EFFECT OF DIFFERENT ANNUAL PASTURES IN SUMMER ON THE ESTABLISHMENT AND EARLY PRODUCTION OF PERENNIAL GRASSES SOWN IN AUTUMN

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SUMMARY
The effect of grazing management and the resulting botanical composition and biomass of annual pastures on the establishment and productivity of temperate perennial grasses is reported. The results showed that successful establishment of perennial grasses sown in autumn relied on low levels of competition. Consequently this was at the expense of animal production in the first 18 months, including 4 months grazing foregone in late autumn/winter following seeding.

Keywords: perennial grass, grazing management, establishment.

INTRODUCTION
Incorporating perennial grasses into annual pastures has shown production benefits at sites receiving > 500 mm rainfall in south west Western Australia (WA) (Nicholas 1979; Rogers et al. 1982). However, many producers are concerned about the persistence of perennial grasses and the cost of animal production foregone in their establishment phase. Areas resown to pasture need to be destocked in late autumn/winter, a time when farmers can least afford to reduce grazing area. The productivity foregone will be considerably less if a run down, neglected pasture is to be replaced.

Conflicting aspects when establishing perennial grasses are the need to maintain early productivity which is related to density of annual and perennial seedlings (Donald 1951) and the effect of competition of emerging annuals on the establishment of the sown perennial grasses.

This experiment was designed to examine and quantify the effect of 3 pasture types on the productivity just before and during the establishment phase of temperate perennial grasses and on the success of their establishment.

MATERIALS AND METHODS
The work was conducted at Mt Barker Research Station (34°38’S,117°32’E), 50 km from the south coast of WA. The climate is Mediterranean with an average annual rainfall of 650 mm. In 1991 and 1992, 604 and 728 mm of rain was received respectively. The soil is a well drained, fertile, sandy to gravelly loam over a medium clay at approximately 50 cm, with an average pH of 5.6 (1:5 soil:water).

The experiment involved 2 phases: (a) the establishment of annual pastures with different bulk and botanical composition characteristics by December 1991 and (b) managing these different pastures from December 1991 up to and including seeding of perennial grasses and then the subsequent grazing management to September 1993.

The first phase started in 1988 when annual pastures were grazed by cattle in 4 management systems. These were continuous grazing (CON), spring deferment with heavy grazing in summer (SPD), summer deferment with heavy grazing in spring (SUD) and 1 that was deferred for 4 weeks after the “break” (AUD). Each of these systems was replicated in 3 randomised blocks. By December 1991 the bulk and botanical composition of feed on offer (FOO) were different among the treatments.

The second phase started from this time when paddocks were stocked at different intensities by weaner steers to reduce FOO by April/May 1992 in preparation for establishing 3 perennial grass species. On 6 April 1992 all steers were removed from the 9 plots to be sown to perennials (SPD, SUD and AUD by 3 replicates). Throughout both phases the 3 CON paddocks were continuously grazed at 2 head/ha as a control treatment.

The annual pasture germinated well by mid May 1992. The 9 plots to be sown were sprayed with 1 L/ha Roundup CT (450 g/L glyphosate) on 15 May and sown on 19 May with 6.2 kg/ha subterranean clover and either 7.6 kg/ha of fescue (Festuca arundinacea cv. Triumph), 5.4 kg/ha phalaris (Phalaris aquatica cv. Sirosa) or 5.8 kg/ha of perennial ryegrass (Lolium perenne cv. Brumby). Seed was mixed with superphosphate, dropped on the soil surface using a combine, and covered with finger harrows. Seeding rates were based on equivalent numbers of seeds per unit area (approximately 325 perennial grass seeds/m²).

Each pasture species was sown into 1 of the previous grazing management system paddocks. Grazing of the paddocks was recommenced when FOO was approximately 1100 kg/ha.

This phase of the experiment involved 4 pastures comprising annuals only and each of the 3
perennial grasses mixed with annual species, in 3 randomised blocks with 3 animals in each plot stocked at 2 steers/ha.

Levels of FOO were determined by calibrated, visual ratings recorded by 2 operators (60 estimates/plot) approximately every 4 weeks. All calibration samples were cut at ground level with a scalpel, washed, then dried at 65°C for 48 hours. Botanical composition was assessed visually by 2 operators (40 assessments/plot) in winter and spring, and pasture in each plot was sampled monthly to determine quality. The number of perennial plants was counted in January and March 1993 in 0.1 m² quadrats placed randomly 40 times/plot by each of 2 operators.

Cattle were weighed directly from the paddock at allocation each December and approximately monthly throughout the year. Metabolisable energy (MJ/ha) (ME) was the common unit used to compare production from grazed pasture and consumption of hay per hectare. For animals, it was calculated from animal weight, weight change and in vitro quality analysis of feed thought to be consumed (Russell and Wright 1983; MAFF 1984) and for hay it was calculated from the energy concentration (MJ/kg) and quantity fed. In 1992 (CON only) and 1993 cattle were fed hay supplied from outside the experiment. It was fed only as a welfare measure based on liveweight change and body condition. Hay samples were analysed for quality for the purpose of ME calculations.

To compare management systems the common unit of ME (MJ/ha) used by the steers was analysed. Analysis of variance was used to compare the effects of previous treatment on FOO, arcsin transformed percentages of pasture components, energy used by steers over different intervals and plant counts.

RESULTS

The effects of the different grazing systems on the botanical composition during 1991 and FOO in December in 1991 are shown in Table 1. The AUD and SUD systems resulted in similar botanical composition to the CON system although the SUD system had 25% less (P < 0.05) FOO by the end of spring. However, the SPD system had significantly (P < 0.05) lower levels of clover and weed, higher levels of grass and 45% more (P < 0.05) FOO than the CON system by the end of spring.

Table 1. The effect of different grazing patterns before and during 1991 on the botanical composition (%) and FOO (kg/ha) in 1991

<table>
<thead>
<tr>
<th>Deferral system up to Dec. 1991</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clover</td>
<td>Grass</td>
</tr>
<tr>
<td>Nil (CON)</td>
<td>66a</td>
<td>27ab</td>
</tr>
<tr>
<td>Spring (SPD)</td>
<td>26b</td>
<td>72c</td>
</tr>
<tr>
<td>Summer (SUD)</td>
<td>72a</td>
<td>21a</td>
</tr>
<tr>
<td>Autumn (AUD)</td>
<td>55a</td>
<td>38b</td>
</tr>
</tbody>
</table>

Within columns, means with different superscripts differ significantly (P < 0.05).

The estimated ME used by steers in the different seasons through 1992 are shown in Table 2. Over the whole year most ME was generated from grazing the SPD system and least from the SUD system. The main period affecting this total was summer (1991/92) when a wide range of grazing pressures was used; 3 times more ME was used by steers grazing the SPD than the CON system over this time, 28% more by those grazing the AUD system while no steers grazed the SUD pastures.

Even though a complete kill of grass was achieved with the herbicide prior to sowing, the combine used for seeding encouraged germination of annual grass seed in the SPD system which quickly swamped the sown perennial grass seed. These areas were subsequently the first to be restocked (28 July). A consequence of a lower amount of volunteer annual species after sowing was slower pasture regeneration in the AUD and SUD systems which delayed restocking until 11 and 25 August respectively. Over the autumn, winter and spring the newly sown areas produced between 75% and 90% of the ME produced by the CON system. However, these newly sown perennial grass pastures had approx 40% more FOO by December 1992 than the continuously grazed annual pasture.

In 1993 ME used by steers by mid September was not different among the treatments though there was a tendency (P<0.1) of higher levels of ME use in the SPD (120%) and AUD (117%) areas compared
with CON (100%). Over the whole period 1992 and 1993 (up to mid September) most (P < 0.05) ME was used by steers in the SPD system (128%), least (P < 0.05) in the SUD system (80%), with the other 2 systems being similar (CON 100% and AUD 103%). The levels of FOO at mid September 1993 were not significantly different though the AUD (80%) tended to be lower (P < 0.1) than the CON (100%).

Table 2. Effect of different grazing patterns before December 1991 on metabolisable energy (MJ/ha) accounted for by the growth of steers in 1992 and on FOO (kg/ha) in December 1992

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil (CON)</td>
<td>7400a</td>
<td>27600a</td>
<td>35000a</td>
<td>3800a</td>
</tr>
<tr>
<td>Spring (SPD)</td>
<td>21800b</td>
<td>24700b</td>
<td>46500b</td>
<td>5100b</td>
</tr>
<tr>
<td>Summer (SUD)</td>
<td>0c</td>
<td>20600b</td>
<td>20600c</td>
<td>5400b</td>
</tr>
<tr>
<td>Autumn (AUD)</td>
<td>9500d</td>
<td>23400b</td>
<td>33000d</td>
<td>5600b</td>
</tr>
</tbody>
</table>

Within columns, means with different superscripts differ significantly (P < 0.05).

More perennial grass plants (P <0.05) established in the SUD and AUD systems and fewer died over the first summer (7% to 16% c.f. 61%) than in the SPD (Table 3). At this time perennial plant size was also associated with the previous management system, with the SUD system supporting the largest, strongest plants followed by the AUD system and then the SPD system with the smallest, spindly plants, with least tillers. There was no significant effect of the species of perennial grass sown in 1992 on any of the dependent variables listed in Tables 1, 2 or 3. However, as no replicates of new species by original grazing management system were included, interactions of these parameters could not be tested, though none were apparent.

Table 3. Effect of different grazing patterns before December 1991 on the establishment of perennials sown (plants/m²) in 1992, on metabolisable energy (MJ/ha) accounted for by the growth of steers up to October 1993 and on FOO (kg/ha) in mid September 1993

<table>
<thead>
<tr>
<th>Deferral system up to Dec. 1991</th>
<th>Establishment</th>
<th>Metabolisable Energy to mid Sept. 1993</th>
<th>FOO 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil (CON)</td>
<td>---</td>
<td>---</td>
<td>23800</td>
</tr>
<tr>
<td>Spring (SPD)</td>
<td>234</td>
<td>94</td>
<td>28600</td>
</tr>
<tr>
<td>Summer (SUD)</td>
<td>56b</td>
<td>47b</td>
<td>26500</td>
</tr>
<tr>
<td>Autumn (AUD)</td>
<td>43b</td>
<td>40b</td>
<td>27800</td>
</tr>
</tbody>
</table>

Within columns, means with different superscripts differ significantly (P < 0.05).

DISCUSSION

By December 1991 the grazing management systems resulted in 3 basic annual pasture types: a bulky, grassy pasture with some clover and virtually no weed (SPD), typical of lax grazing systems; another with little bulk that was clover dominant with some grass and weed (SUD), similar to pastures stocked by sheep; and another with similar botanical composition but with more bulk (CON and AUD), reflective of well stocked cattle pastures.

In 1992 the large differences in ME realised during the summer period were a result of attempts to reduce FOO to a minimum in preparation for the sowing of the perennial grasses. The main differences over the green feed period depended on how soon the areas sown to perennial grasses in May could be restocked. The 28% more total ME used by steers in the SPD system from December 1991 to mid September 1993 shows that resowing of pastures can be undertaken without necessarily reducing energy output. However this was at the expense of good establishment of the perennials.
Where sowing of perennial grasses is the objective, reduction in competition is of most importance, and a longer period before restocking is the price. Reduced numbers of small perennial plants is expected to delay their contribution to production and hasten their disappearance from the sward. Low numbers of perennial plants leads to increased selection over summer/autumn from increased grazing pressure per plant, while small plants (Hoen 1968) are more likely to disappear over the first 2 summers. From the authors’ experience of other perennial pastures continuously grazed for 6 years at this site, and that of others (Nicholas 1979; Rogers et al. 1982), the higher counts of perennial grasses (>40/m²) would contribute significantly to animal production in the long term.

The AUD system that started with a pasture type similar to the control showed no decrease in ME utilised, and was not significantly different in perennial grass counts to the best system tested (SUD). By December 1992, the higher levels of FOO in the recently sown paddocks than in the CON paddocks does indicate that higher grazing pressures over spring, or earlier commencement of grazing, may have been feasible, which would have further improved the amount of energy used and possibly reduced the competitive effect of the annual species with the developing perennial grass seedlings.

The use of minimum tillage seeding machinery, where seed and fertiliser are placed in slots cut by coulters, is likely to have improved the perennial plant establishment, especially, in the SPD system, as less volunteer ryegrass would have been stimulated. However less ME would have been available.

ACKNOWLEDGMENTS
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REFERENCES