Breeding white clover with improved tolerance of nitrogen fertiliser

T.A. Williams, M.T. Abberton and P. Olyott
Legume Breeding and Genetics Team, Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth, Ceredigion SY 23 3EB, Wales, U.K., Email: michael.abberton@bbsrc.ac.uk

Keywords: persistence, yield, agronomic performance, mixed sward

Introduction White clover (*Trifolium repens* L.) is often considered a forage legume with a primary use in 'low input/ low output' systems. One facet of this is the perception that the persistency of this species is poor when Nitrogen (N) fertiliser is applied. However, new varieties of white clover are able to play a significant role in highly productive systems (Williams *et al.*, 2000) and show consistent yields over ten years at a range of applied N levels (Williams *et al*., 2003). Germplasm improvement for nitrogen tolerance has been carried out with the aim of not only allowing white clover to perform well under applied N but also to dampen the oscillations in clover yield that may be a consequence of the build up of N fixed by the clover itself. The former aspect is illustrated in this paper with respect to the variety AberConcord.

Materials and methods Four medium leaf size varieties (AberConcord, Menna, Merwi and Grasslands Huia all at 3 kg/ha) were sown in 2 x 1.4m plots with perennial ryegrass (variety Fennema at 25 kg/ha). Plots were sown in 1998 in a randomised complete block design with four replicates. Four different treatments were imposed: No Nitrogen (N 0), 150kg N/ha per year (N1), 300kg N/ha per year (N2) and 450kg N/ha per year (N3). The experiment was sampled six times in each of 1999, 2000 and 2001 to obtain clover and grass dry matter.

Table 1 Clover content (as proportion dry matter of total sward) of four varieties at four N levels over three years

N0 Treatment	Year 1	2	3
AberConcord	75.6	79.8	58.5
Menna	73.7	73.8	50.8
Merwi	74.7	78.4	59.0
Huia	77.5	73.0	58.8
N1 Treatment			
AberConcord	50.0	63.8	42.2
Menna	46.3	43.5	33.0
Merwi	43.1	54.4	32.1
Huia	46.3	48.6	38.1
N2 Treatment			
AberConcord	29.8	55.9	37.5
Menna	21.1	39.9	14.9
Merwi	20.4	46.8	28.8
Huia	20.3	37.7	24.9
N3 Treatment			
AberConcord	15.5	47.0	42.8
Menna	12.6	27.4	14.4
Merwi	20.6	40.7	28.4
Huia	10.9	31.6	30.2

Results AberConcord showed consistently higher yields than the other varieties at all N levels (Table 1). However, differences were more pronounced at higher N levels. Thus, at N 2, AberConcord gave a clover dry matter yield of 4.3 t/ha in the third year compared to a mean of 3.1t/ha across all varieties. At the highest N application, AberConcord had yields of 5.8 and 4.9 t/ha in years 2 and 3, significantly higher than the other varieties.
Indeed, AberConcord had a higher yield at N3 than at N1 or N2 in the third year. Clover contents of 47% and 42% in the 2nd and 3rd years were achieved by AberConcord at the highest N level with total dry matter yield of 12.4 and 11.6 t/ha respectively.

Conclusions The results suggest that breeding for improved tolerance of N allows a considerable white clover contribution to be maintained even at levels of N fertiliser application of 450 kg/ha per year. Although N fixation is likely to be reduced, gains in animal production, derived from the forage quality and intake characteristics of white clover are still likely to be realised. The competitiveness of the white clover allows a balanced sward to be maintained along with high total dry matter content.

Acknowledgements The authors thank the Department of Environment Food and Rural Affairs for financial support. IGER is grant-aided by the Biotechnological and Biological Sciences Research Council.

References

Williams, T.A. M.T. Abberton, D.R. Evans, W. Thornley, & I. Rhodes (2000). Contribution of white clover varieties in high-productivity systems under grazing and cutting. *Journal of Agronomy and Crop Science,* 185, 121-128.

Williams, T.A. D.R. Evans, I. Rhodes, & M.T. Abberton (2003). Long-term performance of white clover varieties grown with perennial ryegrass under rotational grazing by sheep with different nitrogen applications. *Journal of Agricultural Science,* 140, 151-159.