THE PASTURE FEED-BASE FOR BEEF CATTLE PRODUCTION ON THE NORTHERN TABLELANDS OF NEW SOUTH WALES: A REVIEW

R.W. DICKER[A], J.F. AYRES[A], R.C. DOBOS[B], M. J. McPHEE[B], K.S. NANDRA[B] and A.D. TURNER[A]

[A] NSW Agriculture, Agricultural Research and Advisory Station, Glen Innes, NSW 2370
[B] NSW Agriculture, NSW Agriculture Beef Centre, Armidale, NSW 2350

SUMMARY

This review describes the pasture feed-base for introduced pastures of the Northern Tablelands of New South Wales in terms of growth periodicity, nutritive value and beef cattle performance. Key limitations identified are low green biomass in winter, decline in pasture quality in late spring and only moderate pasture quality in summer/autumn. These limitations restrict the backgrounding performance of both autumn and summer weaners. New research directions are proposed for the development of improved nutritional strategies for feeder steers to meet feedlot entry specifications.

Keywords: pasture feed-base, feed-year, nutritional limitations

THE PASTURE ENVIRONMENT

Climatic constraints

The Northern Tablelands is a cool temperate highlands environment (average altitude 800 m) bounded by latitudes 28°15' - 31°30'S. Climate is characterised by high annual rainfall (750 - 1000 mm) with marked summer incidence, a long frost interval and cold winter conditions. Soil moisture has a well defined seasonal pattern. Despite summer rainfall dominance, soil moisture is progressively depleted during spring/summer, remains low and variable in late summer/autumn and is recharged in winter when evaporative demand is low (Begg 1959). Pasture growth is limited by low soil moisture due to high evaporation in summer/autumn and by low temperature in winter (Smith and Johns 1975).

Native pasture

A wide diversity of native and naturalised species is present in Northern Tablelands pastures. Grasses recorded number 160 species of which about 40 are widespread (Whalley *et al.* 1978). Native legumes (eg *Glycine tabacina*) have declined in distribution and presence. The native grasses are classified into species types on the basis of growth characteristics - 'warm season perennials', 'cool season perennials' and 'year-long green perennials' (Lodge *et al.* 1990). Pastures are predominantly based on these native and naturalised perennials with 'warm season annuals' and 'cool season annuals' invading unstable plant communities. The species type that is most widespread is 'warm season perennials' (eg *Themeda triandra, Bothriochloa macra*) but the grazing value of this complex of species is low, especially during late autumn - spring due to short growing season and lack of frost tolerance (Archer and Robinson 1988). The 'cool season perennials' (eg *Elymus scaber*) and especially those with 'year-long green' characteristics (eg *Danthonia spp., Microlaena stipoides*) have relatively high nutritive value (Archer and Robinson 1988) but are generally only a minor component of the sward.

Introduced pasture

The region is suited to pasture development with introduced 'cool season perennials' (eg tall fescue, phalaris, cocksfoot, perennial ryegrass and white clover). Introduced pastures presently total 23 per cent of farm area (Australian Bureau of Statistics 1993/94). Pastures based on introduced species have an extended growing season, greater growth potential and better grazing value in winter compared with native pastures (Langlands and Holmes 1978). The introduced pasture type is best suited to meet the nutritional demands of intensive cattle and sheep production systems and is the pasture feed-base under consideration in this review.

THE INTRODUCED PASTURE FEED-BASE

Pasture growth cycle

The availability of pasture of suitable quality to meet animal requirements is determined primarily by the seasonal growth rhythm of species components. Research has quantified the phenological development, growth pattern, biomass accumulation and nutritive value of the major species components of introduced pasture. The growth cycle of pasture based on introduced species comprises i) a cool season vegetative growth phase from April to June, ii) slow growth from the period of intensive frosting during July to August, iii) a spring primary growth phase from late September to mid December, and iv) a summer secondary regrowth phase from January to March.

Growth periodicity

Data from a number of studies in this environment suggest a sinusoidal growth rhythm. Cotsell=s (1958) 'pasture production curve' depicts a rapid growth phase in spring, diminishing growth in summer and 'growth troughs' in autumn and winter. Begg (1959) reported low growth (12 to 20 kg DM/ha/day) in May to August, high growth (42 to 52 kg DM/ha/day) in September to November and moderate growth (19 to 48 kg DM/ha/day) in December to April. McPhee *et al.* (1997) contrasted the growth rhythms of tall fescue/ white clover with phalaris/white clover. Their data show high growth (>50 kg DM/ha/day) during the spring primary growth cycle, moderate growth (20 to 50 kg DM/ha/day) during the secondary regrowth cycle in summer/autumn and low growth (<20 kg DM/ha/day) in winter.

Nutritive value

Phenological changes associated with seasonal growth patterns confer changes in pasture quality due to effects on sward botanical content, plant fractional composition, and the nutrient composition of dietary components. On the Northern Tablelands, moisture stress in summer/autumn and intensive frosting in winter promote leaf senescence. Archer and Robinson (1988) showed that the most important factor influencing animal production is the presence of white clover. The digestibility and nitrogen content of white clover is higher than companion grasses especially in summer/autumn. The seasonal pattern of digestibility for the grasses is similar and declines sharply through spring. For white clover, the concentrations of rumen degradable protein, digestible undegradable protein and fermentable metabolisable energy also decline through spring (K.S. Nandra, unpubl.). Results from current work at Glen Innes (Dicker *et al.* 1995) for a pasture comprising introduced species (white clover, tall fescue, phalaris) show that the proportion of green biomass in total biomass is high (75 to 85%) in spring/summer but low (10 to 20%) in winter. During periods of active growth (spring/summer/autumn) the digestibility of aerial tops fluctuates within a moderate quality range (57 to 65% digestibility). The digestibility of green leaf is high (70 to 80%) only in cool season months and declines sharply over spring in conjunction with onset of phenological maturity. Digestibility continues to decline thereafter through the summer/autumn to levels unlikely to sustain high levels of animal performance without supplementation.

Modelling grazing systems

Donnelly *et al.* (1997) developed GrazPlan, a suite of complementary decision support systems general in application and modular in structure. GrazPlan comprises MetAccess, LambAlive, GrassGro and GrazFeed. GrassGro is a tactical decision support system that predicts the amount of herbage (total, green, dead and litter) present each day and its digestibility distribution. It projects productivity in time and is currently being validated for beef production on the Northern Tablelands (D. Alcock, pers. comm.). SheepO is a financial and biological decision support system originally developed for winter rainfall areas (McLeod and Bowman 1992). It has been modified and validated for the Northern Tablelands environment (McPhee 1996). McPhee *et al.* (1997) used SheepO to show that the competing influences of pasture growth and forage consumption at low and high stocking rates result in discretely different levels of net available biomass for each pasture type. In the years under study (1984-1987), the level of pasture biomass provided by tall fescue/white clover was always greater than that provided by phalaris/white clover. Biomass of fescue/white clover at low stocking rate rose from 1250 kg DM/ha in winter to a maximum of 2600 kg DM/ha in spring. The corresponding biomass range for phalaris/white clover was 825 - 1700 kg DM/ha. At high stocking rate, the biomass range for fescue/white clover was 850 - 1900 kg DM/ha and for phalaris/white clover it was 550 to 1300 kg DM/ha. This study highlighted two important features of the pasture environment that impose restrictions on the pasture feed-base for grazing animals: i) the protracted winter trough, and ii) low levels of pasture biomass associated with close grazing by sheep.

MANAGING BEEF PRODUCTION

Cow/calf nutrition

The performance of breeding cows was studied to identify optimum grazing pressure (Hennessy and Robinson 1979; Robinson and Hennessy 1981). Small breeding groups were grazed at a wide range of stocking rates and cow liveweight, calf weaning weight and pasture biomass were measured. Results indicate that stocking rate up to 1.0 cow/ha in most seasons and up to 1.3 cows/ha in the short term, allows a high weaner liveweight/ha to be achieved without adversely affecting breeding cow performance or pasture re-growth. High and low yearling growth rate selection lines were evaluated on high, medium and low levels of nutrition to determine growth rate, reproductive rate, herd productivity and profitability (Dicker and Farquharson 1994). Results confirmed that within herd selection for high yearling growth rate leads to cattle that grow faster and are more profitable. Main conclusions were that calving rates of all lines were similar but depressed at low nutrition, growth responses persisted in new environments and although feed conversion efficiencies of breeding cows of each line were not different, the high line was the most profitable.

Weaner growth

Weaner production was examined in a cow/calf system to determine whether stocking rate and weaning weight could be increased by fodder conservation or by sowing either a summer or winter forage crop on 12 per cent of the grazing area (Robinson and Hennessy 1981). Farmlet systems compared were introduced pasture alone, pasture plus forage sorghum and pasture plus forage oats. Initially at 0.75 cows/ha and later at 0.9 cows/ha, there were no overall benefits due to fodder conservation or forage crop. Grow-out of autumn weaners was studied to investigate the effects of stocking rate, forage oats, oat grain supplement, hay and silage (Hennessy and Robinson 1978). The objective was to increase weaner growth during winter to produce a finished yearling at 270 kg. A medium stocking rate of 2.8 weaners/ha with access to a forage oat crop sown on 45 per cent of the grazing area was the most profitable system. However, forage oats was unreliable for providing high quality feed. The increase in liveweight over pasture-only was small and not enough to cover the cost of the crop. The feeding of oats grain consistently increased liveweight but the high quantities required and the costs made this supplement uneconomic. The target liveweight of 270 kg was achieved only with the feeding of forage oats and oat grain together. This practice was economic only when a premium price was received for the finished yearlings.

Backgrounding

The nutritional management of weaners during grow-out to produce steers that meet feedlot entry specifications is termed ‘backgrounding’. Beef producers on the Northern Tablelands typically grow out spring-born autumn weaners (~250 kg) over the winter/spring/summer period. Autumn-born summer weaners (~295 kg) from southern regions are also grown out over the summer/autumn period for the same markets. Feedlot entry specifications are based on genotype, conformation, liveweight, age and fatness. For domestic feeders, objective specifications are 300 kg liveweight, 12 to 15 months of age and 1 to 6 mm P8 fat. For export feeders, these are 370 to 430 kg, 18 to 24 months and 7 to 12 mm. Current research at Glen Innes is evaluating alternative pasture-based backgrounding systems for autumn weaners at similar stocking rates. These systems are i) the pasture base (phalaris/fescue/white clover) alone, ii) pasture plus up to 1 kg/head per day of a pelleted high protein concentrate supplement, iii) pasture plus access to a biennial Italian ryegrass forage crop. The concentrate supplement and forage crop are aimed at filling the winter feedgap. Summer weaners are grown out on pasture without supplementation. Growth paths for autumn weaners and for summer weaners on pasture alone differed between years, depending on seasonal conditions. Autumn weaners grew at 450 g/day in 1995 (a drought year) and at 760 g/day from weaning to feedlot entry in 1996 (a drought recovery year). With supplement or forage in 1995, domestic feeders were turned off up to seven weeks earlier, and export feeders up to eleven weeks earlier, than those from pasture. In 1996, the response to forage was much less: equivalent periods were two weeks and four weeks. Summer weaners grew at 496 g/day in 1995 and at 777 g/day in 1996. However, they did not reach export feeder weight before the onset of winter. Poor liveweight gain of autumn weaners was due to low pasture biomass and especially low green biomass in autumn/winter. Liveweight of summer weaners plateaued from mid autumn due to a decline in green biomass digestibility indicating a 'quality of feed-gap' over summer/autumn.

FUTURE DIRECTIONS

Increasing feedlot capacity and utilisation, and an estimated 400,000 cattle currently on feed indicates a strong annual feeder steer demand of about 1.3 million head. To satisfy this demand and meet particular feeder steer specifications, the industry requires nutritional management strategies to improve the feed-base for young cattle in the backgrounding phase. This review identifies limitations of the pasture feed-base for intensive beef production in this environment. Key limitations are: for native pasture, low grazing value especially during autumn/winter/spring; and for introduced pasture, low green biomass in winter, sharp decline in nutritive value through the spring primary growth cycle, and nutritive value plateauing at a moderate quality level during summer/autumn secondary regrowth. The development of improved nutritional management of weaners to produce steers meeting feedlot entry specifications requires research on:

- How to increase the grazing value of native pasture to exploit this major under-utilised pasture resource;
- valuation of new species to overcome low green biomass in winter and quality decline in summer;
- The content, composition and supply of protein and energy components of pasture during warm season growth to refine supplementary feeding practices;
- Laboratory based prediction of grazing intake to assist testing of improvements to the feed-base;
- Management strategies for a) backgrounding to improve diet quality , and b) the breeding herd to increase supply of weaners; and
- A strategic decision support system for beef cattle production.

ACKNOWLEDGEMENTS

Backgrounding research at Glen Innes is a component of the Cattle and Beef Industry CRC.

REFERENCES

ARCHER, K.A. and ROBINSON, G.G. (1988). *Aust. J. Agric. Res.* **39**, 425-436.
BEGG, J.E. (1959). *Aust. J. Agric. Res.* **10**, 518-529.
COTSELL, J.C. (1958). *Agric. Gaz.* NSW 68, 167-176.
DICKER, R., AYRES, J., MURISON, B., ALSTON, C., ROBINSON, D., TURNER, A., KAMPHORST, P., DENT, B., LOWIEN, J. and DAWES, P. (1995) Proc. Tenth Ann. Conf. Grassld. Soc. NSW, 1995, 93.
DICKER, R.W. and FARQUHARSON, R.J. (1994). *Proc. Aust. Soc. Anim. Prod.* **20**, 20-22.
DONNELLY, J.R., MOORE, A.D. and FREER, M. (1997). *Agric. Sys.* **54**, 57-76.
HENNESSY, D.W. and ROBINSON, G.G. (1978). *Aust. J. Exp. Agric. Anim. Husb.* **18**, 183-189.
HENNESSY, D.W. and ROBINSON, G.G. (1979). *Aust. J. Exp. Agric. Anim. Husb.* **19**, 261-268.
LANGLANDS, J.P. and HOLMES, C.R. (1978). *Aust. J. Agric.Res.* B, 863-874.
LODGE, G.M., ROBINSON, G.G. and SIMPSON, P.C. (1990). NSW Agriculture Agfact P2.5.32.
McLEOD, C. R. and BOWMAN, P. J. (1992). 'SheepO users guide version 3'. (East Melbourne: Vic. Dept. of Food and Agric.)
McPHEE, M.J. (1996). *Environmental Software* **11**, 105-112.
McPHEE, M.J., AYRES, J.F. and CURLL, M.L. (1997). *Aust. J. Agric. Res.* **48**, 831-841.
ROBINSON, G.G. and HENNESSY, D.W. (1981). AG Bulletin 8, Dept of Agric. NSW.
SMITH, R.C.G. and JOHNS, G.G. (1975). *Aust. J. Exp. Agric. Anim. Husb.* **15**, 250-255.
WHALLEY, R.D.B., ROBINSON, G.G. and TAYLOR, J.A. (1978). *Aust. Rnglnds. J.* B, 174-190.