PASTURE AND CLIMATIC EFFECTS ON CATTLE LIVESTOCK GAIN FROM STYLO-BASED PASTURES IN THE SEASONALLY DRY TROPICS

R.J. JONES*, D.B. COATES* and M.R. McCASKILL*

SUMMARY

Annual live weight gain (LWG) of cattle grazing stylo-based pastures at Lansdown in the seasonally dry tropics was related to four climatically derived variables and to pasture dry matter (DM) yields. There was a close linear relation ($r^2 = 0.76$) between annual LWG and the derived index GWGI which estimates the number of weeks in the year with green feed available. There was no relation with the index GTH (growth weeks) or with pasture yield (total or legume DM).

INTRODUCTION

Cattle production in much of northern Australia is limited by the generally low quality of the feed in the dry season and the length of the growing season (Shaw and Norman 1970). Animal production on native pastures in these dry tropical zones is essentially constrained by soil moisture availability since temperature and solar radiation are rarely limiting factors. McCown (1980-81) on the basis of a weekly growth index (GI) was able to simulate a 'green season' during which cattle gained weight and a 'dry season' during which they lost weight. Applying this model to liveweight change data for cattle grazing native pastures, it was shown that the annual LWG was strongly related to the length of the 'green season' (McCown et al. 1981), but it was not expected that such a prediction method, based on green feed supply duration, would work equally well with improved pastures because of the contribution of dry legume to LWG during the 'dry season'.

In this paper we examined the relation between the climatic variables and pasture yields and annual LWG of cattle on four grass/legume pastures over a range of seasons. The object was to ascertain whether some relation between climatic data and animal production could be used to estimate cattle gains on improved pastures in the widely fluctuating annual rainfall regime common in parts of northern Australia.

MATERIALS AND METHOD

The work was conducted at the Lansdown Pasture Research Station 50 km south of Townsville, Queensland, in the seasonally dry tropics. Annual rainfall averages 861 mm, 86% of which falls during the summer period between October and March. The rainfall is highly variable in amount and distribution, ranging from 235 mm in the driest year on record to 1767 mm in the wettest. Temperature criteria for a range of tropical grasses listed by Ivory and Whiteman (1978) indicate no likely low-temperature restriction on growth during summer, but that during winter, low temperatures would restrict these grasses to 25-50% of their maximum growth rates. Frosts are rare.

Two adjacent grazing trials (A and B) provided the pasture and animal data. Pastures differed in the species sown but all were grass/legume mixtures. In trial A, three mixtures were used, viz. Urochloa (Urochloa mosambicensis cv Nixon), Callide Rhodes (Chloris gayana cv Callide) and native grasses each in combination with a mixture of Verano (Stylosanthes hamata cv Verano) and S. viscosa CPI 34904. In trial B, the mixture comprised Urochloa and native grasses with Verano and Seca (S. scabra cv Seca). Pasture yield (DM on offer)
and botanical composition were estimated annually at the end of the wet season in May or June by the BOTANAL technique (Tothill et al. 1978).

In each trial, there were three animals per paddock and treatments were replicated twice. Trial A was a factorial combination of three pasture types by three stocking rates (0.65, 0.95 and 1.25 an/ha). Superphosphate (100 kg/ha) was applied every second year. Trial B was a factorial combination of four fertilizer rates by two phosphorus supplement levels (+ or - supplement) with a common stocking rate of 0.8 an/ha. Data from only 12 paddocks were used, those from the nil fertilizer treatments being excluded. Trials A and B differed in other respects as follows:

<table>
<thead>
<tr>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment (sowing date)</td>
<td>Jan 1977</td>
</tr>
<tr>
<td>Grazing period</td>
<td>July - June</td>
</tr>
<tr>
<td>Animal age (months)</td>
<td>8-20; 20-32</td>
</tr>
<tr>
<td>Class of animal</td>
<td>Droughtmaster steers</td>
</tr>
<tr>
<td>Years of suitable data</td>
<td>1980 to 1986 &amp; 1989</td>
</tr>
<tr>
<td>(8 years)</td>
<td>(6 years)</td>
</tr>
</tbody>
</table>

The year designates the date at the end of the grazing year and only those years where cattle grazed for the full 12 months could be used in the analysis. The missing years (1987, 1988 for trial A and 1988 for trial B) were the result of temporary destocking due to drought.

Four climate-derived parameters were calculated from standard weather records made close to the experimental site and rainfall recorded on site. The calculations were based on a model described by McCown et al. (1981). The model calculates a water index (WI) of between 0 and 1 from a water balance, a temperature index (TI) from temperature data, and a growth index (GI) as GI = WI x TI. Whereas the original model used a weekly timestep and average weekly temperatures, the version reported here used a daily timestep and actual daily temperature data interpreted into a TI by an equation of Ivory and Whiteman (1978) for buffel grass (Cenchrus ciliaris). A soil water store of 150 mm was used. Parameters calculated were:

(i) green weeks based on WI only (GWWI), calculated as the number of weeks in the year with WI>0.1;
(ii) green weeks based on GI (GWGI), calculated as the number of weeks in the year with GI>0.1.
(iii) growth time (GTH), which is calculated from GI and is related to the amount of herbage growth (McCown 1973); and
(iv) evapotranspiration (EPT, mm/yr) calculated by the model.

Standard regression analysis was performed using GENSTAT (Payne et al. 1987).

RESULTS

When annual LWG was related to the climate-derived variables, and to end-of-wet pasture yield, the best relation was with GWGI (green weeks based on GI). (Table 1). The only other parameters to attain significance were GWWI and EPT. In trial A the relation between GWGI and LWG was also determined for the different pasture mixtures and for the different stocking rates. These linear regressions were all highly significant (P<0.01), but did not differ from one another in either slope or intercept. LWG was therefore meaned over all paddocks and trial A compared with Trial B. The relation in trial B was stronger than in trial A (r² of 0.94 and 0.62 respectively). However, the slopes and intercepts did not differ significantly and the results were pooled to derive the relation shown in Fig. 1.
Table 1: Comparison of some variables for predicting annual liveweight gain of cattle grazing stylo based pastures using linear regression of variable on liveweight gain

<table>
<thead>
<tr>
<th>Predictive parameter</th>
<th>Range</th>
<th>r²</th>
<th>r.m.s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWG, green weeks based on GI (wk)</td>
<td>20.8 - 43.7</td>
<td>.76</td>
<td>*** 17.8</td>
</tr>
<tr>
<td>GWG, green weeks based on WI (wk)</td>
<td>25.0 - 46.8</td>
<td>.65</td>
<td>*** 21.6</td>
</tr>
<tr>
<td>GG, growth time (wk)</td>
<td>5.2 - 25.0</td>
<td>.14</td>
<td>n.s. 33.8</td>
</tr>
<tr>
<td>EFT, evapotranspiration (mm/yr)</td>
<td>230 - 639</td>
<td>.35</td>
<td>* 29.6</td>
</tr>
<tr>
<td>End-of-wet pasture on offer (kg/ha)</td>
<td>1632 - 7346</td>
<td>.09</td>
<td>n.s. 34.0</td>
</tr>
<tr>
<td>End-of-wet logum on offer (kg/ha)</td>
<td>782 - 2018</td>
<td>.08</td>
<td>n.s. 35.0</td>
</tr>
</tbody>
</table>

*P<0.05; ***, P<0.001; r.m.s., residual mean square

DISCUSSION

The results clearly show the dominating effect of climatic variables on yearly variation in LWG on these sown legume based pastures. Of the variables investigated, GWGI was the best predictor of annual LWG accounting for 74% of the variation. Thus, the green weeks prediction method has worked equally well for sown stylo/grass pastures as for native pastures. For native pastures, GWGI equates with the number of weeks during which cattle gain weight and relates to the length of time that green feed is available (McCown et al. 1980–81). Compared with native pasture, cattle on stylo pastures gain weight for a longer period of the year because the nutritive value of the diet remains adequate for growth longer into the dry season. Thus, although GWGI does not equate with the duration of animal gain, our work demonstrates that it correlates well with annual LWG of cattle grazing stylo pastures in the seasonally dry tropics. The relation for grass stylo pasture was virtually parallel to that of McCown et

al. (1981) for native pastures in the same region (Fig. 1), but sown pastures have a consistent advantage (of approximately 45 kg/hd) over native pastures irrespective of season, even though stocking rates on sown pasture are three to four times higher. The low LWG of only 83 kg in trial A (Fig. 1) occurred early in the experiment when pastures had only received 10 kg P/ha. This low gain is attributed to the low P concentration in feed (unpublished data of R.J. Jones). GWGI was a better predictor of annual LWG than GWWI. This demonstrates that while the effect of low temperature on GI at tropical sites is relatively slight compared with higher latitudes (McCown 1980-81), temperature effects should not be ignored.

End-of-wet season pasture yield and even legume yield, which varied over a wide range, proved to be very poor predictors of annual LWG. Other workers have also found poor relations between pasture yield and animal gain, although better relations were found between LWG and yield of green matter or green leaf ('t Mannetje and Ebersohn 1980). Such relations were, however, determined within the annual growth cycle and in these instances LWG was asymptotically related to green material in the pasture ('t Mannetje 1974).

Unlike the twining tropical legumes siratro and desmodium, which decline under heavy grazing (Jones 1974), the percent Verano did not decline with increasing stocking rate. This behaviour could explain the relatively small decline in animal gain/yr with increasing stocking rate. The linear relation depicted in Fig. 1 will clearly not hold under drought conditions when feed availability falls to very low levels. Trial A, for example, had to be destocked in 1987 when feed availability fell to 500 kg DM/ha at the high stocking rate.

The regression of LWG on GWGI will need verification over other years and in other areas. The approach has promise for predicting LWG from stylo based pastures in areas where stylo grows successfully. It also shows promise for estimating LWG over sequences of years for risk assessment and economic return.

REFERENCES