The benefits of increasing defoliation interval

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The response of individual plants to defoliation is controlled by a complex interaction of plant physiological processes and abiotic effects (McNaughton 1979). Land managers have the ability to exert a degree of control on two main aspects of defoliation: the amount of leaf area removed (height) and the length of time plants are exposed to animals (frequency). Defoliation initiates immediate reactions within the plant which vary depending on the type and amount of material removed in combination with environmental conditions (Richards 1993). Repeated defoliation has much longer lasting effects on the vigour of grasses and these effects are cumulative (Voison 1961). Identifying the effects of varying the defoliation interval on the production of individual species is necessary to improve long-term productivity from multi-species pastures.

This experiment was designed to complement field experiments conducted on commercial properties. Field comparisons of the effect of extended rest periods and continuous grazing on the persistence and productivity of dominant perennial grasses showed the proportion of desirable species in the sward increased when they were not subjected to continuous selective grazing pressure (Earl and Jones 1996). The focus on a single aspect of the grazing process reported here - defoliation frequency - was designed to quantify the effects on individual species.

Method

Four dominant perennial grasses were selected from the field sites. The grasses were planted into PVC tubes containing soil of similar type to their natural environment. The tubes were 90 mm in diameter and 1 metre long so as not to inhibit root growth and were watered as necessary so moisture would not limit growth. The pots were set up outdoors to expose the plants to otherwise normal environmental conditions. The species selected for this experiment were: paddock lovegrass (*Eragrostis leptostachya*), speargrass (*Stipa scabra*), parramatta grass (*Sporobolus creber*) and wiregrass (*Aristida ramosa*) from one site and phalaris (*Phalaris aquatica*), redgrass (*Bothriochloa macra*), Sporobolus creber and poa tussock (*Poa sieberiana*) from the second site.

After establishment of the seedlings, four defoliation treatments were imposed over a period of 13 months. Plants were cut to a height of 3 cm at

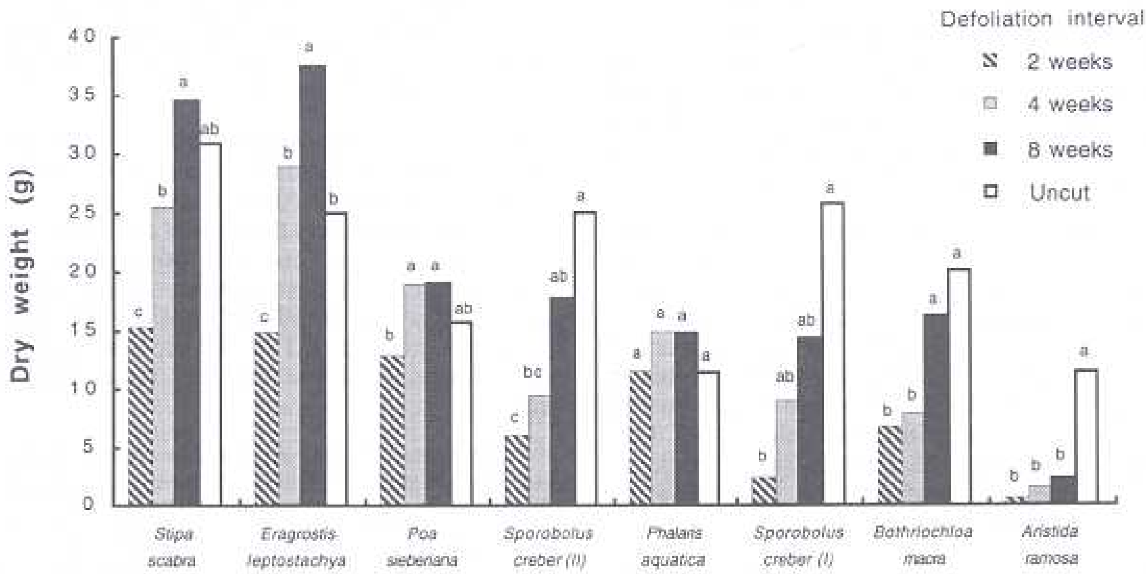

Figure 1. Mean cumulative above ground dry matter production (g/plant) of species cut at 2, 4 and 8 week defoliation intervals or uncut. Within species, columns sharing the same letter are not significantly different at P<0.05.

2, 4 and 8 week intervals and a further treatment remained uncut. Dry weight of harvested material was recorded after each cut. Cumulative dry weights of tops and roots were calculated at the completion of the experiment.

Results

Increasing the defoliation interval from 2 to 8 weeks increased the dry matter production of all native species. When cut at 8 weekly intervals *Stipa scabra*, *Eragrostis leptostachya* and *Bothriochloa macra* produced significantly ($P<0.05$) more dry matter than when cut more frequently (Figure 1). The highly palatable warm season native grass *E. leptostachya* was the only species to produce significantly ($P<0.05$) more above ground biomass when defoliated in comparison to remaining uncut. Defoliation interval had no significant effect on the herbage production of only one species - *Phalaris aquatica* (Figure 1).

With defoliation to 3 cm height at 8 weekly intervals, the production attained from most of the native grasses exceeded that of phalaris (Figure 1). In two species, *Eragrostis leptostachya* and *Stipa scabra*, production was more than double that of phalaris. Conversely, the frequent 2 week defoliation interval had a more deleterious effect on some native species than on phalaris. *Aristida ramosa* did not tolerate any of the cutting treatments and most cut plants of this species died within the first two months of the treatments being imposed. The 8 week defoliation interval was of benefit to the more desirable native species in comparison with more frequent defoliation.

Among all species, production of both above ground material and roots increased significantly

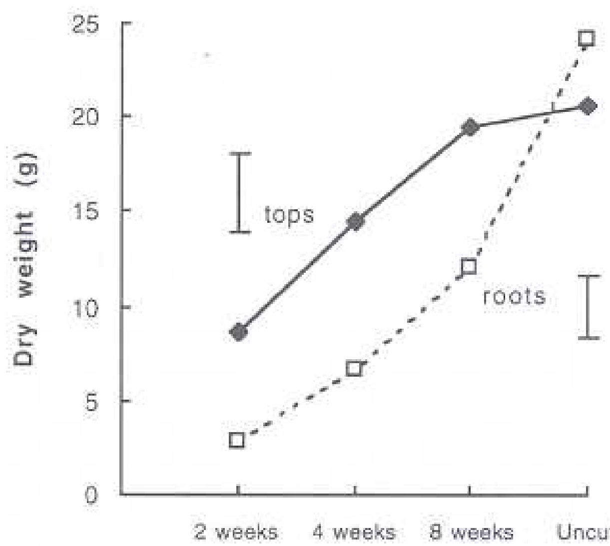

Figure 2. Cumulative dry weight of tops and roots averaged over all species cut at 2, 4 and 8 week defoliation intervals or uncut. Error bars indicate one standard error.

($P<0.05$) as the interval between defoliations increased (Figure 2). However, there was no significant difference in shoot production between plants which were uncut and those cut at 8 weekly intervals. In contrast, root production within all treatments was significantly different ($P<0.05$). Root biomass was reduced in all defoliation treatments compared with uncut plants and 8 week cutting intervals were insufficient to replenish root reserves (Figure 2). Uncut plants averaged more than double the root biomass of plants cut every 8 weeks.

As the period between defoliations was reduced the basal diameter of all species decreased significantly (P<0.05) relative to uncut plants. Defoliation at 8 and 4 weekly intervals reduced basal diameter of cut plants to 18 and 25% the size of uncut plants respectively. The basal diameter of plants cut every 2 weeks was 43% smaller than uncut plants, a significant (P<0.05) reduction in comparison with all other treatments.

Discussion

Selection of exotic species for animal production has been based on the ability of these species to tolerate frequent defoliation via rapid regeneration of leaf material. This strategy is highly effective under conditions of high fertility and soil moisture content, however, under less than ideal conditions introduced species tend to decline in vigour and their representation in pasture subsequently declines. Most native grasses are well adapted to persist under adverse conditions of low fertility and/or low soil moisture.

Many native grasses, particularly warm season species, possess lower leaf to stem ratios than introduced species. Grasses with a lower leaf to stem ratio are better suited to intermittent grazing than to continuous grazing (Hyder 1972). In addition many native species possess indeterminant flowering mechanisms. Thus, continuous grazing results in a larger proportion of leaf material being regenerated from axillary buds rather than intercalary meristematic regions. This process requires a greater time period to achieve comparable levels of leaf area (Briske 1992).

Following defoliation, root growth ceases for varying periods in different species. Approximately 2 weeks is the period most frequently quoted. In this experiment, 8 week intervals between defoliation events was insufficient to replenish root reserves (Figure 2). Root weights of all plants cut at this frequency averaged only half that of plants which remained uncut. As the frequency of defoliation increased, the root biomass declined significantly (P<0.05).

Reduction in root biomass effectively reduces a plants ability to aquire nutrients and limits the potential uptake of soil moisture. The ability of individual plants to compete for limited resources may also be reduced if fewer or shallower roots occupy a given volume of soil. These factors may combine to significantly affect the productivity of grasses (Cornish 1987).

Defoliation at 2 weekly intervals resulted in a reduction in the basal diameters of all species. Plant basal diameter gives an indication of plant vigour. If the basal diameter of pasture plants is reduced due to frequent defoliation, the susceptibility of those plants to extreme environmental conditions such as drought increases. When the basal diameter of pasture plants is reduced, subsequent changes in the competitive relations of the community are likely to result in changes in the botanical composition (Briske 1992).

Conclusion

Increasing the defoliation interval significantly increased production of the more desirable native grasses. Root biomass and plant basal diameter of all species increased as the interval between successive defoliations increased. The combination of these factors indicate that the production and persistence of desirable pasture species will be enhanced when allowed more time to recover from a single defoliation event.

In many Tableland areas periods of moisture stress are experienced frequently. Pastures which are maintained in a healthy, more vigorous state through these periods will be able to regenerate more quickly when favourable conditions return. Allowing plants extended periods of rest will encourage growth of more extensive root systems and increase the ability of plants to extract nutrients and water, particularly in times when these resources are limited.

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