N rates were included showed significant difference in NFE content between seasons and a significant impact of mineral N (Table 3). In the first year there was on average 791g of NFE per kg DM of barley grain, in the second season 766g. Increasing mineral N fertilising rate lowered the NFE content (Table 11), that was true in the experiment of Peers and Taylor (1977), and with one exception (one variety of three on one mould type of soil) in the experiment of Valaja et al. (1997).

The same results were obtained when comparing all three examined systems with two mineral N rates included.

Our findings agree with Stekar and Stibilj (1991) who confirmed a significant impact of the season on the Weende analysis parameters in CP and NFE content in both analyses, but not in the CA where differences between seasons in our experiment could not be confirmed. Considering Pirman and Orešnik (1999) who found small degree of variability in Weende analysis parameters between barley varieties grown at the same location under the same agrotechnique, on the basis of the results of our experiment N3 fertilising rate for winter barley at all examined management systems would be suggested.

NUTRITION VALUE FOR RUMINANTS

Metabolizable energy content and metabolizable energy yield

One kilogram of barley grain dry matter contained on average 12.78 MJ of ME. With each 1,000 MJ ME.ha^{-1} we gained 13.6 kg metabolizable crude protein. Comparing MM and SM when four mineral N rates were included showed that ME content differed significantly between seasons but not between systems and mineral N rates (Table 3). In the first examined year, the ME content was 12.72 MJ per kg of grain DM, in the second examined year 12.83 MJ. When MM, SM, AM with two mineral N rates

Table 11. Significance of differences in metabolizable energy (ME) (MJ.ha^{-1}), net energy for lactation (NEL) (MJ.ha^{-1}), metabolizable crude protein content (MCP) (g.kg^{-1} DM), MCP yield (kg.ha^{-1}) and nitrogen-free extract content (NFE) (g.kg^{-1} DM) by mineral N rates in MM and SM when four mineral nitrogen rates (N0, N1, N2, N3) were included; $p < 0.05$ according to Duncan test

N rates	ME.ha^{-1}	NEL.ha^{-1}	MCP	MCP.ha^{-1}	NFE
N0	38,677 a	24,334 a	155 a	470 a	795 a
N1	58,408 b	36,735 b	158 b	723 b	791 a
N2	67,436 c	42,377 c	164 c	860 c	771 b
N3	69,007 c	43,337 c	168 d	905 c	757 b
Average	58,382	36,696	161	739	779

Table 12. Significance of differences in metabolizable crude protein (kg.ha^{-1}) in MM, SM and AM when two mineral nitrogen rates (N0, N3) were included; $p < 0.05$

	AM	MM	SM	Average
2000	713 a	699 a	732 a	715
2001	648 ab	714 a	605 b	656
Difference	65	15	127*	
Average	681	707	668	

* significant at $p < 0.05$

included were compared, no significant differences could be confirmed (Table 4).

While an increased CF content usually lowers the energy content of barley for pigs (Teverner and Farrell 1981) there was no relation between CF content and ME content for ruminants in our experiment.

On average 57,333 MJ ME per ha was produced with barley in our experiment. Comparing MM and SM when four mineral N rates were included confirmed the difference between mineral N rates, but not between seasons and systems (Table 3). ME yield per ha was increasing with increased mineral N rates, although there was no significant difference between N2 and N3 rates (Table 11). Comparing MM, SM and AM when two mineral N rates were included confirmed significant differences between mineral N rates and seasons (Table 4).

NEL content and NEL yield

One kilogram of barley grain dry matter gave in the average 8.03 MJ of NEL. There were no significant differences between mineral N rates and seasons.

Average NEL per ha was 36,035 MJ. With each 1,000 MJ NEL.ha^{-1} we gained 21.6 kg MCP. Comparing MM and SM when four mineral N rates were included showed significant impact of mineral N fertilising on this parameter. There was significant interaction between mineral N rate and season (Table 3). Increasing mineral N fertilising meant increasing of NEL.ha^{-1}. Maximum NEL.ha^{-1} was obtained at N3 rate, although significant difference could not be confirmed between N2 and N3 rates (Table 11).

Table 13. Significance of differences in metabolizable crude protein (kg.ha^{-1}) by mineral N rates in MM, SM and AM when two mineral nitrogen rates (N0, N3) were included; $p < 0.05$ according to Duncan test

	N0	N3	Difference	Average
2000	517	912	395*	715 a
2001	410	902	492*	656 b
Difference	107*	10		
Average	463 a	907 b		

* significant at $p < 0.05$

Comparing MM, SM and AM when two mineral N rates were included showed a significant impact of mineral N rate and season. Beside significant interaction between management system and season, this analysis showed significant interaction between mineral N rate and season.

Metabolizable crude protein content and yield

One kilogram of barley grain dry matter contained in the average 161 g of MCP. Comparing MM and SM showed significant impact of mineral N fertilising on the MCP content (Table 3). MCP content was increasing with increased mineral N rates (Table 11). The same results were obtained by the analyses of MM, SM and AM when two N rates were included (Table 4).

Higher yield meant lowering of MCP content in all the four mineral N rates, but its absolute value was not decreasing with increased mineral N rates as was true with CP content (Table 11). Yield, increased by one tone, resulted in 0.8–2.9 g.kg^{-1} decrease in MCP content considering mineral N rate.

There was in the average 728 kg of MCP.ha^{-1}. The biggest yield of MCP was achieved at the highest N rate (N3), although significant difference between N2 and N3 rates could not be confirmed (Table 12). Comparing MM, SM, AM with two N rates showed significant impact of season on the MCP yield in SM and differences between systems in the second season, there was the biggest MCP yield in MM and the smallest in SM (Table 12). At both N rates (N0 and N3) there was lower MCP yield in the second season when compared with first one, but at N3 significant differences between seasons could not be confirmed (Table 13).

CONCLUSIONS

A significant impact of mineral N rate on ME content and NEL content of barley grain could not be confirmed, while ME.ha^{-1} and NEL.ha^{-1} were increasing with increased mineral N rates. Although the protein content was increasing with increased mineral N rate from 9.2–14.2% (by 35%) ME content and NEL content did not significantly differ considering mineral N rate, ME.ha^{-1} and NEL.ha^{-1} increasing with increased mineral N rates was the circumstance of the yield increasing with increased mineral N rates.

A significant impact of mineral N fertilising on CA, EE, CF could not be confirmed, NFE was decreasing with increased mineral N rates.

As CP content, also MCP content was increasing with increased mineral N rates. Higher yield meant lower CP and MCP content in all mineral N rates.

A significant impact of the management system on the Weende analysis parameters, NEL content, ME content and MCP could not be confirmed.

At both analyses, a significant impact of the season was confirmed on CP content and NFE content.

Abbreviations

N – nitrogen, MM – management system with animal manure ploughing in, SM – management system with straw and maize straw ploughing in, AM – management system with mineral fertilising only, CA – crude ash, CP – crude protein, EE – ether extract, CF – crude fibre, NFE – nitrogen-free extract, ME – metabolizable energy, NEL – net energy for lactation, MCP – metabolizable crude protein

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ABSTRAKT

Vliv systému hospodaření a dávek minerálního dusíku na složení zrna ječmene a jeho nutriční hodnotu pro přežvýkavce

Složení zrna ječmene a jeho nutriční hodnotu ovlivňuje řada faktorů, zejména klimatické a půdní podmínky, genotyp a hnojení. Cílem výzkumu bylo zhodnocení vlivu dávek minerálního N při různých systémech hospodaření ve stacionárním dlouhodobém pokusu s tříletým osevním postupem kukuřice na zrno, pšenice a ječmene na chemické složení zrna ozimého ječmene a jeho nutriční hodnotu pro přežvýkavce. Obsah N látek a obsah využitelných N látek se zvyšoval se stoupajícími dávkami minerálního N. Vyšší výnos znamenal nižší obsah N látek a využitelných N látek při všech dávkách minerálního N. Průměrný obsah N látek v zrnu ječmene uvedený v tabulkách DLG (1997), který činí 12,4 %, byl dosažen aplikací dávky 110 kg N.ha^{-1} při systému organického hnojení. Významný vliv hnojení minerálním N na obsah popelovin, extraktu éterem a vlákniny nebyl potvrzen, obsah bezdusíkatých výtažkových látek klesal se stoupajícími dávkami minerálního N. Rovněž nebyl potvrzen významný vliv systému hospodaření na ukazatele Weendeho analýzy, netto energii pro laktaci (NEL), metabolizovatelnou energii (ME) a využitelný dusík. Při obou analýzách jsme zjistili významný vliv ročního období na obsah N látek a na obsah bezdusíkatých výtažkových látek. Ačkoliv se obsah N látek zvyšoval se stoupající dávkou minerálního N od 9,2 do 14,2 % (o 35 %), rozdíl mezi obsahem ME a NEL nebyl významný, pokud jde o dávku minerálního N; zvýšení $ME.ha^{-1}$ a $NEL.ha^{-1}$ se stoupajícími dávkami minerálního N znamenalo zvýšení výnosu se stoupající dávkou minerálního N.

Klíčová slova: ozimý ječmen; nutriční hodnota; přežvýkavci; Weendeho analýza; chemické složení; obsah bílkovin

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