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EFFECTIVENESS OF PERMANENT MEADOW FOLIAR FERTILISATION WITH NITROGEN

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ABSTRACT

In the present research an effectiveness of soil fertilisation with lower dosages of nitrogen combined with top supplying with a 10% water solution of carbamide was compared with that of the standard test soil fertilisation (PK + 220kg N/ha). A similar reaction of meadow sward in both cases of nitrogen feeding was observed. Fertilising the soil only with 55 kg of N/ha along with foliar fertilisation caused neither a decrease in the yield nor its quality. The application of the second spray for the second cut did not cause any decrease in yield, however it had positive effect on the content of total protein and crude fibre in the feed. A significant impact of the subsequent years of fertilisation on the combined effect of soil and foliar nitrogen fertilisation with carbamide solution was noted.

Key words: grassland, yielding, total protein, crude fibre, soil nitrogen fertilisation, foliar fertilisation with carbamide.

INTRODUCTION

Crop foliar fertilisation is not a new problem; the results of numerous researches [1,3,16,17] showed that that method of providing fruits, vegetables, cereals and root crops with nutrients causes an increase in yields and does not pose a threat to the environment.

Extensive research [4,11,14] on grassland fertilisation calls for new solutions as regards fertilisers which should be cost-effective, efficient and fast acting. Bearing in mind a scarcity of research on grass community foliar fertilisation, an attempt has been made to compare soil fertilisation with nitrogen with such when accompanied by foliar fertilisation.

MATERIALS AND METHODS

The research was conducted on the border between the Siedlce Highlands and Lukow Plain in the Zawady Agricultural Research Institute from 1993 to 1996 on mineral permanent meadow. The test trial was set on the ground gley soil of light soil origin. In its humic layer, the soil showed a neutral pH and a high content of available phosphorus and potassium and an average magnesium content (compliant with The fertilisation guidelines for the RZD - Zawady issued by Regional Agricultural Chemistry Research Institute in Wesola in 1992). The field trial was set with a randomised block design with four replications on 15 (3 x 5) sq. m plots.

The impact of mineral fertilisation with nitrogen was researched when soil-introduced only and when accompanied by foliar fertilisation on yield and on the content of nutrients in feed. With lowered nitrogen doses being applied in soil fertilisation (namely 110 and 55 kg N/ha) foliar fertilisation with a 10% water solution of carbamide was used (namely, 13.8 kg N/ha) once and twice within a single cut regrowth. A control test combination consisted of soil fertilisation with nitrogen at the amount of 220 kg N/ha. Phosphorus and potassium was constant for all the fertiliser combinations. Once, in spring, 80 kg of $P_2 O_5$/ ha was applied in a form of triple superphosphate and 40 kg K_2O/ha for each regrowth as a potassium salt.

The following fertiliser combinations were applied:

1. PK + 220 kg N/ha
2. PK + 110 kg N/ha
3. PK + 55 kg N/ha
4. PK + 110 kg N/ha + 10% carbamide solution x 1 spray
5. PK + 110 kg N/ha + 10% carbamide solution x 2 sprays
6. PK + 55 kg N/ha + 10% carbamide solution x 1 spray
7. PK + 55 kg N/ha + 10% carbamide solution x 2 sprays

During the vegetation period three cuts were collected. Straight afterwards green mass was weighed, separately from each plot, and 0.5 kg of green mass was sampled to calculate the initial drying coefficient, and then for chemical analyses. Hay chemical analyses were conducted for the three cuts to determine the contents of crude fibre: the Henneberg-Stohmann method, Lepper modification, total nitrogen: Kjeldahl method to calculate total protein content (% N x 6.25). For each of the traits researched, a variation analysis was made compliant with the model for randomised block design with repeated sets [15]. The analysis was complimented with adequate orthogonal contrasts.

A three- year research period showed a considerable variety in weather conditions during vegetation, as compared with the mean values for the respective period. All the years were definitely warmer and drier. The highest temperatures were observed in 1995, especially from May to August. The mean temperature in July was 5°C higher than the mean value for the respective period with significantly lower rainfalls. The rainfall for the years of research being conducted did not differ significantly from the mean values for the respective period, however it had a very unfavourable timing during the vegetation period. From June to August 1994 and from April to August 1995 considerable rainfall shortages were observed. In July 1994 the rainfall amounted to 0.4 mm only.

RESEARCH RESULTS

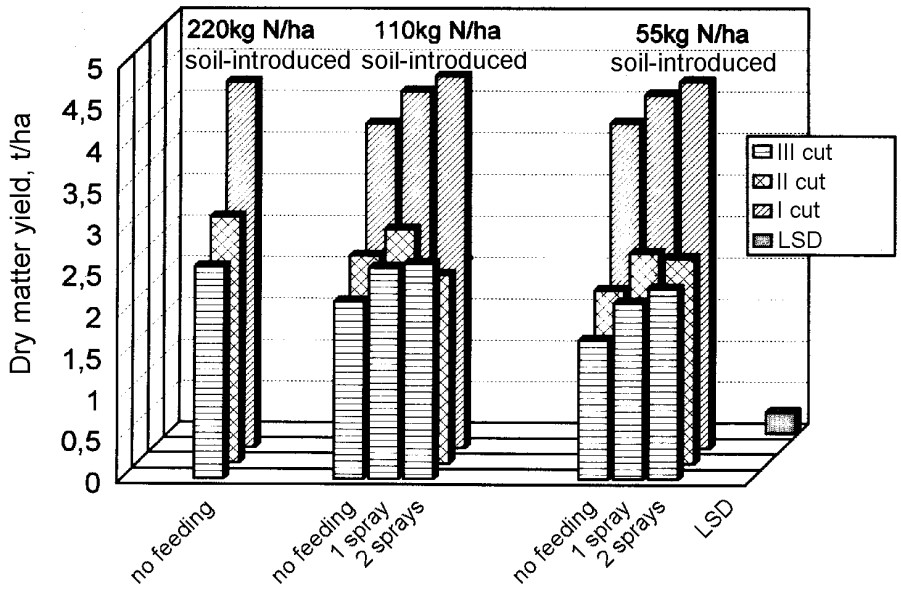
Hay yield remains one of the crucial criteria to determine an efficiency of grassland fertilisation. In the present research a considerable impact of the dose and the nitrogen application method on crop yields was analysed. However compounding the methods tested of providing meadow sward with nutrients differentiated the yields in subsequent researched years significantly. The average dry matter yield (Table 1) in the years 1994-1996 amounted to, respectively: 8.53; 9.32; 9,49 tons per ha. The total hay yield obtained from the soil-fertilised objects amounted to 110 or 55 kg N/ha calculated together with foliar fertilisation did not differ significantly from the yield where a standard fertilisation was applied and amounted to, respectively: 9.19; 9.68 and 9.82 tons per one ha of dry matter. A thorough statistical analysis showed a significant increase in yield as the result of the second dosage of foliar fertilisation being applied only in the first year of research, however in the subsequent

years the differences showed to be insignificant. However the analysis of spray amounts of foliar fertilisation for respective cuts (Fig. 1) showed a significant increase in yield when sprayed for the second time for the first and third regrowths. However the treatment proved futile for the second regrowth. Determining the amounts of foliar fertilisation for respective regrowths requires a thorough diagnosis of the weather factors and economic requirements on permanent meadow cropping. A high temperature and low humidity during the meadow sward summer regrowth can lower the effectiveness of foliar fertilisation. The insignificant differences, observed in the present research, in cropping between the standard mineral fertilisation (PK + 220 kg N/ha) and combined fertilisation (110 or 55 kg N/ ha, soil-introduced, plus a 10% water solution of the carbamide top-supplied) showed that the compound effect of soil fertilisation combined with foliar fertilisation may contribute to a more intensive and safer for the environment grassland farming.

Table 1. Mean dry matter yield (ton/ha) and organic nutrient contents (% in dry matter) depending on the fertilisation

OBJECTS	Dry matter yield (t/ha)				Total protein content (% in dry matter)				Crude fibre content (% in dry matter)			
	Years				Years				Years			
	1994	1995	1996	Mean	1994	1995	1996	Mean	1994	1995	1996	Mean
220kg N/ha (control test)	9,74	9.65	10.46	9.95	15.00	18.93	17.69	17.21	22.86	23.64	22.37	22.96
110kg N/ha	7.70	9.38	8.28	8.45	13.87	17.18	17.18	16.08	23.54	24.29	24.17	23.99
55kg N/ha	6.58	8.85	7.72	7.72	13.27	16.04	14.35	14.55	24.28	24.46	23.83	24.19
110kg N/ha + 1 spray	9.04	9.51	10.48	9.68	13.64	17.04	15.14	15.27	22.71	2.86	23.82	23.46
110kg N/ha + 2 sprays	9.65	9.59	10.34	9.86	13.88	17.40	15.66	15.62	24.75	24.42	23.53	24.23
55kg N/ha + 1 spray	8.12	9.13	9.51	8.92	13.11	15.96	13.82	14.30	23.41	24.29	23.23	23.65
55kg N/ha + 2 sprays	8.86	9.11	9.62	9.19	13.38	16.34	14.65	14.79	23.83	24.55	23.85	24.08
Mean	8.53	9.32	9.49		13.72	16.98	15.50		23.63	24.21	23.54	
$NIR_{0.05}$	For years - 0.20 For objects - 0.37 For the interaction of years x objects - 0.44				For years - 0.99 For objects - 0.41 For the interaction of years x objects - 0.67				For years - 0.60 For objects - 1.13 For the interaction of years x objects - 0.70			

Figure 1. Mean dry matter yield (ton/ha), depending on the fertilisation level and method for respective cuts.



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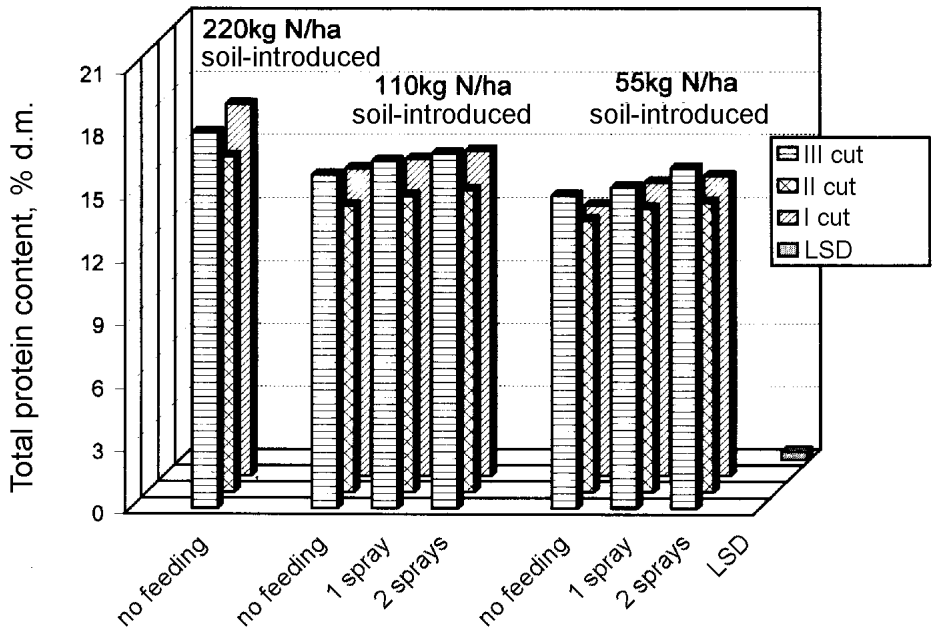
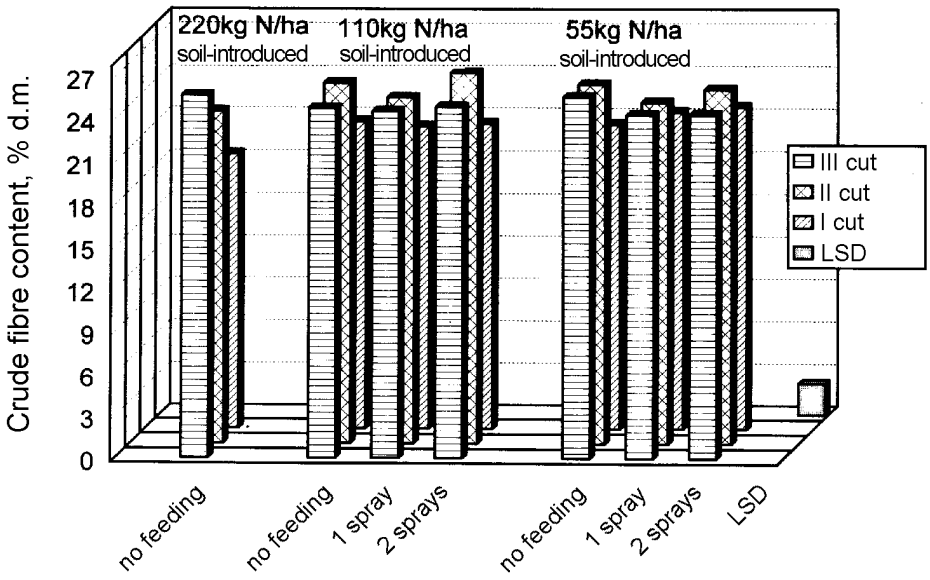
One of the more essential indicators of feed nutritive value is the total protein content. As seen from the data presented in Table 1, its content in the feed dry matter changed due to the fertilisation applied and its values differed. In respective years, a significantly higher mean level of that nutrient was observed in 1995. Analysing the impact of the variants of nitrogen fertilisation, the highest mean protein content (17.21 % in dry matter) was observed under the standard fertilisation (PK + 220 kg N/ha). Significant differences in the total protein content were observed in the feed from subsequent regrowths. The evaluation of the combined effect of soil fertilisation with foliar fertilisation (Fig. 2) showed a higher content of that nutrient under two-time spray with carbamide solution for each regrowth. Foliar fertilisation with carbamide solution while applying lower doses of soil-introduced nitrogen (even up to 55 kg N/ha) had a favourable effect on the total protein content in feed, which was compliant with the feeding standards.

Figure 2. Mean total protein content (% in dry matter), depending on the fertilisation level and method for respective cuts.



A crude fibre content is yet another essential feed quality indicator. Estimating the impact of foliar fertilisation (Table 1) on the level of its content in feed, a higher content was observed when the second spray was applied. Significant content differences were also observed in the yields from subsequent vegetation seasons and respective regrowths. The object where the standard fertilisation was applied, the crude fibre content increased for subsequent regrowths (Fig. 3), however for the combinations with foliar fertilisation, the highest content was observed in the feed from the second regrowth. A compound effect of soil fertilisation and foliar fertilisation gave different crude fibre contents in the feed researched independently of the dose of the soil –introduced nitrogen.

Figure 3. Mean crude fibre content (% in dry matter), depending on the fertilisation level and method for respective cuts.



DISCUSSION

A significance and attractiveness of grassland fertilisation is evident from numerous multi-year research [4,7,9,11,14]. Farming grasslands, high yields can be obtained e.g. due to high fertilisation [5,9]. A continuous agricultural production intensification also due to an increase in nitrogen fertilisation resulted in numerous unfavourable environmental changes. Consequently, more and more frequently, the authors [13,18] started to draw attention to lowering nitrogen doses on grasslands and continuing research on combined effects of various fertilisation methods. Here foliar fertilisation can be of great importance [414] economising on fertiliser is possible thanks to its high effectiveness and fast acting. The results of research conducted on fruits [6,10], vegetables [8], cereals [3,12] and root crops [2] showed that the foliar fertilisation with nitrogen has a double or even greater effect, as compared with the nitrogen introduced into the soil.

The above are also confirmed by the present research on grasslands, where combined fertilisation was applied (55 kg N/ha plus foliar fertilisation with a 10% carbamide solution) on grasslands which gave similar results, as compared with those of the standard fertilisation.

The attempts of partial replacement of soil introduced nitrogen fertilisation with foliar fertilisation on grasslands made, presented in the present paper, remain a novelty. The research is quite difficult; e.g. due to multi-species being found in meadow communities. Consequently, the evaluation of the results obtained is not an easy task and it requires even more thorough research.

CONCLUSIONS

8. The level of yields shows that combined fertilisation (110 or 55 kg N/ha introduced into the soil and combined with foliar fertilisation with the carbamide solution) gives similar results to those of the standard fertilisation (PK + 220kg N/ ha).
9. Slight differences in the contents of total protein and crude fibre observed due foliar fertilisation do not change the feed nutritive value.
10. Similar contents and quality of the traits analysed in hay call for a need to apply economic calculations as significant in foliar fertilisation on grasslands.

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