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ROLE OF WHITE CLOVER IN THE IMPROVEMENT OF ECONOMICAL EFFICIENCY OF FEEDS FROM GRASSLANDS

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Abstract

The aim of the research was to analyse the role played by white clover in the improvement of economical efficiency of feeds obtained from permanent grasslands. The influence of the proportion of white clover in the pasture sward on unit production costs of yield, energy and crude protein and the profit threshold in milk production was analysed taking into account three white clover cultivars, nitrogen fertilisation, irrigation and overdrilling. The investigation procedures employed the author's own calculation models elaborated in optimisation programs based on production conditions found in dairy farms in the region of Wielkopolska. It was proved that the role of different cultivars of white clover in reducing unit production costs of DM, NEL and CP as well as of profit threshold in milk production is greater in conditions of the absence or low level of nitrogen fertilisation and without irrigation. Among the examined cultivars, Astra was found to be the most beneficial. Overdrilling of pastures with white clover increased fodder economical efficiency more in conditions of lack of nitrogen fertilisation.

Keywords: cultivar, feed economical efficiency, grassland, white clover

Introduction

Among leguminous plants used on permanent grasslands white clove appears to be the most important. White clover enriches pasture forage in protein, mineral components and increases energy concentration in herbage. Its presence in sward improves its palatability and increases its utilisation efficiency. The role that white clover plays in reducing nitrogen fertilisation of grasslands, due to its symbiotic co-existence with *Rhizobium*, is unquestionable and, therefore, the plant is often referred to as environmentally friendly.

In this context it is interesting to ascertain the extent of economical advantages which could be attributed to the presence and maintenance of white clover in permanent grasslands, especially in view of the fact that there is little available information concerning economical justification of introduction of white clover into pasture sward botanical composition in the process of their renovation.

The aim of this research was to assess the role played by white clover in increasing economical efficiency of feed from permanent grasslands.

Material and Methods

The influence of white clover on economical efficiency of feeds was analysed using the author's own models developed in optimisation programs based on production conditions found in dairy farms in the region of Wielkopolska. The period of summer feeding, typical for the region where the described investigations were carried out, during which pasture sward was used as the basis of feeding amounted to 165 days. Current prices from the beginning of 2000 were used for the performed calculations (1 PZL = 0,24 US$). Other methodological data can be found in other publications (Goliñski, 1997; 1998). For the purpose of analysis of the research objective, initial data which were considered as the most characteristic ones for conditions of the region where experiments were conducted, were employed. The employed

data referred to the presence of white clover in grasslands, including the feeding effect, i.e. intake of dry matter by cows and milk production (Ostrowski and Daczewska, 1988).

Results and Discussion

The influence of the proportion of white clover in sward botanical composition on unit production costs of yield, energy and protein was analysed during three years of pasture utilisation renovated according to the method of conventional tillage taking into account different levels of nitrogen fertilisation, sprinkling and three white clover cultivars applied in mixtures. It turned out that the cheapest forage could be obtained in the absence of nitrogen fertilisation, although the lowest cost of production of energy unit was achieved without sprinkling, while the lowest cost of production of 1 kg DM and 1 kg CP was observed in irrigated treatments (Table 1). Sprinkling resulted in a considerable increase of yield as well as in the increase of white clover proportion in sward. It means that the irrigation expenditures were well compensated for by yields obtained from the pasture.

Also nitrogen fertilisation contributed to yield increases by markedly decreasing the proportion of white clover in sward. This correlation is reported by many researchers, among others González-Rodriguez (1998). However, the effectiveness of nitrogen supplied as mineral fertilisers was too small to exert any influence on the reduction of production unit costs of DM, NEL and CP. In comparison with the treatment without fertilisation, a drop of production costs of 1 kg CP was recorded only in the sward with the Podkowa cultivar when it was fertilised with the dose of 120 kg ha^{-1} N. On the other hand, when the effect of irrigation with the dose of 120 kg ha^{-1} N was compared with the same dose of nitrogen applied at the absence of irrigation, it was found that production costs of 1 kg CP decreased, production costs of 1 MJ NEL increased, while the costs of production of 1 kg DM varied depending on the cultivar of white clover.

Feeding costs of ruminants with basic feeds play the most decisive role in influencing animal production. In the case of dairy cattle, milk production threshold values turned out to be good indicators of such effects (Goliński, 1998). It appears that these values are affected by different cultivars of white clover with its specific response to fertilisation (Table 2). Astra and, to a lesser degree, Rema cultivars were found to do well in the absence of nitrogen fertilisation. When the Podkowa cultivar was used, the profit threshold was by 0.016 PZL higher in comparison with Rema and by 0.019 PZL higher in relation to Astra. The lowest value of the profit threshold in milk production for the Astra cultivar was observed when cows were fed pasture sward fertilised with the dose of 120 kg ha^{-1} N. On the other hand, for the Podkowa and Rema cultivars the lowest value of the profit threshold occurred at the highest nitrogen dose. This phenomenon should be interpreted rather by an increased gain resulting from the increase of grass yields which displaced white clover than by the presence of this species in pasture sward.

The most important problem associated with the application of white clover in permanent grasslands is its capability to persist in sward. In Polish site conditions the phenomenon of white clover displacement is widespread when grasslands are subjected to renovation either by traditional sowing or overdrilling. Therefore, economical benefits resulting from the presence of this species on meadows and pastures do not go beyond the first two years of utilisation. In this situation, the fastest method of restoring the appropriate content of white clover in sward is overdrilling (Muto and Martin, 2000). It turns out that this effect is varies inversely with nitrogen fertilisation. Application of pasture overdrilling by white clover can reduce the profit threshold in milk production from cows amounting to 0.027 PZL kg^{-1} and, at the same time, increase additional expenditures for seeds and the drilling operation.

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Table 1 - Unit production costs of yield, energy and protein in dependency on nitrogen fertilisation, irrigation and cultivars of white clover

Cultivars	Nitrogen fertilisation (kg ha^{-1})	Irrigation	Proportion of white clover in sward (%)	Unit production costs of DM (PZL kg^{-1})	NEL (PZL MJ^{-1})	CP (PZL kg^{-1})
Podkowa	0	No	14.8	0.1015	0.0188	0.5983
Rema			19.8	0.0970	0.0164	0.4606
Astra			28.2	0.0860	0.0159	0.4465
Podkowa	120		5.5	0.1046	0.0201	0.5842
Rema			5.3	0.1106	0.0215	0.6171
Astra			9.8	0.0997	0.0174	0.5351
Podkowa	240		4.2	0.1094	0.0212	0.5307
Rema			4.9	0.1086	0.0206	0.5398
Astra			6.8	0.1071	0.0206	0.5192
Podkowa	0	Yes	26.8	0.1002	0.0190	0.5084
Rema			31.3	0.0941	0.0175	0.4518
Astra			40.4	0.0942	0.0174	0.4433
Podkowa	120		10.4	0.1101	0.0214	0.5862
Rema			13.6	0.1103	0.0212	0.5683
Astra			22.2	0.1010	0.0190	0.4973
Podkowa	240		9.9	0.1155	0.0225	0.5874
Rema			14.7	0.1167	0.0227	0.5744
Astra			20.6	0.1134	0.0215	0.5318

Table 2 - Dependency of profit threshold in milk production on the level of nitrogen fertilisation of pastures with different cultivars of white clover (PZL kg^{-1} milk)

Cultivars	Nitrogen fertilisation (kg ha^{-1})		
	0	120	240
Podkowa	0.866	0.852	0.845
Rema	0.850	0.862	0.841
Astra	0.847	0.837	0.841