How can graziers manage perennial grasses to survive through drought?

J.M. Scott, S.P. Boschma and G.G. Rapp

Department of Agronomy and Soil Science, University of New England, Armidale, NSW, 2351.

Perennial grasses are the most stable component of pastures on the Tablelands and nearby slopes (Kemp 1991). However, persistence of sown perennial grass pastures is poor, many reputedly lasting as little as 5 years (Lees and Reeve 1995). Because it is known that some sown pastures can last for 30 or more years (K.J. Hutchinson *pers. comm.*), a better understanding of the stress thresholds of these species is necessary, especially under drought conditions, so that they can be managed as sustainable and productive pastures.

An experiment was conducted under controlled drought conditions (using rain-out shelters) on the Northern Tablelands of NSW to determine the mortality thresholds of six important perennial grasses (*Danthonia richardsonii, Microlaena stipoides*, cocksfoot, tall fescue, perennial ryegrass and phalaris). These were subjected to a range of drought and defoliation intensities over two six month seasons (spring-summer and summer-autumn) during 1994/95.

Plant mortality

The controlled droughts ('severe' – 10 percentile seasonal rainfall; 'moderate' – 40 percentile seasonal rainfall) resulted in more plant deaths than the 'non-stress' moisture treatment which received rainfall equivalent to 80% of pan evaporation. Few plant deaths occurred in the non-stress moisture treatment, regardless of defoliation or season. Thus, in above-average rainfall seasons, perennial grasses are less susceptible to mortality under grazing (Boschma *et al.* 1996).

More plants died in the drought intensities imposed over spring-summer compared with those in summer-autumn. One of the most significant findings of this project is that a moderate spring-summer drought caused greater mortality of a number of perennial pasture grasses than a more severe drought (Figure 1). This was especially the case with two introduced species, perennial ryegrass and cocksfoot, while relatively few losses were recorded

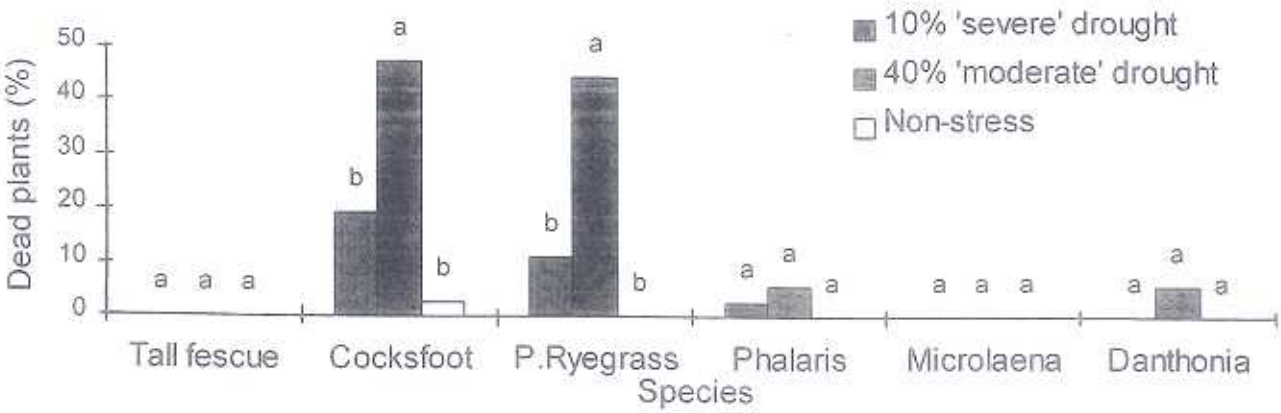

Figure 1. Percentage of plants of six perennial grass species which died during the spring-summer period under a 10% 'severe' drought, 40% 'moderate' drought or 'non-stress' moisture regime. Letters indicate significant variation within a species.

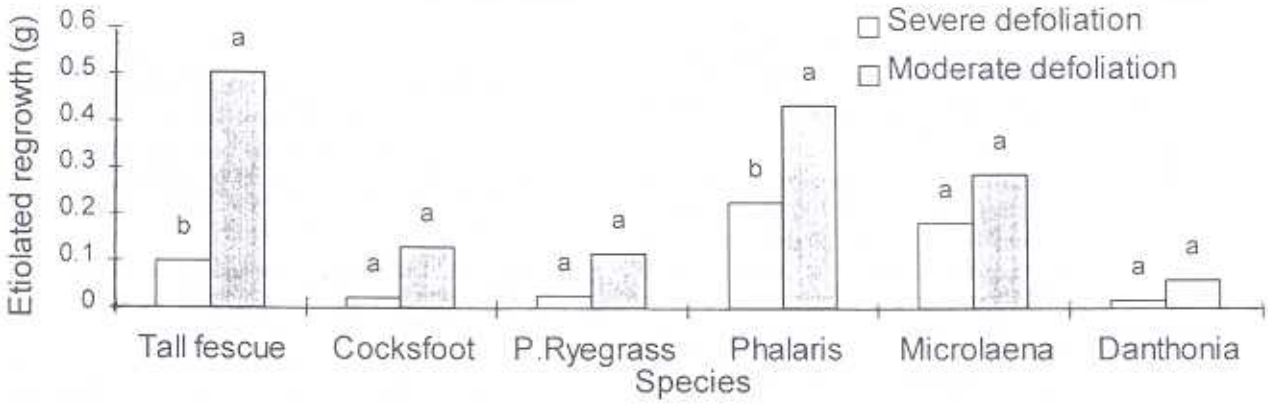

Figure 2. Etiolated regrowth of six perennial grasses following severe and moderate defoliation regimes through drought. Data are averaged over moisture regime. Letters indicate significant variation within a species.

for the other species.

The rainfall during a moderate spring-summer drought appears to have been sufficient for the plants to continue to grow but at the expense of the plants' energy reserves. In contrast, a severe spring-summer drought appears to have resulted in greater plant dormancy, thereby enabling plants to save their reserves. This highlights the importance of lenient grazing during spring and early summer, especially during moderately dry periods.

Thus, it is important to graze perennial pastures carefully during *any* dry time and not just during severe drought. All droughts begin as 'moderate' droughts as a grazier cannot know the severity of a drought until after the fact. However, use of tools such as the Southern Oscillation Index (SOI) may assist in predicting drought severity.

Kemp (1991) devised a pasture management 'envelope' system aimed at neither over- nor under-grazing pastures and maintaining the legume component. It was suggested that the forage on offer should be maintained between 1200-2500 kg DM/ha and the legume composition controlled between 15 and 50% (Kemp 1991). The defoliation intensities imposed in this drought trial were based on the centre and lower boundary of the grazing envelope; more severe grazing resulted in greater plant deaths and lower plant reserves thus confirming that grazing within the envelope is desirable. This is especially important with grazing by different animals as sheep tend to graze considerably closer leaving less plant biomass able to photosynthesise to support root growth and survival.

Plant reserves

In general, during the spring-summer period, drought intensity affected plant water soluble carbohydrate reserves more than defoliation intensity. During the summer-autumn period, the reverse occurred (Boschma *et al.* 1997). The effect of severe defoliation on plant reserves was species dependent. After three months of a spring-summer drought the reserves of cocksfoot, *Microlaena* and tall fescue were reduced by severe defoliation. After six months of spring-summer drought the reserves of tall fescue and *Microlaena* were still reduced due to severe defoliation. Similarly, during the month of April in the summer-autumn drought, severe defoliation reduced plant reserves in all species except tall fescue. This highlights the crucial importance of managing defoliation intensity. During both spring-summer and summer-autumn droughts, plant reserves increased with increasing moisture regime.

Regrowth potential

One of the few findings that applied to all species is that defoliation intensity caused a consistent reduction in the regrowth potential of plants following drought. This suggests that moderate defoliation is one way of ensuring greater regrowth potential from all of the species assessed (King *et al.*, 1996). Again, the species varied in their response (Figure 2); the regrowth potentials of tall fescue and phalaris were highest of the species whilst tall fescue was most seriously affected by severe defoliation.

Factors affecting persistence

Persistence through drought is strongly linked to changes in plant reserves and basal cover. Persistence during a summer-autumn drought is also linked to changes in plant quality at certain times of year. Basal area is of particular importance because if the basal area of a species drops, not only does protection against soil erosion drop but the plant population is likely to decline further. These parameters vary considerably between species; consequently management recommendations need to be formulated with care for each individual species.

More work is needed to model the effects of the various treatments on mortality over a range of soil types and climatic environments before the recommendations can be extended more widely.

Summary of key points

- Perennial grasses are generally well adapted to our environment and can survive drought provided that they are not grazed intensively during the dry period.
- In a dry season, once the pasture biomass has been grazed off to a level of 1000 kg DM/ha, it is imperative that the pasture be de-stocked until sufficient re-growth occurs (at least to 1500-2000 kg DM/ha).
- Moderate grazing with cattle is likely to be less damaging to grass survival than severe, close grazing with sheep.
- Dry periods in spring-summer are an especially important period over which to manage grazing severity.

References

Boschma, S.P., Hill, M.J., Scott J.M. and Lutton, J.J. 1997. Carbohydrate reserves of perennial grasses: Effect of drought and defoliation intensity. Proc. XVII International Grassland Congress 1997, Canada. (In Press).

Boschma, S.P., Hill, M.J., Scott J.M. and Rapp, G.G. 1996. Effect of different intensities of drought and defoliation upon the mortality of perennial grasses. Proc. 8th Australian Agronomy Conference, 1996. p 624.

Kemp, D. 1991. Defining the boundaries and manipulating the system. Proc. 6th Annual Conference of the Grassland Society of NSW. p 24-30.

King, J.R., S.P. Boschma, J.M. Scott and M.J. Hill. 1996. Etiolated regrowth as a measure of potential forage grass recovery following drought stress in New South Wales, Australia. Canadian Journal of Plant Science 76: 811.

Lees, J. and Reeve, I. (1995). Summary of 1994 producer survey. Temperate Pastures Newsletter (MRC). No. 95/1, pp. 4-5.