IMPROVING DEGRADED UPLAND PASTURES IN SOUTH-EAST QUEENSLAND BY HERBICIDE, OVERSOWING AND FERTILISER

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SUMMARY
Applications of glyphosate and nitrogen and sulfur fertilisers and oversowing with kikuyu (Pennisetum clandestinum) and white clover (Trifolium repens) were used to improve the productivity of degraded upland pastures in a grazed site in south-east Queensland. The naturalised pastures based on Rhodes grass (Chloris gayana), paspalum (Paspalum dilitatum), carpet grass (Axonopus sp.) and kikuyu have been invaded by inedible grass weeds, swamp foxtail (Pennisetum alopecuroides), blady grass (Imperata cylindrica) and fine-leaved tussock (Poa sieberina). Herbicide application substantially reduced the density of grass weeds. However over 4 years, weeds reinvaded treated areas and periodic retreatedreatment with herbicide will be necessary for long term control. Fertiliser and increased stocking pressure without herbicide treatment increased the yield of all grasses and increased liveweight gain (LWG)/ha but did not control the spread of the inedible grasses. The frequency and yield of kikuyu increased over the 4-year study period but because dry springs were experienced, white clover made little contribution. Over a 3-year grazing period, nitrogen fertiliser costs had not been fully recovered by increased LWG but animal response increased each year.

Keywords: naturalised pasture, glyphosate, liveweight gain, kikuyu, foxtail, fine-leaved tussock.

INTRODUCTION
Extensive areas of quality grazing lands on the slopes of the McPherson Range in south-eastern Queensland are used for beef cattle production using Bos indicus cross animals. Stocking rates average 0.7 adult equivalents (AE) per hectare but are being substantially reduced by the invasion of unpalatable grass weeds such as swamp foxtail (Pennisetum alopecuroides), fine-leaved tussock (Poa sieberina) and blady grass (Imperata cylindrica). Nitrogen has been shown to improve pasture and animal production on kikuyu pastures (Mears and Humphreys 1978) and to change the botanical composition of pastures containing mainly edible species (Gartner 1969). However, there is little information on management practices which can be used in steep country to increase edible pasture availability, reduce grass weeds and improve animal production. The pasture and animal responses to fertiliser, oversowing of improved species and application of herbicides were studied in this project.

MATERIALS AND METHODS
The trial was located in the foothills of the McPherson Range, south of Beaudesert, Qld. The topography was steep, broken and unsuitable for machinery movement. The soils were brown clay loams derived from basalt and had the following fertility status: pH(H2O) 6.1, P (Colwell) 30 µg/g, K 0.37 mmol(+)/100 g, SO4 6 µg/g. The area was split into 4 paddocks each of 3.5 ha. The visual rating, ‘BOTANAL’ method (Tothill et al. 1978) indicated that 1 paddock had a considerably higher proportion of edible grasses. This paddock was allocated to the control treatment. The aim was to determine if the treatments could restore the productivity of the other areas to that of the control. The fertiliser treatments, 40 kg S/ha as Canadian Bright (elemental sulfur)(N&), 115 kg N/ha as urea in spring and autumn (N&-J and 40 kg S/ha as Canadian Bright PLUS 115 kg N/ha as urea in spring and autumn (NISI), were randomly allocated to the other paddocks. Triple superphosphate (125 kg/ha) was applied annually to all areas. All fertiliser was applied by helicopter. Kikuyu and Haifa white clover were sown with the initial fertiliser on 25 March 1987. Three plots, each 12 by 60 m in the most accessible area of each paddock except the control, were treated with glyphosate (360 mL/L, active ingredient) on 12 February 1987. One area had the chemical applied by a wickwiper (3 L/ha) while the other 2 areas were sprayed with a boom at 6 and 9 L/ha of glyphosate in 100 L of water.

Three steers per treatment, averaging about 450 kg, entered paddocks on 24 August 1987. Animals were removed when ready for sale at around 600 kg and replaced. Extra stock were added to specific treatments depending on pasture availability (≈ 1000 kg DM on offer/steer). The mean stocking rate over the 3-year period was 1.1, 1.2, 1.5 and 1.5 AE/ha for the control, N&-J, N&-J-NISI treatments respectively (1AE is equivalent to a 500 g steer). Animals were weighed on entry and exit from treatments.
Pastures were assessed for composition and forage on offer in early spring and late summer using the ‘BOTANAL’ technique (Tothill et al. 1978) with 3 operators making 50 observations per paddock. The glyphosate-treated areas were assessed as part of this evaluation with 10 recordings per plot. Yield and frequency of occurrence (the presence of a species in a quadrat, expressed as a percentage of the total number of quadrats assessed) of components were determined by this program. Species yield responses to fertiliser treatments were analysed using regression analysis against time by comparison of slopes.

RESULTS

Pasture composition and yield responses to fertiliser treatments

Yield of all components except other ‘species’ (including white clover) increased over the 4-year period as a result of improved seasonal conditions (Table 1). Total yield reflects the interaction of fertiliser and stocking rate. The control treatment maintained the highest quantity of edible and lowest quantity of inedible pasture components throughout. The proportion of edible species in the nitrogen fertilised paddocks increased from around 15% at the beginning of the trial to about 53% at the end. All fertiliser treatments significantly increased the yield of foxtail and fine-leafed tussock grasses over time compared with the control treatment. Paspalum, Rhodes grass and herbaceous weeds were not influenced (P > 0.05) by fertiliser treatment over time, while kikuyu yield was increased (P < 0.01) only by the N+S treatment. Blady grass was significantly reduced by the N+S and N+S treatments. Frequency of occurrence of kikuyu in the fertilised paddocks increased markedly (data not presented) but other component changes were small.

Table 1. The effect of fertiliser treatment (N+S control; N+S 40 kg S/ha; N+S 115 kg N/ha; N+S 40 kg S/ha and 115 kg N/ha) on components of feed on offer (t/ha) in the large grazing paddocks in the first (7 January 1987) and fourth summers (22 April 1991)

<table>
<thead>
<tr>
<th>Component</th>
<th>N+S 40</th>
<th>N+S 115</th>
<th>N+S 40</th>
<th>N+S 115</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yr 1</td>
<td>Yr 4</td>
<td>Yr 1</td>
<td>Yr 4</td>
</tr>
<tr>
<td>Paspalum/Rhodes grass</td>
<td>0.38</td>
<td>3.68</td>
<td>0.50</td>
<td>2.48</td>
</tr>
<tr>
<td>Kikuyu</td>
<td>0.29</td>
<td>1.02</td>
<td>0.21</td>
<td>0.89</td>
</tr>
<tr>
<td>Foxtail/tussock</td>
<td>1.49</td>
<td>2.69</td>
<td>1.43</td>
<td>3.47</td>
</tr>
<tr>
<td>Blady grass</td>
<td>0.36</td>
<td>0.99</td>
<td>0.20</td>
<td>1.89</td>
</tr>
<tr>
<td>Herbaceous weeds</td>
<td>0.16</td>
<td>0.49</td>
<td>0.18</td>
<td>0.28</td>
</tr>
<tr>
<td>Other spp.</td>
<td>0.21</td>
<td>0.02</td>
<td>0.08</td>
<td>0.11</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2.85</td>
<td>8.89</td>
<td>2.60</td>
<td>9.12</td>
</tr>
<tr>
<td>% Edible</td>
<td>29</td>
<td>53</td>
<td>30</td>
<td>38</td>
</tr>
</tbody>
</table>

**P < 0.01; significantly different trends over time for fertiliser treatment compared with control.

Effect of herbicide application

Spraying glyphosate was more effective in controlling the invading grasses than wickwiper application but there was no difference (P > 0.05) between the high and low spraying rates. Herbicide application initially decreased the yield of all pasture components (Fig. 1). All components except herbaceous weeds increased over time but only kikuyu was influenced (P < 0.01) by method of herbicide application. Kikuyu yield was significantly increased over time in the sprayed treatment compared with the wickwiper treatment. Fertiliser treatments did not influence (P > 0.05) species performance in the 2 herbicide treatments. The percentage of edible species in the total pasture on offer increased from 22% prior to glyphosate treatment to an average of 53 and 40% in the sprayed and wickwiper treatments respectively.

Animal production

The total number of beast grazing days in the nitrogen treatments was 44% higher than in the control and N+S treatments. Mean LWG/ha.day was increased by nitrogen but was unaffected by sulfur, either alone or in combination with nitrogen (Fig. 2). On the other hand mean LWG/head.day was similar for all treatments.
Fig. 1. Effect of glyphosate applied to the pasture by spraying or wickwiper and the effects of these treatments on subsequent production of pasture components. (a) paspalum, (b) kikuyu, (c) invaders, (d) weeds, (e) total.

Fig. 2. The effect of fertiliser treatment (□ control; ■ N₀S₀; ■ N₀S₁; ■ N₂S₀; ■ N₂S₁) on mean liveweight gain (kg).
DISCUSSION

Forage and animal production of upland pastures degraded by the invasion of unpalatable grass weeds can be improved by applying nitrogenous fertilisers although the spread and dominance of these invading species was not suppressed by fertiliser or increased stocking rate. The unpalatability of these grass weeds, even when receiving moderate levels of nitrogen fertiliser, and their upright habit and free seeding ability, which allows them to dominate the sward, are the reasons for the lack of control experienced here. The cost of fertilisation was not recouped by the increased animal production on the N\textsubscript{2}S\textsubscript{0} treatment, but this should be viewed in the context that pasture production and composition had been inferior to that of the control at the commencement of the demonstration. It is difficult to place a monetary value on returning this paddock to the level of the control. The performance of these treatments will be monitored for 2 more years as the full effect of nitrogen fertilisation on dairy pastures is not expressed in milk production until the third or fourth year (Lowe 1991).

The lack of response to sulfur in this demonstration reflects the poor performance of white clover during the later years of the demonstration, associated with lower than average spring rainfall. Responses from grasses would not be expected from sulfur at levels measured in these soils.

Glyphosate was effective in reducing the frequency and production of the weed grasses but without regular retreatment, possibly on a 4- or 5-yearly basis, weed grass dominance will return to pretreatment levels. The results show a considerable increase in the frequency and production of kikuyu, particularly in areas sprayed with glyphosate and oversown with seed. Kikuyu spread from already established areas and it was observed that little invasion of weed grasses occurred where a healthy, vigorous sward of kikuyu was present. It is the authors’ opinion that an investment of some $A200/ha, spread over a 5-year period, for seed, fertiliser and herbicide may be justified for long term property viability.

ACKNOWLEDGMENTS

We thank Mr Leon Blank for the use of his land and animals, Incitec Ltd for supplying the fertiliser and Monsanto Ltd for supplying and applying the glyphosate.

REFERENCES


