MAXIMIZING SHEEP PRODUCTION FROM GRASSLAND

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Abstract

Levels of sheep production/ha obtained on research farmlets have been considerably greater than those obtained on farms on similar land, probably because the higher stocking rates used resulted in greater levels of pasture utilization.

Rate of growth early in life influences potential productivity of the mature breeding ewe. Good rearing and the use of genetically superior stock both appear essential for maximizing production.

Short-term studies have identified critical periods when level of feeding could have a potential impact on over-all productivity. Such work has re-emphasized the potential importance of feeding pre-mating especially for reducing liveweight loss and for light ewes. Optimum pasture conditions for flushing have been defined, along with the possible role of supplements such as wilted silage.

INTRODUCTION

The purpose of this paper is to review how some recent sheep research can assist in maximizing sheep production from grassland. Its relevance to farming in Westland is also discussed. It is not intended to be a comprehensive review, but rather a brief coverage of certain aspects that could have a real impact on current levels of production.

DISPARITY BETWEEN RESEARCH AND FARM PRODUCTION LEVELS

STOCKING RATE

Production levels achieved on various classes of farm in 1978-9 are shown in Table 1 (N.Z. Meat and Wool Boards' Sheep and Beef Farm Survey, 1979), and do not differ markedly from long-term average values. Production levels from a Ruakura farmlet trial (Table 2) are much greater than on the North Island intensive fattening farms and demonstrate the trends for production/ha

TABLE 1: SURVEYED LEVEL OF PRODUCTION ON NEW ZEALAND FARMS

	<i>North Island</i>			<i>South Island</i>		
	<i>Hard Hill</i>	<i>Hill</i>	<i>Intensive Fattening</i>	<i>Hill</i>	<i>Fattening Breeding</i>	<i>Intensive Fattening</i>
Stock units (SU) /ha	8.5	10.7	13.3	2.9	8.7	12.4
Lambing percentage	82	91	98	91	103	112
Meat/ha (kg)	78	114	166	28	99	174
Wool/ha (kg)	29	43	53	11	42	73

TABLE 2: PRODUCTION LEVEL ON RUAKURA FARMLETS
(4-year average, 1974-78)
(From Rattray et al., 1978)

Elves/ha*	16	21	26
Lambing percentage	122	112	108
Lamb meat/ewe (kg)	17.5	14.8	13.3
Wool /ewe (kg)	6.0	5.5	5.5
Meat/ha (kg)	280	312	346
Wool/ha (kg)	96	116	143

*Mixed-age Coopworth ewes.

to increase and production/ewe to decrease as stocking rate increases. Research at Invermay has shown similar trends and superiority over South Island intensive farms (Edgar, 1973). While differences in climate, soil fertility, fertilizer practices, pasture type, level of pasture production, labour available, level of subdivision, scale of operations, or the use of all-sheep on the research farmlets could all have contributed to the superior production, the single most important factor was probably because more of the pasture produced was utilized by the higher stocking rates adopted. In the Ruakura trial, as stocking rate increased from 16 to 26 ewes/ha annual pasture utilization per hectare increased from 13 120 to 16 120 kg DM, with a corresponding decline in utilization per ewe from 820 to 620 kg DM/ewe (Rattray et al., 1978).

On most farms there appears to be considerable potential for increased production/ha and higher profits through carrying more stock (Rattray et al., 1978). Some compromise must be reached in accepting some decline in per ewe performance to achieve satisfactory levels of per hectare production.

GRAZING MANAGEMENT

Farm advisers are currently advocating rotational grazing on sheep and beef farms and claiming either that it allows improved per head performance at existing stocking rates, or that stocking rates can be increased without an associated decline in per head production (Smith et al., 1979). However, experimental comparisons of continuous and rotational grazing have failed to demonstrate the clear superiority of either method (Wheeler, 1962) but it appears that advantages to rotational grazing may sometimes occur only at very high stocking (Campbell, 1970; Lambourne, 1956). If stocking rates are increased, management may have to be modified. Solely increasing stock numbers will not always guarantee a production response if the standard of management is suboptimal.

WESTLAND

The average stocking rate in Westland is 10-11 SU/ha, which puts the region amongst the more productive areas of the South Island. Data on levels of pasture production in Westland are limited, but at Ohaura and Westport, over 6 years, has averaged 9 480 kg DM/ha (7 800-11 720 range) and 10 900 kg DM/ha (10 000-11 700), respectively (J. D. Morton, pers. comm.; DSIR, 1980). At 85% pasture utilization and current levels of production per stock unit, potential carrying capacity at these two sites could be 13.9 and 16.0 SU/ha. These pasture data and the reliability of rainfall (nil days of moisture deficit in 1976-7, 1977-8 and 1978-9; N.Z. Meat and Wool Boards' Annual Review of the Sheep and Beef Industry, 1980) would suggest that there is potential for carrying more stock on many farms. Some progress has been made, however, in increasing sheep numbers in the region over the last few years: 1976 to 1977, +4.2%; 1977 to 1978, +18.8%; and 1978 to 1979, +4.2% (N.Z. Meat and Wool Boards' Annual Review of the Sheep and Beef Industry, 1980). Undoubtedly some of these were at the expense of cattle and on newly developed or developing areas.

GROWTH OF YOUNG SHEEP**FINISHING LAMBS**

High growth rates are more efficient in converting pasture into meat than low growth rates because of the relative contributions of maintenance requirement to the total feed requirement (Rattray

FIG. 1: Influence of amount and type of herbage on lamb growth rate. (Jagusich et al., 1979)

et al., 1976). Maximum growth rates are therefore desirable for finishing lambs. Recent trials (Fig. 1) have shown how to achieve maximum growth rates on a variety of pasture types (Jagusich et al., 1979). Lambs on legumes achieved near-maximum growth rates at lower allowances than those on ryegrass type pastures (2.5-3 vs. 5 kg DM/lamb/day). Low levels of utilization are essential on the latter types of pastures to ensure high rates of gain (30% vs. 40-50% on legumes). Pre-grazing DM/ha (in the range 2000-5000 kg) had no added influence on growth rates; however, lower levels than these may have been restrictive. Set-stocking or spreading lambs out to achieve a slower rotation also increased gains because of the higher allowances offered.

In Westland special crops or special-purpose pastures should not be required as the normal reliable pasture growth should give sufficient levels of DM/ha for maximum gains. Using grazing management to create clover dominance could be beneficial, however.

HOGGET GROWTH

1. Consequences

Growth rate early in life may affect the reproductive performance of a ewe subsequently, and therefore her potential to con-

vert pasture into production. In two experiments different growth rates from weaning until the end of hogget oestrus influenced the incidence of hoggets exhibiting oestrus (Moore *et al.*, 1978; Moore and Smeaton, 1980). Both the effects of growth rate and the incidence of hogget oestrus significantly influenced two-tooth and four-tooth reproductive performances (Table 3) (Moore, 1980).

TABLE 3: EFFECTS OF HOGGET GROWTH AND OESTRUS ON SUBSEQUENT REPRODUCTION
(From Moore, 1980)

	Mean	Difference H-L Feeding	Oestrus- No Oestrus	
Two-tooth:				
Pre-mating weight (kg)	44	3.1	4.2	
Ovulations/100 ewes	126	21	25	
Lambs born/100 ewes	85	7	1	5
Lambs weaned/100 ewes	67	0	8	
Four-tooth:				
Pre-mating weight (kg)	44	1.5	1.8	
Lambs born/100 ewes	82	8	19	
Lambs weaned/100 ewes	74	8	18	
Six-tooth:				
Pre-mating weight (kg)	48	0.1	0.3	
Lambs born/100 ewes	83	-1	5	
Lambs weaned/100 ewes	75	-4	-1	

2. Management

Good rearing of hoggets appears essential in all environments. During *et al.* (1980) compared 5 levels of feeding under: a quick rotation (shifted twice weekly); a slow rotation (shifted every 10-14 days); or set-stocking (60 days). The pasture measurement most closely correlated with liveweight gains was the mean live herbage present (kg DM/ha) for the set-stocking or left post-grazing for the rotational treatments. Target growth rates and residual herbage levels required to achieve a weight of 50 kg by 15 months of age are summarized in Table 4. It was difficult to achieve good gains in summer. Except in spring (October-November) rotational grazing is preferred. For most of the year a residual of 1200 kg live DM/ha is a reasonable target when height of residual pasture will be 2.3 to 3 cm under set stocking and 3.5 to 5.5 cm under rotational grazing. In spring, summer and autumn, other classes of stock may be required for pasture control.

TABLE 4: TARGET GROWTH RATES AND RESIDUAL LIVE HERBAGE LEVEL FOR HOGGET GROWTH
(From During et al., 1980)

Period	Growth Rate (g/day)	Residual Live Herbage (kg/DM/ha)	
		Rotational Grazing	Set-stocking
10 Jan. — 31 Mar.	50	1200	1200
1 Apr. — 31 May	90	1400	1400
1 Jun. — 31 Aug.	72	800	1100
1-30 Sep.	100	1000	1000
1 Oct. — 10 Dec.	130	1700	1200

PERFORMANCE PER EWE

Taylor (1979) has emphasized the importance of per head performance in influencing overall productivity and net profitability independently of stocking rate. Any increase in per head production at existing stocking rates will improve per hectare production and profitability. Generally, high performance per ewe is associated with heavy ewes and higher annual feed requirements. Rattray (1978) showed that, as mating weight increased from 45 to 65 kg, lambs weaned per 100 ewes mated, and annual pasture intake both increased linearly from 83 to 123% and 515 to 775 kg DM/ewe, respectively.

GENOTYPE

1. Breed

Several studies have recently shown the superiority of Coopworths and Perendales over Romneys in production per ewe. The Perendales appear suited to hill country or high stocking rates, while the Coopworths appear suited to intensive conditions or low stocking rates (Dalton *et al.*, 1978; Rattray *et al.*, 1978, 1979). In the latter studies the Coopworths continued to increase in production per head as feeding level increased and ewe mating weights increased to over 70 kg, whereas the Perendales tended to level off in production per head at lower feeding levels, failing to respond in terms of lambs born or weaned when mating weight exceeded 60 kg.

The potential of highly prolific crosses such as the Booroola for increased per head and per hectare production appears considerable.

2. Selection

Research with the Ruakura strains of Romney showed that selection for twinning resulted in higher meat production per head and per hectare (Rattray *et al.*, 1978). The potential for permanent improvements in production in all areas from the use of highly selected lines, such as the Waihora Romney, in appropriate environments must also be emphasized (Clarke, 1978).

SHORT-TERM FEEDING TRIALS

In recent years a number of short-term experiments have been run with breeding ewes during the pre-mating period, mid-pregnancy, late-pregnancy, and lactation to determine optimum or minimum feeding levels during the various stages of the year, and also to ascertain if there were any critical periods of the year when level of feeding could have a marked effect on potential annual productivity. Over a wide range, feeding level did not appear critical at any phase other than prior to mating. At other stages of the year, ewe body weight could be drastically affected but fluctuations in wool growth-rate, wool quality and lamb birth-weight or growth-rate were relatively minor (Jagusch and Rattray, 1978; Rattray and Jagusch, 1978, 1979, 1980); however, carry-over effects were not always measured.

1. Premating Weight and Weight Changes

The one time of the year when it appeared that level of feeding could dramatically affect potential annual productivity was pre-mating (Rattray *et al.*, 1980b). Figure 2 shows the effects of pre-flushing liveweight (LW_1) and post-flushing (or pre-mating) liveweight (LW_2) and therefore the influence of amount or direction of weight change achieved over a 6-week period prior to mating (LW_2 minus LW_1) on the proportion of multiple ovulations. Weight gain is beneficial and weight loss is detrimental. Light ewes are more responsive than heavy ewes and can attain similar ovulation rates.

On-farm studies (Kelly and Knight, 1979) have shown low ovulation rate is the major factor limiting lambing performances and that, for every extra 10 ova shed, approximately 7 extra lambs are born.

FIG. 2: The influence of pre-flushing liveweight (LW_1) and pre-mating liveweight (LW_2) on the expected proportion of multiple ovulations in Coopworth ewes. The lines represent contours of probability of a multiple ovulation and the values on the right and top perimeters are the probability values or expected proportion of multiple ovulations. (Rattray et al., 1980b)

2. Flushing on Pasture

The influence of amount of pasture fed and of pre-grazing green herbage mass is shown in Fig. 3. Optimum ovulation responses occurred at allowances of 3 to 4 kg green DM/ewe/day from pasture with over 2000 kg green DM/ha pre-grazing. Ovulation rate also increases curvilinearly with increasing post-grazing herbage residue — levelling off at round 1000 kg green DM/ha. The dangers, therefore, of grazing very short pasture or attempting to achieve high levels of utilization per grazing at this time are obvious.

A high proportion of green material is desirable in the sward because it is highly digestible (Rattray, 1978) and it is selectively

FIG. 3: **The effects of amount of pasture fed and level of pasture per hectare on ovulation rate.** (Rattray et al., 1980b)

grazed by the ewes (Table 5). Gains and flushing responses are also greater on clover-dominant than on ryegrass-dominant pastures (Fig. 4).

TABLE 5: PROPORTION OF GREEN MATERIAL IN PRE- AND POST-GRAZING PASTURE
(From Rattray 1978)

Pre-grazing Post-grazing Grazing pressure:	DM/ha (kg)	1977		1978	
		4310	2710	3250	1810
Proportion		%	%	%	%
Pm-grazing		52	34	57	40
Post-grazing					
Low		42	32	46	22
Medium		37	24	38	19
High		19	16	22	4

*DM basis.

FIG. 4: The effect of amount of pasture on the ovulation rate of heavy (56 kg) and light (43 kg) ewes grazing either clover- or ryegrass-dominant pasture.

3. Flushing on Supplements or Crops

In areas of low summer rainfall where it is impossible to achieve the levels of pasture required, some form of supplementary feeding may be essential at this time to achieve ewe liveweight gains and satisfactory lambing performances.

In areas where silage-making operations are possible, high quality pasture silage has proven to be an ideal flushing feed. In a recent trial (Rattray *et al.*, 1980a), marked ovulation responses were obtained by supplementing ewes on limited grazing with high quality wilted pasture silage. However, there are a number of problems involved in this practice and the economics are questionable (Rattray *et al.*, 1980a, 1980b).

Trials in Northland (Piggot *et al.*, 1978) have shown that hay, silage, concentrates or green maize can be effective flushing feeds, with the exception of lucerne hay in some instances. Lucerne grazed *in situ* is ideal flushing fodder, if it is free from fungal infection, and therefore coumestans (Jagusich *et al.*, 1980).

WESTLAND

The average tailing percentage in Westland in recent years has been higher than the national average and second only to the

Southland area in 1977 and 1978 (N.Z. Meat and Wool Boards' Annual Review of the Sheep and Beef Industry, 1979). However, the average lambing performance (99.5 and 96.9%, respectively) must be capable of considerable improvement. The reliability, level and distribution of rainfall and pasture growth should allow all the requirements for flushing on pasture to be met. Little reliance would have to be placed on crops or silage for this purpose; however, the latter may prove valuable for self- or pad-feeding during excessively wet periods.

CONCLUSIONS

To ensure maximum sheep production from grassland, high carrying capacities appear essential to ensure high levels of utilization of grown pasture. Some modification of grazing management may be desirable to enable higher stocking rates to be carried.

Rapid finishing of export lambs results in greater feed conversion efficiency and removes competition from the ewe flocks.

Good rearing of replacement hoggets will ensure that the potential of the ewe can be realized when mature. The use of sound selection policies or superior breeds and strains will increase the potential maximum production per head and per hectare.

Of the various physiological states of the ewe during the year, the pre-mating period appears to be the most critical, where nutritional manipulation may have the greatest potential impact for improving subsequent production by maximizing ovulation rate and subsequent lambing performance: This appears to be especially true for light ewes. However, these may also require preferential treatment at other times of the year because they have few body reserves to buffer nutritional demands. The major aim of flushing is to improve the level of feeding at this time, ideally to achieve liveweight gain, but more importantly to reduce liveweight loss.

The provision of correct quantities of high quality pasture, or alternatively of high quality supplement, are means whereby this can be achieved. Had flushing been used as effectively in earlier farmlet studies (Table 2) much higher levels of production per hectare would surely have been possible. Attempts to flush ewes in later farmlet studies (25 ewes/ha) resulted in much higher lambing performances than would have been predicted from the pre-mating weights alone (Jagusich et al., 1980).

REFERENCES

- Campbell, A. G., 1970. *Proc. N.Z. Grassld. Ass.*, 32: 145-52.
- Clarke, J. N., 1978. *Proc. Ruakura Fmrs' Conf.*, Aglink: FPP 160.
- Dalton, D. C.; Clarke, J. N.; Rattray, P. V.; Kelly, R. W.; Joyce, J. P., 1978. *Proc. Ruakura Fmrs' Conf.*, Aglink: FPP 132.
- DSIR, 1980. Land alone endures. *DSIR Disc. Paper No. 3*: 126
- During, C.; Dyson, C. B.; Webby, R. W., 1980. *Proc. Ruakura Fmrs' Conf.*: 97-103.
- Edgar, D. G., 1973. *Proc. Ruakura Fmrs' Conf.*: 34-45.
- Jagusch, K. T.; Rattray, P. V., 1978. *Agric. Res. N.Z. Min. Agric. Fish., A. Rep. Res. Div. 1977-78*: 41
- Jagusch, K. T.; Rattray, P. V.; Smith, J. F.; Lynch, R. J.; Oliver, T. W., 1980. *Proc. Agron. Soc. N.Z.* 10; (in press).
- Jagusch, K. T.; Rattray, P. V.; Winn, G. W.; Scott, M. E., 1979. *Proc. Ruakura Fmrs' Conf.*: 47-52.
- Kelly, R. W.; Knight, T. W., 1979. *Proc. Ruakura Fmrs' Conf.*: 19-26.
- Lambourne, L. J., 1956. *N.Z. Jl Sci. Tech.*, 37: 555-568.
- Moore, R. W., 1980. *Agric. Res. N.Z. Min. Ag. Fish., A. Rep. Res. Div. 1979-80*; (in press).
- Moore, R. W.; Knight, T. W.; Whyman, D., 1978. *Proc. N.Z. Soc. Anim. Prod.*, 38: 90-96.
- Moore, R. W.; Smeaton, D. C., 1980. *ibid.*, 40: 27-33.
- N.Z. Meat and Wool Boards' Ann. Rev. Sheep and Beef Industry, 1980. *Publ. No. 1830*.
- N.Z. Meat and Wool Boards' Sheep and Beef Farm Survey, 1979. *Publ. No. 1813*.
- Piggot, G. J.; Packard, P. M.; Renshaw, J. A., 1978. *Proc. N.Z. Soc. Anim. Prod.*, 38: 105-9.
- Rattray, P. V., 1978. *Proc. Agron. Soc. N.Z.*, 8: 103-8.
- Rattray, P. V.; Jagusch, K. T., 1978. *Proc. N.Z. Soc. Anim. Prod.*, 38: 121-6.
- , 1979. *Agric. Res. N.Z. Min. Ag. Fish. A. Rep. Res. Div. 1978-79*: 38-9.
- ; ———, 1980. *Ibid.*: (in press)
- Rattray, P. V.; Jagusch, K. T.; Clarke, J. N.; MacLean, K S., 1978. *Proc. Ruakura Fmrs' Conf.*, Aglink: FPP 164.
- Rattray, P. V.; Jagusch, K. T.; Maclean, K S., 1979. *Proc. N.Z. Grassld. Ass.*, 40: 89-103.
- Rattray, P. V.; Jagusch, K. T.; Smith, J. F.; Winn, G. W.; Farquhar, P. A., 1980a. *Proc. N.Z. Grassld. Ass.*, 41: 63-71.
- Rattray, P. V.; Jagusch, K. T.; Smith, J. F.; Winn, G. W.; MacLean, K. S., 1980b. *Proc. Ruakura Fmrs' Conf.*: 105-18.
- Rattray, P. V.; Joyce, J. P.; Drew, K. R.; Moss, R. A.; Beetham, M. R., 1976. *Ibid.*: 27-33.
- Smith, M. E.; McLaren, P. N.; Hopkins, D. R., 1979. *Proc. N.Z. Soc. Anim. Prod.*, 39: 251-253.
- Taylor, N. W., 1979. *N.Z. Meat & Wool Bds' Econ. Serv. Publ. No. 1802*.
- Wheeler, J. L., 1962. *Herb. Abst.*: 32: 1-7.