# EFFECTS OF GRAZING FREQUENCY AND SOIL WATER SUPPLY ON BASAL COVER OF FOUR PERENNIAL GRASSES

A.J. Bowcher and J.M. Virgona
N.S.W. Agriculture, Agricultural Research Institute, PMB, Wagga Wagga, New South Wales, Australia, 2650

## ABSTRACT

Changes in basal area and soil water extraction were examined in four perennial grasses, *Phalaris aquatica* cv. Sirosa, *Dactylis glomerata* cv. Porto, *Festuca arundinacea* cv. Demeter and *Danthonia richardsonii* cv. Tarana. Treatments were factorially arranged with four species, three different grazing intervals (2-, 5- and 8- weeks) and two watering regimes (rainfed and supplementary water)and were imposed from early spring to mid-autumn in 1994/5 and 1995/6. In 1994/5, the basal area of all species declined except for the native, *D. richardsonii* under rainfed and watered conditions. The grazing treatments had no effect on changes in basal area in this season. In 1995/6 the basal area of *D. glomerata* and *F. arundinaceae* increased under watered or the 5 week grazing treatment. The basal area of *D. richarsonii* declined in 8 week grazing treatment but increased in the 5 week treatment. The results are dicsussed with respect to grazing management under drought conditions.

## KEYWORDS

Persistence, basal area, grazing management, *Phalaris, Festuca, Dactylis, Danthonia*

## INTRODUCTION

In improved permanent grasslands of temperate Australia, the persistence of perennial grasses is a key factor in determining the productivity and sustainability of the pasture system. The perennial grasses provide a large quantity of herbage and are efficient at utilising soil water and nitrogen. The ability to withstand grazing pressure under conditions of limited soil water availability is an important trait that confers greater persistence (Kemp and Culvenor, 1994). Soil water deficit can frequently occur over the spring-autumn period. It is over this period, particularly in spring that introduced grass species (eg. *Phalaris aquatica, Dactylis glomerate Festuca arundinaceae*) are most vulnerable to damage by defoliation (eg. Culvenor 1994; Volaire 1994). Defoliation at critical times can cause damage by plant death, tiller death and/or restricting regrowth after autumn rains. In mature swards (> 1 year old) individual plants become indistinguishable. Hence measurements of persistence must rely on a measure of basal cover. When higher levels of basal cover are maintained the perennial grass is able to compete with annual species which germinate in the following autumn.

In this study we measure changes in basal area from spring to autumn (over two seasons) of four perennial grass species (three introduced and one native), in response to grazing at different frequencies. A watering treatment was included to simulate an environment with more frequent summer rainfall.

## METHODS

The field trial was established at Wagga Wagga ( 35½ 5' S, 148½ 6' E., Elevation: 219 m, average annual rainfall: 572 mm) in south western New South Wales, Australia on 30 August, 1993. The factorial design consisted of four perennial grass species (*Phalaris aquatica* cv. Sirolan, *Dactylis glomerata* cv. Porto, *Festuca arundinaceae* cv. Demter and *Danthonia richardsonii* cv. Taranna) within three grazing regimes within two watering treatments replicated twice. Laneways containing one plot (10.8 x 6 m) of each species were fenced with electrified wire and grazed in common to approximately 500 kg/ha at intervals of two, five and eight weeks with cross-bred wethers from spring until autumn (for details see Table 1). A travelling irrigator applied 40 mm of water at approximately monthly intervals to the irrigated plots. Groups of two irrigated and two non-irrigated laneways were separated by 5 metre buffers sown to a mixture of the species plus Medicago sativa. At the commencement of grazing in year 1, two permanent quads were established in each plot to determine basal area and plant density. In the second year four new permanent quadrats were located in each plot. Basal area was measured in for both years in mid September and the following May by placing a 25 $mm^2$ square mesh over the sampling area and counting the proportion of squares which had at least half the area occupied by a plant base. The results are presented on the basis of a percentage change form the original basal cover in each season. Plant density was recorded only in year 1 as in most cases individuals were still distnguishable. Herbage mass was estimated before and after each graze at fixed points in each plot using a regularly calibrated falling plate. The experiment was analysed as a split-split plot using Genstat Ver. 5.3.

## RESULTS

The 1994/5 season occurred in the middle of a drought that affected most of eastern Australia. The three introduced species suffered considerable reduction in basal area (Table 2) over the experimental period. Under rainfed conditions *P. aquatica* was less affected than *D. glomerata* and *F. arundinaceae*. Under watered conditions, the basal areas of all three species declined. The outstanding result was that the basal area of *D. richardsonii* actually increased over the same period under rainfed or watered conditions. This was due to enlargement of the bases of the original plants and some recruitment. There was no visual evidence of plant death in contrast to the introduced species. Grazing frequency did affect dry matter accumulation (data not shown) but had no effect on basal area. In the 1995/6 season, there were significant species by watering and species by grazing interactions (Table 2). Basal area of the three introduced species did not significantly change under rainfed conditions or when grazed at the 2 and 8 week intervals. Basal area of *F. arundinaceae* and *D. glomerata* expanded under watered conditions and when grazed every 5 weeks. For *D. richardsonii* grazing every 5 weeks increased basal area whereas grazing every 8 weeks decreased it. In the second, wetter season, basal area did not generally decrease for the introduced species as in the previous year nor did basal area increase as in 1994/5 for *D. richardsonii*.

## DISCUSSION

The two years produced markedly different responses from the species examined, the overwhelming difference between the seasons being the prolonged period of water deficit in the first. It appears that grazing interval was more critical in the wetter year than in the drier one. This result is in conflict with some of the published data (mainly on *P. aquatica*) which has shown that overgrazing at phenologically senstitive stages (eg. stem elongation, ear emergence and flowering) may cause serious damage to the persistence of perennial grasses. This did not seem to be the case in 1994/5 where, under drought conditions, there was no effect on the grazing strategies examined. Perhaps an extra ungrazed treatment would have provided some useful insights into the potential of totally de-stocking. We propose that the decline in basal area of *P. aquatica* in 1994/5 under watered conditions was due to the the breaking of bud dormancy (McWilliam and Kramer, 1968; Oram and Freebairn, 1984) under this watering regime.

The extraordinary resilience of *D. richardsonii* over the 1994/5 season is intriguing. The cultivar was selected in a summer rainfall environment approximately 700 km north of Wagga. However it appeared well adapted to drought conditions and was able to form a viable seed bank. In the second year the basal area of this species increased when grazed every 5 weeks but decreased when grazed every 8 weeks. The 8 week period gave annual C4 grasses such as *Panicum effusum* the opportunity to establish and compete with *D. richardsonii* whereas the shorter interval did not.

These results suggest that the impact of systems of grazing management such as rotational or cell grazing will strongly depend on the species and seasonal conditions. Another important factor, the effective density of the species can also be an important determinant of persistence. The mechanisms that lead to the maintenance of plant density or basal area of *D. richardsonii* need to be further researched in order to understand important traits for persistence in this environment.

**REFERENCES**


**Culvenor, R.A.** 1994. The persistence of five cultivars of phalaris after cutting during reproductive development in spring. Aust. J. Agric. Res. **45**: 945-962.

**Kemp, D.R. and Culvenor, R.A.** 1994. Improving the grazing and drought tolerance of temperate perennial grasses. New Zeal. J. Agric. Res. **37**: 365-378.

**McWilliwm, J.R. and Kramer, P.J.** 1968. The nature of the perennial response in Mediterranean grasses. I. Water relations and summer survival in *Phalaris*. Aust. J. Agric. Res. **19**: 381-395.

**Oram, R.N. and Freebairn, R.D.** 1984. Genetic improvement of drought survival ability of *Phalaris aquatica* L. Aust. J. Exp. Agric. Anim Husb. **24**: 403-409.

**Volaire, F.** 1994. Effects of summer drought and spring defoliation on carbohydrate reserves, persistence and recovery of two populations of cocksfoot (*Dactylis glomerata*) in a Mediterranean environment. J. Agric Sci., Camb. **122**: 207-215.


**Table 1**
Experimental details for both years

| | 1994/5 | 1995/6 |
|---|---|---|
| Treatments commence | 22 September | 13 September |
| Treatments conclude | 20 March | 23 April |
| Rainfall (during experiment) | 260 mm | 397 mm |
| Number of grazings: | | |
| 2 week | 15 | 16 |
| 5 week | 5 | 6 |
| 8 week | 3 | 4 |
| Initial basal cover | | |
| *P. aquatica* | 12.8 | 18.5 |
| *D. glomerata* | 15.6 | 14.4 |
| *F. arundinaceae* | 15.7 | 13.0 |
| *D. richardsonii* | 9.8 | 15.1 |
| Number of irrigations | 5 | 8 |

**Table 2**
Species, species x watering and species x grazing effects where significant ($P < 0.05$) on % changes in basal area from commencement to completion of treatments in 1994/5 and 1995/6.

| | Phalaris | Cocksfoot | Tall fescue | Danthonia a | LSD* |
|---|---|---|---|---|---|
| 1994/5 Species x wateringt | | | | | |
| rainfed | -25.7 | -68.4 | -73.1 | 52.1 | 26.1 |
| water | -43.6 | -44.3 | -63.6 | 55.6 | (16.1) |
| 1995/6 Species x watering | | | | | |
| rainfed | -12.4 | 10.7 | -8.3 | 7.6 | 18.6 |
| water | 14.2 | 38.8 | 34.0 | -14.4 | (20.0) |
| Species x grazing | | | | | |
| 2 week | 4.5 | 28.8 | -3.6 | -2.6 | 29.8 |
| 5 week | 13.0 | 35.2 | 34.4 | 30.6 | (24.5) |
| 8 week | -15.0 | 10.2 | 7.7 | -38.1 | |

* LSD in brackets for comparisons within drought or grazing treatments as appropriate.