The effect of grassland management on bovine nitrogen efficiency

N.J. Hoekstra[1,2], R.P.O. Schulte[1], E.A. Lantinga[2] and P.C. Struik[2]
[1]Teagasc, Johnstown Castle, Wexford, Ireland, Email: nhoekstra@johnstown.teagasc.ie, [2]Department of Plant Sciences, Wageningen University, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands,

Keywords: nitrogen, herbage, nitrogen partitioning, high sugar grass

Introduction Nitrogen (N) losses through grazing bovines are at the heart of the current debate on environment and agriculture. N utilisation of grazing bovines is predominantly determined by the form and amount of energy and protein in their diet, which in Ireland consists mainly of grazed grass. The two main problems of grazed grass with respect to animal N utilisation are 1) the imbalance between total N content and energy content, and 2) the lack of synchronisation between the release of N and carbohydrates in the rumen. It was hypothesised that both the balance and synchronisation of N and energy in herbage could be improved through grassland management. The objective of this study was to study the effect of grassland management on herbage carbohydrate and protein fractionation.

Materials and methods The effects of perennial ryegrass variety (high sugar (HS), Aberdart; low sugar control (LS), Respect), N-application rate (0, 90 and 390 kg N/ha per year), rotation length (T) (2, 4 and 6 weeks), and cutting height (8 and 12 cm) on N and carbohydrate fractions in lamina and sheath material were examined, in a cutting plot experiment at Johnstown Castle Research Centre over 4 periods in 2002 and 2003. The data were subjected to multiple regression analyses and the results of the summer period in 2003 are presented here.

Results The water soluble carbohydrate (WSC) content was increased by (i) the high sugar variety, (ii) increasing T and (iii) decreasing N application rate (Table 1). In the lamina, the total N content decreased with lower N application rates, and with longer T. For sheaths, the total N-content decreased with longer T only at higher N application rates. Lower N application rates generally lowered the estimated degradation rate of N (increasing NDIN, decreasing NPN), whereas this rate increased with longer T.

Table 1 Regression equations of carbohydrate and N fractions

		Regression equation[1]	R^2	p
Lamina	WSC[2]	10.4+7.76V+0.12T-0.01N-0.0003VTN	0.88	<0.0001
	N-total	2.12+0.0048N–0.00007TN	0.90	<0.0001
	NDIN (%N)			ns
	NPN (%N)	17.7+0.16T+0.02N	0.52	<0.0001
Sheath	WSC	26.83+5.5V+0.26T-0.032N+0.0007TN	0.88	<0.0001
	N-total	0.73+0.005T+0.0024N-0.0007TN	0.89	<0.0001
	NDIN (%N)	38.1-0.16T-0.026N	0.59	<0.0001
	NPN (%N)	25.1+0.14T+0.03N	0.71	<0.0001

[1]V=Variety (LS=0, HS=1), T=regrowth length (days), N=N application rate (kg N/ha/yr)
[2]WSC=water soluble carbohydrates, NDIN=Neutral Detergent Insoluble Nitrogen (slowly degradable cell wall N), NPN=Non protein N (very fast degradation in rumen)

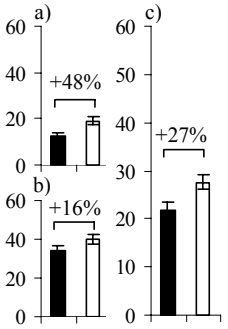

Figure 1 The WSC (%DM) content in lamina (a), sheath (b) and whole plant (c) material for the LS (solid bar) and HS (open bar) variety. Error bars represent 2xSE.

The reported increase in sugar content for the HS variety was more distinct in the lamina material compared to the sheath material, especially on a relative basis (Fig. 1). As the lamina material forms the bulk of the intake during grazing, this might explain why HS varieties have shown more promising results when managed for grazing (Lee *et al.,* 2001) compared to silage (Conaghan *et al.,* 2002).

Conclusions The balance and synchronisation of N and energy in the rumen can be improved through decreasing N application, increasing T and using HS varieties which appear especially effective under grazing.

References

Conaghan, P., P. O'Kiely, F.P. O'Mara & P.J. Caffrey (2002). Yield and chemical composition of lines of Lolium perenne L. selected for high water-soluble carbohydrate concentration. In: Proceedings of the Agricultural Research Forum, March 2002, Tullamore, pp. 39.

Lee, M.R.F., E.L. Jones, J.M. Moorby, M.O. Humphreys, M.K. Theodorou, J.C. Macrae & N.D. Scollan (2001). Production responses from lambs grazing on *Lolium perenne* selected for elevated water-soluble carbohydrate concentration. *Animal Research*, 50, 441-449.