Paper ID: 179
Theme 1. Grassland resources
Sub-theme 1.1. Dynamics of grassland resources – global database

Net herbage accumulation rate (NHAR) of plantain and chicory based sward mixes

Sharini Carol Somasiri[1*], P.R. Kenyon[2], P.D. Kemp[2], P.C.H. Morel[2], S.T. Morris[2]
[1*]Coconut Research Institute, Lunuwila, Sri Lanka
[2]Massey University, Palmerston North, New Zealand
[*]Corresponding author e-mail : sharinisc@yahoo.com

Keywords: *Cichorium intybus*, Net herbage accumulation rate, *Plantago lanceolata*, Sward mixes

Introduction

The managed grasslands of New Zealand have a range of forage species comprising grasses and legumes that can be grown and utilised in a wide range of conditions (Saggar *et al*., 2007). Perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*) are the dominant grass and legume species found in these grasslands (Hodgson *et al*., 2005; Waghorn and Clark, 2004). Annual pasture production is affected by the soil moisture status, nutrient levels and temperatures (Valantine and Kemp, 2007). Therefore, monthly pasture production can vary from year to year. Net herbage accumulation rate (NHAR) is a measurement of pasture production (Valantine and Kemp, 2007). Net herbage accumulation rate can be used to help with livestock management by determining the carrying capacity of the land. Alternative forages such as plantain (*Plantago lanceolata*) and chicory (*Cichorium intybus*) are becoming popular in New Zealand. Kemp *et al*., (2010) suggested that farmers could achieve 'marketable target weight' of lambs sooner by feeding a herb and legume mix consisted of plantain, chicory, white clover (*Trifolium repens*) and red clover (*Trifolium pratense*) compared to a ryegrass/white clover pasture. However, a significant potential limitation in the use of these herbages is the seasonality of their production. There is a dearth of knowledge on NHAR of these herb-clover mixes. Therefore, the aim of this study was to determine NHAR and NHAR curves for plantain and chicory based sward mixes.

Materials and Methods

There were three herbage treatments; (i)'Pasture mix' perennial ryegrass cultivar One50 and white clover cultivar Bounty; (ii) 'Plantain mix' plantain cultivar Ceres Tonic, white clover and red clover cultivar Sensation; (iii) 'Chicory mix' plantain, chicory cultivar Puna II, white- and red-clover. A grazing experiment was undertaken using weaned lambs in these herbage treatments for five different periods (winter, early spring, late spring, summer and autumn) for two consecutive years. The Plantain and Chicory mixes did not grazed during the winter season. The grazing area per herbage treatment was 2.25 ha consisting of three replicates of 0.75 ha. There were three 0.25 ha paddocks per replicate. In each period, lambs were rotationally grazed until, either the lambs gained initial body weight + 10 kg (maximum 60 days) or the herb/pasture growth was not sufficient to meet lamb ad-lib feeding requirements. The lambs were then sold to a commercial abattoir (Alliance Meat Works, Dannevirke, New Zealand) and the experimental paddocks were allowed to regrow for a maximum of two weeks. Then using a new batch of weaned lambs the same experimental design was continued. Herbage quadrat cuts (0.1 m2) at ground level were taken from each paddock to determine the pre- and post-grazing herbage dry matter (DM) mass each time the lambs were moved to a new paddock (Brown et al., 2005). The samples were washed and oven dried in a draught oven at 100 C for a minimum of 24 hours. These dry weights were used to calculate the herbage mass on a DM basis. Net herbage accumulation rate (NHAR) was calculated using following equation (Matthews et al., 1999; Frame, 1981). "NHAR=" (("most recent pre grazing DM mass - immediate previous post grazing DM mass"))/"interval days between the above sample collections" Then using these values the NHAR curves were developed for each herbage treatment using the "ksmooth" function for "Kernel Smoother" technique in "stats" package in R statistical software (R Core Team, 2013). Two enclosed cages were placed in each paddock during each grazing period. Herbage grab samples were collected from these enclosed cages at each post-grazing time point for herbage quality analysis. In-vitro organic matter digestibility (OMD) and digestible organic matter digestibility (DOMD) were analysed according to Roughan and Holland, (1977). Neutral detergent fibre (NDF) was analysed according to Robertson and van soest (1981). Metabolizable energy was calculated by multiplying DOMD% by 0.163 factor according to Geenty and Rattray (1987).

Results and Discussion

The Plantain and Chicory mixes had higher ($P<0.05$) organic matter digestibility (OMD) and metabolisable energy (ME) and lower ($P<0.05$) neutral detergent fibre (NDF) percentage than the pasture mix in all the periods from early spring to autumn. During year one in early spring and summer and during year two in summer and autumn there was no difference

(P>0.05) in the NHAR between the herbage treatments. During year one in late spring, both Pasture and Plantain mixes had greater (P<0.05) NHAR compared to the Chicory mix. During year one in autumn, both Plantain and Chicory mixes had greater (P<0.05) NHAR than the pasture mix. During year two in early spring pasture mix had greater (P<0.05) NHAR compared to both Plantain and Chicory mixes. During year two in late spring, the Pasture mix had greater (P<0.05) NHAR compared to both Plantain and Chicory mixes. Net herbage accumulation rate (NHAR) curves in the Pasture, Plantain and Chicory mixes show that a greater herbage production occurs during the months of late spring and early summer period compared to the other periods. The herbage production is lowest during the winter months. All the NHAR curves peaked during the late spring period. The Pasture mix NHAR curve showed a binominal pattern. The NHAR curves of both Plantain and Chicory mixes highlight that during summer and autumn periods these herb-clover mixes had a higher (P < 0.05) NHAR than the Pasture mix.

Conclusion

The Plantain and Chicory mixes had greater herbage quality during the early spring to autumn periods. These herb-clover mixes also had higher herbage growth rates during late spring to summer. Therefore, these herb-clover mixes can be used effectively during the early spring to autumn period for lamb meat production replacing the ryegrass/white clover sward mix. The NHAR curves developed for the Plantain and Chicory mixes in the present experiment can be used as a planning aid for farmers.

References

Brown, H. E, D.J Moot and K. M Pollock. 2005. Herbage production, persistence, nutritive characteristics and water use of perennial forages grown over 6 years on a Wakanui silt loam. *New Zealand Journal of Agricultural Research* 48: 423-439.

Frame, J. 1981. Herbage mass. In: J. Hodgson, R. D. Baker, A. Davies, A. S. Laidlaw, J. D. Leaver (eds.) *Sward Measurement Handbook.* The British Grassland Society: Hurley, UK. pp. 39-70.

Geenty, K. G. and P. V. Rattray 1987. The energy requirements of grazing sheep and cattle. In: A. M. Nicol (ed.) *Livestock Feeding on Pastures*. New Zealand Society of Animal Production. Occasional Publication, No.10: pp. 39-53.

Hodgson, J., K. Cameron, D. Clark, L. Condron, T. Fraser, M. Hedley, C. Holmes, P. Kemp, R. Lucas, D. Moot, S. Morris, P. Nicholas, N. Shadbolt, G. Sheath, I. Valentine, G. Waghorn and D. Woodfield. 2005. *New Zealand's pastoral industries*: *efficient use of grassland resources*. Science Publishers, Inc. No. 1578083591, Enfield (NH), USA. 181-205.

Kemp, P. D., P. R. Kenyon and S. T. Morris. 2010. The use of legume and herb forage species to create high performance pastures for sheep and cattle grazing systems. *Sociedade Brasileira de Zootecnia* 39: 169-174.

Matthews, P. N. P., K. C. Harrington and J. G. Hampton. 1999. Management of grazing systems. In: W. James, J. Hodgson (eds.) *New Zealand Pasture and Crop Science*. Oxford University Press Auckland, New Zealand. pp. 153-174.

R Core Team. 2013. 'R: *A language and environment for statistical computing*.' (R Foundation for Statistical Computing, Vienna, Austria.

Robertson, J. B. and P. J. Van Soest. 1981. The detergent system of analysis and its application to human foods. In: W. P. T. James, O. Theander (eds.) *The Analysis of Dietary Fibre in Food* Vol. 3. Marcel Dekker Inc. USA: New York. pp. 123-158.

Roughan, P. G. and R. Holland. 1977. Predicting in-vivo digestibility of herbages by exhaustive enzymic hydrolysis of cell walls. *Journal of the Science of Food and Agriculture* 28: 1057-1064.

Saggar, Surinder, D. L. Giltrap, C. Li and K. R. Tate. 2007. Modelling nitrous oxide emissions from grazed grasslands in New Zealand. Agriculture, *Ecosystems and Environment* 119: 205-216.

Valentine, I. and P. D. Kemp. 2007. Pasture and supplement resources. In: P. V. Rattray, I. M. Brookes, A. M. Nicol (eds.) *Pasture and Supplements for Grazing Animals*. Vol. 14. New Zealand Society of Animal Production. Occasional Publication No. 14: Hamilton. pp. 3-12.

Waghorn, G. C. and D. A. Clark. 2004. Feeding value of pastures for ruminants. New Zealand Veterinary Journal 52: 320-331.

Acknowledgement

International Sheep Research Centre, Massey University and the National Research Centre for Growth and Development for funding this research.