

## GRAZING EFFECTS ON PASTURE AND ANIMAL PRODUCTION FROM **OVERSOWN** TUSsock GRASSLAND

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### Abstract

Continuous stocking was compared with intermittent (two paddock) and rotational (six paddock) grazing at low, medium and high stocking rates equivalent to 1.0x, 1.5x and 2.0x conventional rates for **oversown** tussock country (500 mm annual rainfall). By the sixth year liveweight gain/ha from Merino **wether hoggets** was improved 26% by intermittent and rotational grazing at medium stocking rates from that at conventional stocking rates. A strong interaction was demonstrated, with advantage in liveweight gain from intermittent and rotational grazing strengthening with increasing stocking rate.

Total vegetative cover (75.8%) remained unchanged. Cocksfoot increased under low stocking while **ryegrass** increased under high stocking. A 60% overall loss in **ryegrass** during 1982 was attributed to unusually low winter soil temperatures. White clover cover was affected **more** by climate than by grazing. Although **there were** interim differences, **herbage** production by the sixth year was similar for all treatments.

**Keywords:** Tussock country, oversown, grazing, stocking rate, subdivision, pasture development, utilisation, Merino, liveweight.

### INTRODUCTION

Oversowing with clovers, cocksfoot and **ryegrass** is the dominant form of agricultural improvement in the South Island high country. To date 14% (466,000 ha) has been improved by this method compared with only 4% (14,000 ha) by other means including forestry (Kerr, 1983).

Problems associated with establishment of these traditional species have been largely resolved and dramatic increases in production immediately following improvement have been reported (O'Connor, 1966; Vartha & Clifford, 1973). However, the continued tradition of set stocking this improved high country is inefficient in terms of conversion of feed into saleable animal products (Joyce, 1978).

Better utilisation is a low cost means for runholders to improve their pastoral efficiency. But how is this achieved in the high country environment? What are the long term effects of intensive grazing on pasture and animal performance? To what extent should **oversown** tussock country be subdivided?

A grazing experiment was started at Tara Hills in 1978 to answer such questions, and this paper summarises some of the results to date.

### MATERIALS AND METHODS

#### Design

The 16 ha experiment is located on a steep (30°) mid-altitude (760-930 m) shady aspect of class VIIe country with Omarama Steepland YGE soils (Ni! Soil Bureau, 1968). Low temperatures prevent pasture growth from mid-April to mid-October and the low annual rainfall of 500 mm results in a soil moisture deficit most summers. The area was initially **oversown** with cocksfoot and clovers (cultivars not recorded) and topdressed in 1955, and prior to 1976 was intermittently stocked during the pasture growth season at the conventional rate of around 2.0 **SU/ha/year** (Musgrave,

1977). The area was again **oversown** in spring 1978 with a mixture including cocksfoot (*Dactylis glomerata* L. 'Grasslands Apanui'), **ryegrass** (*Lolium perenne* L. 'Grasslands Nui') and white clover (*Trifolium repens* L. 'Grasslands Huia').

Sward composition at the start of the study was consistent across the site. Blue tussock (*Poa colensoi*, 20.3%) dominated the tussock grasses (**28.7%**), cocksfoot (9.1%) dominated the inter-tussock grasses (**16.9%**), and white clover (8.4%) dominated the **clovers** (12.5%). Other natives and adventives accounted for a further **17.7%**, giving a total standing vegetation of **75.8%**, the balance being detached litter (13.4%) and bareground (10.8%).

The unreplicated 3 x 3 factorial design compared continuous stocking with intermittent (a two paddock rotation with stock shifts approximately every three weeks) and rotational (six paddocks with weekly shifts) grazing at low, medium and high stocking rates. Annual stocking rates varied from year to year according to duration of pasture growth, however the **low:medium:high** ratio was always maintained. Merino **wether hoggets** (35 kg mean initial liveweight) were used, giving mean stocking rates over six years of 1.9, 3.0 and 4.1 **SU/ha/year** (one **hogget** = 0.5 SU over November and December; one **hogget** = 1.0 SU over January to April).

The **hoggets** were regularly drenched with anthelmintics and selenium and given continued access to mineral salt blocks. Sulphur-fortified superphosphate (27% S) was applied at 125 **kg/ha** in 1978 and every second year as maintenance (Douglas & Kinder, 1974).

Orthogonal contrasts were employed to test the significance of the main effects of stocking rate [low vs. high (a), medium vs.  $\frac{1}{2}$  (low + high) (b)] and extent of subdivision [continuous vs. subdivisions (c), intermittent vs. rotational(d)] in addition to the interaction (a) x (c). The remaining contrasts of the interaction were assumed a priori to be random variations.

#### **Pasture and Animal Measurements**

Vegetative cover was assessed from permanent transects each spring by point analysis, recording cover hits for all species (Radcliffe & Mountier, 1964) in addition to litter, rock and bareground. During the grazing season pasture production (net **herbage** accumulation) and utilisation were determined for inter-tussock (all **herbage** except tussocks) and tussock separately using comparative visual assessment (Haydock and Shaw, 1975) calibrated by hand cut **quadrats** of all **herbage** available for grazing. On the continuous stocking treatments **quadrat** areas were regularly caged, allowing assessment of pasture production by difference. Percent utilisation was derived for each grazing as  $[(\text{Pre HM} - \text{Post HM} + \text{NHA})/(\text{Pre HM} + \text{NHA})] \times 100$  where **HM** = **herbage** mass and **NHA** = net **herbage** accumulation. Fasted liveweights were recorded at the start of grazing and at the end of each rotation. Climate parameters were monitored at weekly intervals on site.

## **RESULTS**

For simplicity, only main effects of stocking rate and extent of subdivision are presented, unless an interaction was apparent.

#### **Sward Composition**

##### *Standing vegetation*

After five years standing vegetative cover was not modified by grazing treatment.

##### *Clover cover*

Year to year response was greater (Figure 1) than any treatment effect. The overall threefold increase during the second year was a direct result of the moist growing season (soil moistures 46% above average). The collapse at low stocking rates the following year was attributed to a high porina (*Wiseana* spp) population

which followed this favourable season. Numbers of pupae in October 1981 were greater ( $P < 0.05$ ) under low ( $42/m^2$ ) than high ( $7/m^2$ ) stocking.

*Inter-tussock grass cover*

After three years total inter-tussock grass cover increased more ( $P < 0.01$ ) at both low and high than at medium stocking rates (Table 1). Cover also increased more ( $P < 0.01$ ) under rotational than intermittent grazing.

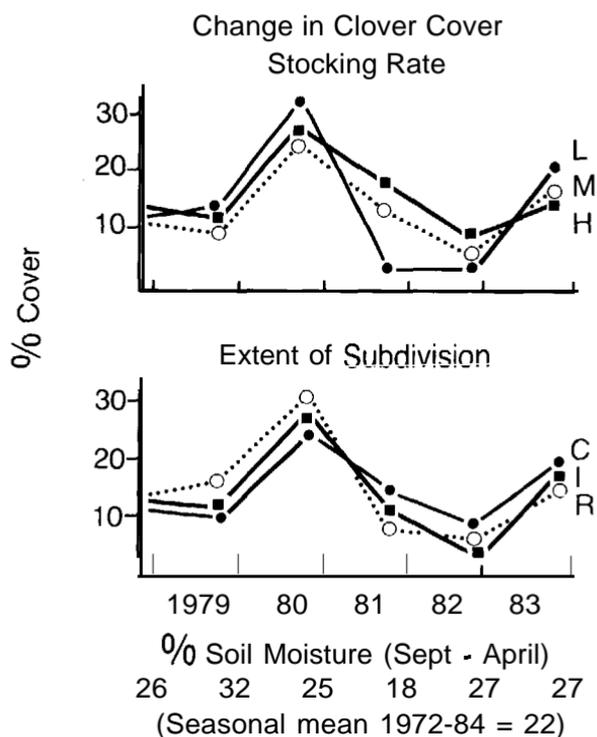


figure 1; Main effects of stocking rate and extent of subdivision on clover cover (spring pointings), and mean 0-10 cm gravimetric soil moisture (September to April inclusive). L low stocking rate; M medium stocking rate; H high stocking rate; C continuous stocking; I intermittent grazing; R rotational grazing.

This response resulted from an interplay between cocksfoot and ryegrass (Grasslands Nui). Cocksfoot increased at low stocking rates but decreased at high rates ( $P < 0.01$ ), and increased under rotational grazing but fell under continuous stocking ( $P < 0.01$ ). In contrast ryegrass increased ( $P < 0.01$ ) at higher stocking rates (Figure 2).

However, by year five (spring 1982) inter-tussock grass cover was reduced, especially under the high stocking rates. This was attributed to cold kill of ryegrass during July 1982 when record low soil temperatures occurred (Figure 3).

*Tussock grass cover*

The change in tussock cover appeared greater at high than at low stocking (-14% cf. -7% ground cover). However, this was not statistically significant due to interactive responses between stocking rate and extent of subdivision which were assumed as random variations by the analysis model.

Table 1: CHANGE IN % COVER OF INTER-TUSSOCK GRASS AFTER THREE YEARS (1978-81). INTER-TUSSOCK DM PRODUCTION (KG/HA) DURING GRAZING IN YEARS FOUR (1981182) AND SIX (1983184). MEAN UTILISATION PER GRAZING DURING YEAR SIX (1983184).

Treatment	Change in inter-tussock grass 1978-81	Inter-tussock DM production		Mean % utilisation per grazing (1983184)	
		1981182	1983184	Inter-tussock	Tussock
low continuous	2.5	1600	1840	37	18
low intermittent	8.8	1170	1370	24	6
low rotational	15.2	760	1450	28	6
medium continuous	-0.2	1130	1720	87	24
medium intermittent	-0.2	1250	1870	79	50
medium rotational	7.4	1490	2550	73	18
high continuous	8.1	1310	1890	94	61
high intermittent	5.7	1980	1360	84	34
high rotational	10.9	1850	2310	89	47
LSD main effects (1%)		550	990 ns	9.8	44 ns
(5%)	3.9			18.0	
SD interaction	1.6	420	760 ns		

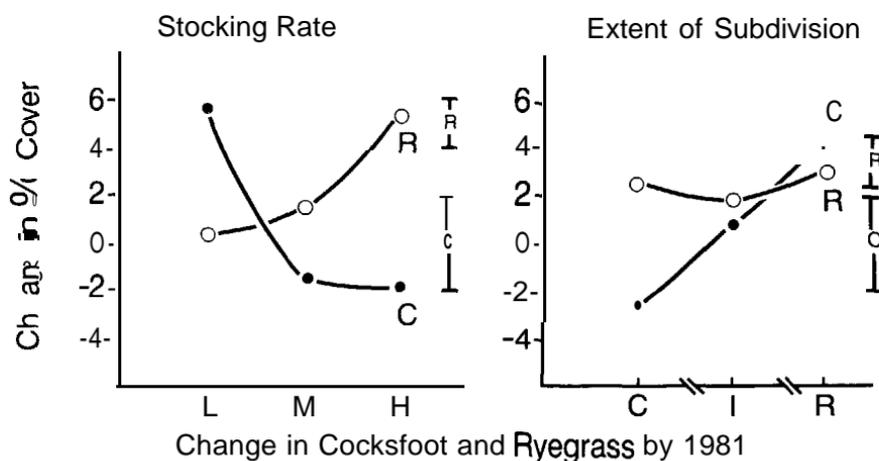


Figure 2: Main effects of stocking rate and extent of subdivision on change in cocksfoot and ryegrass cover after three years. C cocksfoot; R ryegrass; LSD at 5%.

#### Sward Production

By year four (81182) inter-tussock DM production displayed an interaction ( $P < 0.05$ ) with subdivision reducing production at low stocking rates but increasing production at high stocking rates (Table 1). However, this effect, although still apparent, did not reach significance subsequent to the 1982 winter.

Tussock production was 40% that of the inter-tussock species and was not modified significantly by grazing treatment.

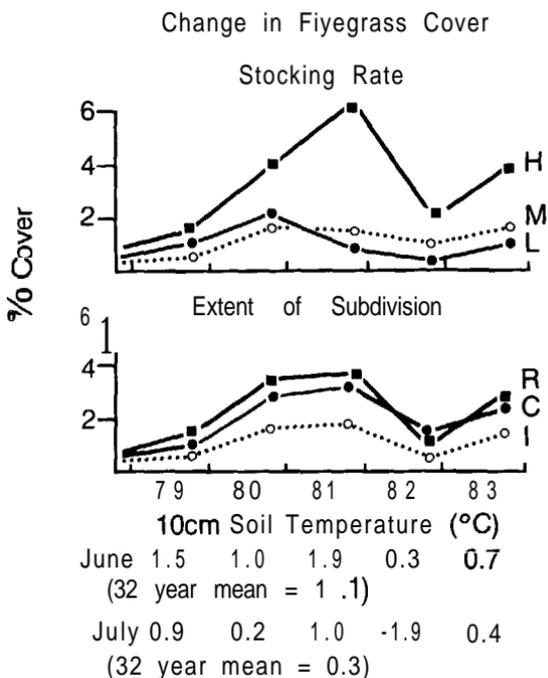


Figure 3: Main effects of stocking rate and extent of subdivision on ryegrass cover (spring pointings), and mean June and July 10 cm soil temperature °C (Tara Hi/s met. site.) L low stocking rate; M medium stocking rate; H high stocking rate; C continuous stocking; I intermittent grazing; R rotational grazing.

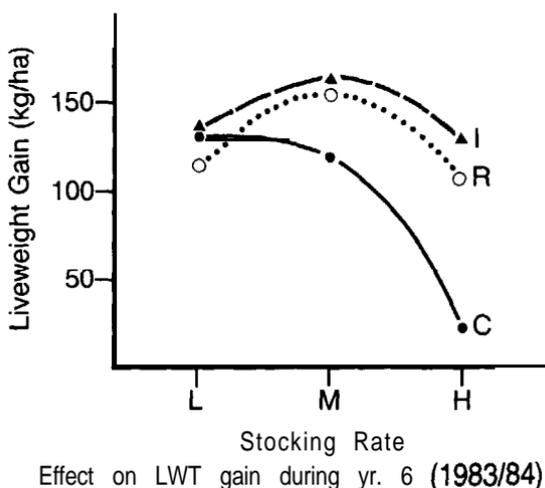


Figure 4: Hogget liveweight response (kg/ha) to stocking rate for different managements during the sixth year (1983/84). L low; M medium; C continuous stocking; I intermittent grazing; R rotational grazing; LSD (main effects) = 2.43 at 1%; SD (interaction) = 10.2.

### Sward Utilisation

By the sixth year (1983/84) mean inter-tussock utilisation per grazing was dramatically increased ( $P < 0.01$ ) at high relative to low stocking (Table 1). Most of this increase was gained by the medium rate. At all stocking rates continuous stocking resulted in higher ( $P < 0.05$ ) mean utilisations than both intermittent and rotational grazing. Tussock was utilised to half the extent of inter-tussock, and here the response to increased stocking rate was linear ( $P < 0.01$ ).

### Fasted Liveweights

By the sixth year (1983/84) liveweight gain/ha was greater ( $P < 0.01$ ) at medium than at low stocking, which in turn was greater ( $P < 0.01$ ) than that at high stocking (Figure 4). There was no difference between intermittent and rotational grazing but both produced more ( $P < 0.01$ ) per hectare than continuous stocking. However, the extent of subdivision interacted strongly ( $P < 0.01$ ) with stocking rate, as there was no effect of subdivision at the low stocking rate.

## DISCUSSION

The maximum liveweight gain/ha from intermittent grazing at the medium stocking rate in year six represents a 26% increase over that from conventional stocking rates regardless of management (Figure 4). This shows that the classical stocking rate/management interaction first reported by McMeekan (1960) can also occur for **oversown** tussock country. The improvement in liveweight gain was achieved by a single subdivision fence, and further subdivision gave no added advantage.

Better utilisation resulted from increased stocking rate rather than increased subdivision. However, it is clear that improved utilisation per grazing does not imply improved animal performance. Although not reported, both intermittent and rotational grazing allowed the generation of a bank of pasture ahead of grazing. The resulting lower utilisation under these treatments than under continuous stocking was due to this feed bank, rather than reduced **herbage** consumption. The high utilisations from high stocking rates reflect the measurement technique that assessed **herbage** mass available to grazing, not that above ground level.

The agronomic results from this study clearly demonstrate that the development of **oversown** tussock grasslands can be manipulated by grazing management. But they have also shown that climatic influences can effect greater change in one year than the grazing animal can in six.

In terms of sward development there are two distinct phases in this experiment. During the first phase, up until the 1982 winter, intensive grazing improved **inter-tussock** grass cover and inter-tussock production. However, the most significant sward response during this period was that of climate on white clover cover. None of the grazing treatments were able to maintain the increases in white clover that occurred during the favourable 1979/80 season, suggesting an inability of this species to withstand selective grazing even at low levels of utilisation. This conflicts with evidence from North Island hill country where sheep did not preferentially select white clover (Clark et al. 1981). However, the incomplete ground cover or open nature of the Tara Hills sward may explain this difference.

The 1982 winter initiated the second phase in this experiment by retarding the improvement in **ryegrass** cover. Over 60% of the **ryegrass** was lost across all treatments but because more was present under high stocking rates, pasture and animal production was most affected at these rates. However, despite this set back the pre-1982 trends for **ryegrass** cover (Figure 2) are continuing.

The risk of **ryegrass** loss on shady faces and the poor response from white clover highlight the limitations of traditional plant material in this environment. In response to this, some 28 legumes and 26 grasses with emphasis on various **white**

clover and ryegrass cultivars and ecotypes have been planted into the treatments of this experiment to assess long term grazing effects on persistence and spread.

To conclude, it is clear that this experiment is by no means completed. After six years a 26% increase in liveweight gain has been achieved by increased stocking rate and a single subdivision fence. However, because the sward development under intensive grazing has been interrupted by climate, I believe that this production advantage, although substantial, is far below the potential. To realise the full potential, however, the use of plant material better adapted to high country conditions is essential.

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### REFERENCES

- Clark, D.A.; Lambert, M.G.; Chapman, D.F. 1980. *Proc. N.Z. Grass/d Ass.* 43: 205-214.
- Douglas, J.A.; Kinder, J.W. 1974. *N.Z. J. exp. Ag.* 3: 127-133.
- Haydock, K.P.; Shaw, N.H. 1975. *Aust. J. exp. Ag. Anim. Husb.* 15: 663-670.
- Joyce, P.J. 1978 *Proc. Conf. Conservation High Mountain Resources (Lincoln College)* p. 24-37.
- Kerr, I.G.C. 1983. *Proc. Hill High Count. Sem. (Lincoln College)* p. 19-26.
- McMeeken, C.P. 1960. *Proc. 8th Int. Grass/d. Congr.* p. 21-26.
- Musgrave, D.J. 1977. Tussock Grass/d. Mountain Lands. *Inst. Rev.* 35: 30-37.
- N.Z. Soil Bureau, 1968. Soil Bureau Bulletin 27, Sheet 11.
- O'Connor, K.F. 1966. *Proc. N.Z. Grass/d Ass.* 28: 59-78.
- Radcliffe, J.E.; Mountier, N.S. 1964. *N.Z. J. Bot.* 2: 90-97.
- Vartha, E.W.; Clifford, P.T.P. 1973. *N.Z. J. exp. Ag.* 1: 181-186.