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PASTURE PRODUCTION AND SWARD DYNAMICS UNDER SHEEP GRAZING

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SUMMARY

Different grazing rotations were applied to perennial ryegrass/white clover pastures on two soil types (peat and clay). Grazing intensity and pre-grazing levels of dry matter had major effects on herbage production. On the clay during spring-summer there was no difference in total herbage production between hard and lax defoliation. However, both live herbage production and ryegrass tiller numbers were higher with hard grazing, while the dead matter content was lower than with lax grazing. On the more drought-prone peat soil lax grazing gave higher dry matter (DM) production than hard grazing. Spring-summer grazings should not be delayed beyond 3000 kg standing DM/ha, as this may result in a considerable decrease in autumn-winter production. A changeover from hard to lax grazing intensity resulted in the highest total and live herbage production during autumn-winter.

Implications of herbage death and long spelling intervals are discussed with reference to defoliation intensity, DM production and tiller numbers.

INTRODUCTION

Numerous studies have examined the effect of the frequency and intensity of defoliation on the herbage production of pasture (Davidson, 1968). Brougham (1970) has suggested optimal ranges for spelling intervals and grazing height throughout the year to maximise production. However, progress towards improving grazing management and the use of higher stocking rates are limited by a lack of knowledge of the basic growth parameters of the grazed sward and how changes in management affect these. Tainton (1974) and Korte and Sheath (1979) studied the influence of tissue death and decay on herbage growth rates within pastures which were spelled until at least 95% of midday light was intercepted. A similar understanding of herbage growth rate parameters for rotationally grazed swards under a wide range of managements is important to evaluate why the potential for production may not be realised in some situations, and to determine how the potential production of the sward could otherwise be realised by using alternative grazing management systems.

This paper presents information on the net dry matter (DM) production, live herbage growth rates and tiller numbers of ryegrass and white clover for pasture swards grazed at different stages of

growth and with different patterns of grazing intensity. The relative importance of these two factors on the productivity of pasture for two contrasting soil types in the Waikato is discussed.

EXPERIMENTAL

The experiment was conducted at Ruakura Agricultural Research Centre from 22 August 1978 to 22 September 1979 on perennial ryegrass (mainly 'Grasslands Nui') 'Grasslands Huia' white clover pasture in which Poa species were present during winter-spring. A factorial design was used employing the following factors:

- (1) Two soil types; Kaipaki shallow peaty loam and a Hamilton clay loam.
- (2) Two grazing intensities; lax to 1700 kg and hard, to 750 kg DM/ha after grazing.
- (3) Three levels of standing DM before grazing; 2000, 3000 and 4000 kg/ha.
- (4) Two grazing intensities were crossed over after the first substantial autumn rains. Changes were from lax to hard and hard to lax for half the treatments.

The cross-over treatments were replicated on the Hamilton clay loam and the continuous treatments replicated on the Kaipaki peaty loam. Paddock size was 0.13 ha. Paddocks were grazed with ewes for 24 to 28 hours periods, the number of stock being adjusted proportional to the level of standing DM and intensity of grazing required.

In each paddock, mean herbage DM levels were determined before and after grazing from 4 quadrats (0.33m^2) cut with a shearing handpiece, then washed and dried. Subsamples were taken to determine botanical composition and live/dead ratios in pre-and post-grazing cuts. Fifteen tiller cores (5 cm diameter) were taken from each paddock on seven occasions throughout the experimental period. Management decisions were based on visual estimates.

RESULTS

DRY MATTER PRODUCTION

Spring-summer: August 1978 to February 1979

On the clay soil the highest level of standing DM (4000 kg/ha) outyielded grazing at 2000 and 3000 kg/ha by 11% (NS) and 16% respectively, while grazing intensity had no effect on production.

On the peat soil, grazing at 3000 and 4000 kg/ha outyielded the lowest level of standing DM (2000 kg/ha) by 14% and 11% respectively (NS). Lax grazing gave higher DM production than hard grazing (+ 16%, NS).

Although there was little difference between grazing intensities in net herbage production on the clay soil, live herbage production under hard grazing was 25% higher than under lax grazing (49 v 39 kg DM/d). On the peaty soil, however, there was no difference. Pre-grazing levels of standing DM had no effect on live herbage production on both soil types (Table 1).

TABLE 1: EFFECT OF MANAGEMENT ON HERBAGE PRODUCTION OVER SPRING-SUMMER: 22.8.78-28.2.79 (kg/DM/ha)

	<i>Peat</i>	<i>Clay</i>	<i>Mean</i>
Main Effects			
Pre-grazing standing DM			
2000	9340	8510	8920
3000	10630	8880	9750
4000	10410	9890	10150
LSD 5%	2220	1350	1180
Grazing Intensity			
Lax	10880	(87%)*	8900
Hard	9370	(99%)	9290
LSD 5%	1810	1100	960

*Percentage live material

Autumn-winter: February 1979 to August 1979

On the clay soil, production was the same whether grazing was commenced at 2000 or 3000 kg standing DM/ha. On peat, production was greater (+ 28%) where the pasture was grazed at 3000 rather than 2000 kg/ha DM. On either soil type grazing at 4000 rather than 2000 kg/ha DM reduced production by 26% (Table 2).

Where hard or lax grazing was continued during autumn and winter there was no effect on production on the peat soil, while hard grazing outyielded lax grazing by 19% (NS) on the clay soil. Where grazing intensity was changed from hard to lax, production tended to be highest on both soil types. However, a change from lax to hard grazing reduced production on peat soil but increased it on the clay soil. None of these differences was significant at the 5% level. On the clay soil the change from hard to lax grazing intensity, in contrast with the change from lax to hard, increased the proportion of live herbage produced by 40%. No comparable figures were available for the peat soil.

TABLE 2: EFFECT OF MANAGEMENT ON HERBAGE
PRODUCTION OVER AUTUMN-WINTER:
28.2.79-22.8.79 (kg DM/ha)

	Peat	Clay	Mean
Main Effects			
Pre-grazing standing DM			
2000	5270	5950	5610
3000	6760	6090	6430
4000	3860	4390	4120
LSD 5%	1450	1170	1030
Grazing Intensity			
Lax	5220	4610 (88%)*	4920
Hard	5460	5500 (97%)	5480
Hard → Lax	5700	6050 (99%)	5880
Lax → Hard	4810	5750 (74%)	5280
LSD 5%	1670	1350	1180

*Percentage live material

Total Production

Differences in grazing intensity had no effect on net total annual DM production on either soil type but on peat soil pasture was more productive when grazed at 3000 kg DM/ha. However, on the clay soil the change from hard to lax grazing intensity outyielded (in live herbage) the change from lax to hard and the lax grazing intensity by 30% and 33% respectively (Table 3).

TABLE 3: EFFECT OF MANAGEMENT ON HERBAGE
PRODUCTION OVER THE WHOLE YEAR (kg DM/ha)

	Peat	Clay	Mean
Main Effects			
Pre-grazing standing DM			
2000	14610	14460	14530
3000	17390	14970	16180
4000	14270	14280	14270
LSD 5%			1740
Grazing Pressure			
Lax	16100	13510 (85%)*	15130
Hard	14830	14790 (98%)	14930
Hard → Lax	15070	15340 (99%)	15370
Lax → Hard	15690	14650 (79%)	15120
LSD 5%			2000

*Percentage live herbage

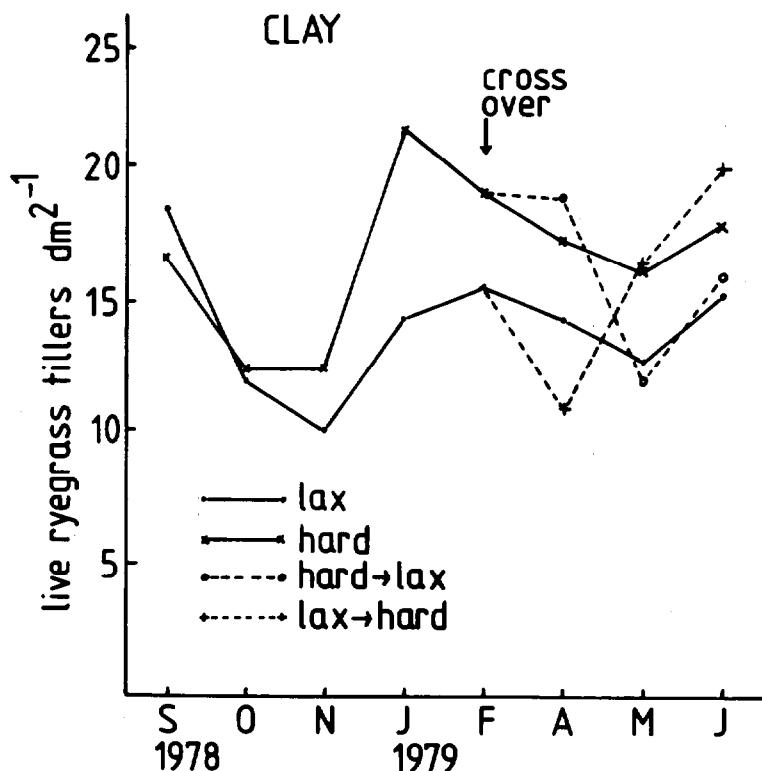


FIG 1: Effect of changes in grazing intensity on seasonal trends of live ryegrass tiller densities on the clay soil.

TILLER NUMBERS

Perennial Ryegrass

On the clay soil, hard grazing resulted in higher tiller numbers than lax grazing throughout the year (Fig. 1). A change in autumn from hard to lax grazing initially increased tiller numbers but subsequently tiller numbers declined. Where hard grazing followed lax grazing the effect on tiller numbers was reversed.

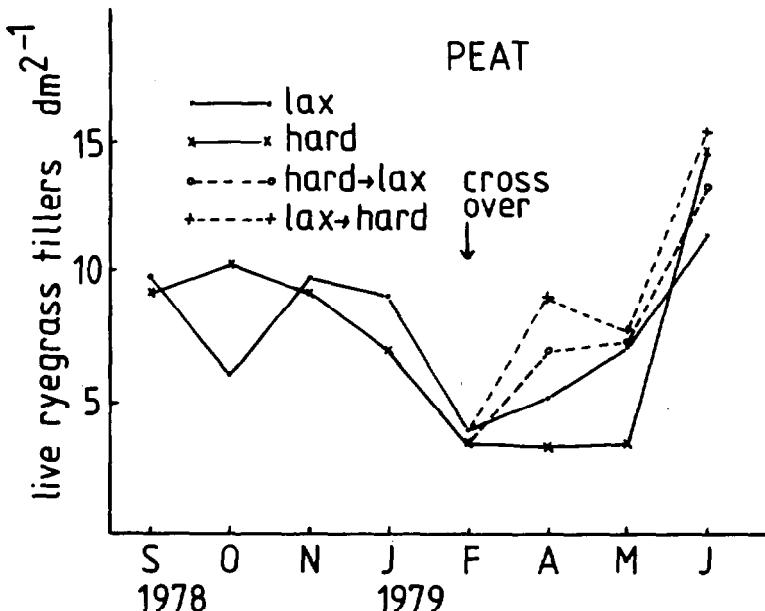


FIG 2: Effect of changes in grazing intensity on seasonal trends of live ryegrass tiller densities on the peat soil.

On the peat soil tiller numbers were considerably lower than on the clay soil (Fig. 2). Under hard grazing there was an initial increase in tiller numbers over lax grazing. Subsequently tiller numbers under hard grazing were reduced progressively. The effect of a changeover from hard to lax grazing on tiller numbers was similar to that on the clay soil.

White Clover

On both soil types (Figs. 3 and 4) grazing at 2000 kg/ha standing DM resulted in higher numbers of rooting nodes, especially over late summer. This effect was more marked on the peat soil with its higher initial clover content.

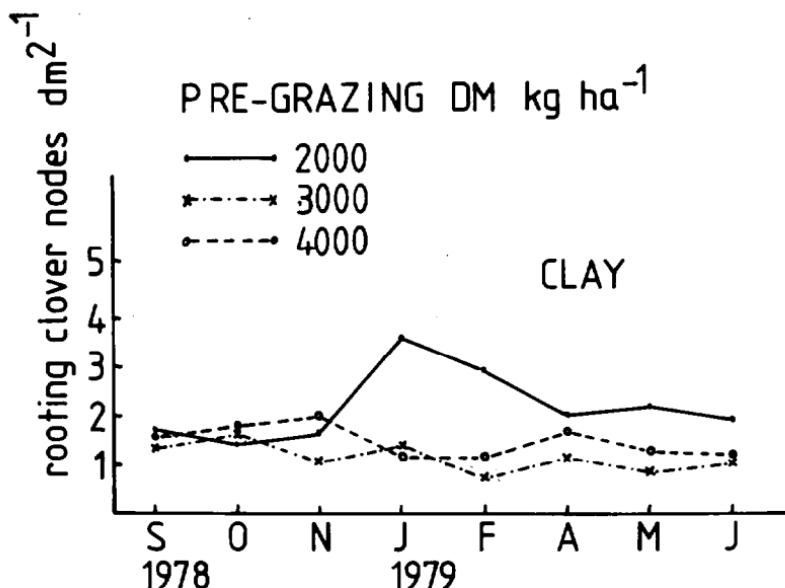


FIG 3: Effect of pre-grazing standing DM levels on the seasonal trend of rooting nodes of white clover on the clay soil.

DISCUSSION

SPRING-SUMMER

To obtain the prescribed pre-grazing levels the average spelling time taken for each level was 25, 30 and 35 days (for 2000, 3000 and 4000 kg DM/ha) respectively. This difference in the length of regrowth periods was probably the main cause of the improved production from treatments grazed at levels higher than 2000 kg DM/ha. These results confirm those of Brougham (1959), Anslow (1967), Boswell (1977), and others. The highest DM production was from 3000 kg/ha on the peat and 4000 kg DM/ha on the clay. This difference can be related to sward composition. The clay soil pasture was ryegrass dominant and the peat clover dominant.

The lack of difference in DM production under lax and hard grazing on the clay soil and the increased DM production under lax grazing on the peat soil are in disagreement with several cutting experiments with grass/clover associations where cutting at 3 cm gave higher production than cutting at 6 cm (Reid 1959, Frame and

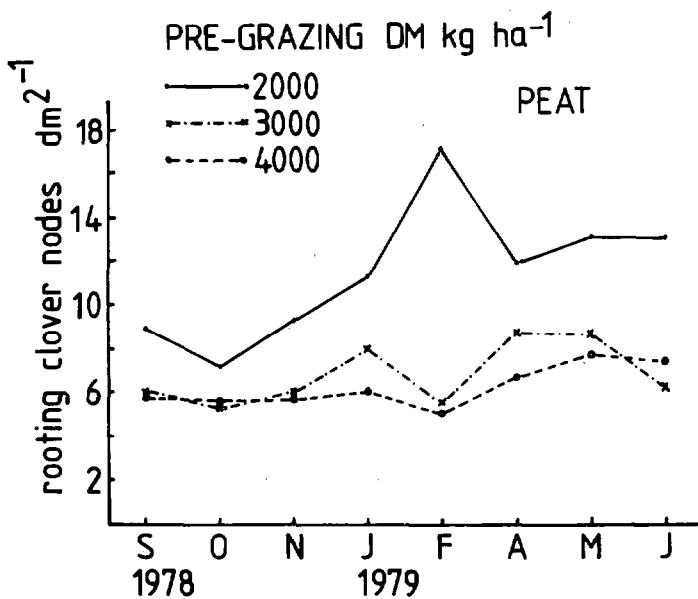


FIG 4: *Effect of pre-grazing standing DM levels on the seasonal trend of rooting nodes of white clover on the peat soil.*

Hunt 1971). On the clay soil the advantage of a higher amount of residual live material associated with lax defoliation, (and thus a higher leaf-area index) was apparently less than expected because of senescent leaves and dead material which accumulated below defoliation height, reducing the effective leaf area. This was confirmed by the higher percentage of dead material in the post-grazing cuts under lax grazing over this period (27%, compared with 9% under hard grazing). It also explains the considerable difference in live herbage production (1810 kg DM/ha between lax and hard grazing on the clay soil). Similar findings have been reported by Tainton (1974) and Korte and Sheath (1979) for canopies defoliated at 95% light interception.

Conclusions about the effect of management can thus differ on the basis of live or total herbage production. Consideration of live and total herbage production is of importance in comparing data from grazing and mowing experiments. Most of the herbage regrowth cut with mowers is usually live material. This explains the agreement between this grazing trial and mowing experiments (see

above) when live rather than total herbage production is considered. Campbell (1964) already emphasised this point with respect to the autumn flush.

The higher DM production under lax grazing on the peat can be explained by the very weak, shallow rooting system of ryegrass on this soil type. At various times between November 1978 and January 1979 there were high soil moisture deficits in the surface layers. Ryegrass is very susceptible to moisture stress on this soil type (Goold and Hupkens van der Elst 1980) and this explains the 16% increase in DM production brought about by lax grazing. Brougham (1970) has recommended lax grazing over dry summer periods. However, little or no moisture stress was evident on the clay soil as monthly rainfall was above normal. Live herbage production was similar under lax and hard grazing on the peat soil compared with the 25% advantage on the clay soil. This may be explained by the larger number of live ryegrass tillers under hard grazing on the clay soil, while the clover dominant pastures on the peat soil had higher rates of decay under lax grazing compared with hard grazing.

In general therefore, a rotation during the spring-summer period, where pastures are grazed relatively hard at about 3000 kg DM/ha, seems to be best from the viewpoint of herbage production and sward condition (i.e. high live tiller numbers and a high percentage of live herbage after grazing). These recommendations should be considered in conjunction with the autumn-winter results discussed below. Hard grazing was even more important than grazing at the right pre-grazing DM level as laxly grazed pastures had about 18% more dead matter than hard grazed pastures, irrespective of pre-grazing DM. Significantly, sheep tend to avoid the intake of dead herbage (Rattray, 1977) and consequently hard grazings are beneficial to both pasture and animal.

AUTUMN-WINTER

Table 2 indicates the importance of spring-summer management on DM production over this period. Grazing pastures at a standing DM level of 4000 kg DM/ha in spring-summer with continuation over autumn-early winter, decreased DM production over the latter period. This decline in total DM production compared with grazing at 3000 kg DM/ha amounted to 36%. This shows that long mature spring-summer herbage, will become senescent and decay with a detrimental effect on subsequent production.

For producing good quality feed throughout the year it is important that grazing should not be delayed beyond a pre-grazing level of 3000 kg DM/ha and early utilisation is imperative. The importance of pasture control throughout spring-summer to maintain maximum pasture performance throughout autumn-winter is also obvious from the grazing intensity effects. Continued lax grazing leads to lower net production on both soil types (NS) and even lower live herbage production (Table 2: clay soil) since over this period dead material decays in the sward.

Results suggest that even with continued lax grazing and relative rapid rotation based on pre-grazing levels of 2000 kg DM/ha subsequent production levels may be expected to drop. At least occasional hard grazings in spring are necessary to prevent thinning out of the sward and loss of autumn-early winter production.

On the other hand a change from hard to lax grazing resulted in higher net and live herbage production. Thus lenient defoliation on pastures which had high live ryegrass tiller numbers and a low dead matter content led to far more rapid recovery growth than other treatments during the autumn-winter period.

CONCLUSIONS

The findings in this paper suggest that seasonal DM accumulation is considerably affected by pre-grazing levels of standing DM and grazing intensity. Spring-summer grazing at higher levels than 3000 kg DM/ha results in decreased production when continued over autumn-early winter. A primary objective of good spring-summer management should be to maintain a photosynthetically active sward after defoliation. Production is high when the amount of senescent and dead material is low and live tiller numbers are high. Obviously close defoliation is only desirable without moisture stress as shown by the higher DM production with lax compared with hard grazing on the peat soil. Over autumn-early winter lax grazing following hard spring-summer grazing had higher live herbage accumulation rates than lax grazing all year round.

Thus it is important to establish a compromise between reduction of decay by close grazing and leaving a satisfactory amount of live herbage after grazing. Pasture composition is important, as is shown by the effect of the changeover from lax to hard grazing on the peat soil. DM production decreased because of the high clover content and reduced ryegrass content under lax grazing. Further attention should be given to factors influencing the balance between

death of herbage, decay and tillering as they determine net and live herbage production, botanical composition, quality and ultimately animal production.

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