THE USE OF A MICROCOMPUTER FOR PASTURE MANAGEMENT ON A SHEEPFARM IN THE PUMICE COUNTRY

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ABSTRACT

The technology is now available to take pasture models developed as a consequence of research into pasture management and make these available in an easy-to-use form for extension workers and farmers.

Additional Key Words: pasture models, lambing date, electronic spreadsheet, MULTIPLAN

INTRODUCTION

A successful sheep farming operation demands constant decisions in both pasture and animal management. Some of these decisions only seem to have short-term consequences, like the start and end of grazing on a paddock and the time of nitrogen application. Others, like lambing date, selling of animals and conservation of pastures have long-term implications. However, the web of relationships is so intricate that there are few short-term consequences to any action (Milligan and Smith, 1984). For any decisions, proper planning tools are highly desirable. Planning of grazing management will help to make the best possible use of the pasture grown and to define management systems which maintain pastures of high tiller density and in a continual growing state.

This paper presents an overview of how more efficient feed utilisation was achieved on a farm in the pumice country by using improved knowledge of pasture growth rates, adopting research information on pasture management and using a microcomputer for long-term planning of pasture management and paddock shifts.

GENERAL

The property of 110 effective ha is situated 8 km from Tokoroa. The carrying capacity was 17.5 stock units (SU)/ha in 1980 but the present carrying capacity is 25 SU/ha. From available data for the pumice country for the more productive hill soils (Baars *et al.,* 1975) it was calculated that the average carrying capacity at 90% utilisation, assuming an annual dry matter requirement of 550 kg DM/SU/annum, is 14 SU/ha. This was based on a mean annual production of 9000 kg DM/ha and indicates that the rate of growth technique underestimates absolute levels of pasture production in this region.

The number of main paddocks was 37 in 1981, however the present number is 54, with more holding paddocks, and direct lane access to 28 paddocks.

Grass Growth

Accurate data on the seasonal pattern of pasture growth and its expected variability are desirable in any feed budgeting exercise.

The nearest locality to the farm for which pasture growth rates were available for more than five years was Wairakei (Baars *et al.,* 1975). It is quite common to extrapolate rate of growth trials to other sites within a district. However, pasture growth rates can vary greatly according to local climatic differences, frequency and intensity of defoliation, pasture composition and soil type. For example, Fig. 1 shows the difference in long-term pasture growth patterns at Wairakei Research Station (50 km from Kinleith), the closest rate of growth trial to the farm, and Kinleith, the nearest meteorological station to the farm (only 8 km away). Thus, because no long-term pasture growth rate data were available for the area, a pasture model was used (Baars, 1980).

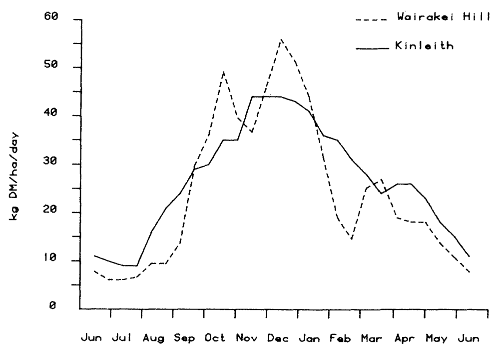

Figure 1: Seasonal patterns of pasture growth at Wairakei Resarch Station (actual: 1964-71) and Kinleith (simulated: 1967-80) with fortnightly cutting.

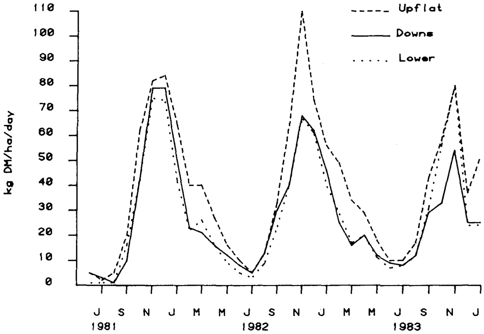

Figure 2: Seasonal pattern of pasture growth with monthly cutting at the Tokoroa sheep farm (1981-1984).

Fig. 2 shows the pattern of pasture growth measured on three representative areas of the farm, using a cutting interval of 4 weeks and a trim technique (Radcliffe, 1974).

Fig. 3 shows the variability in simulated pasture growth due to 10 cm soil temperature and rainfall using the model and long-term meteorological data from Kinleith (New Zealand Meteorological Service, 1983).

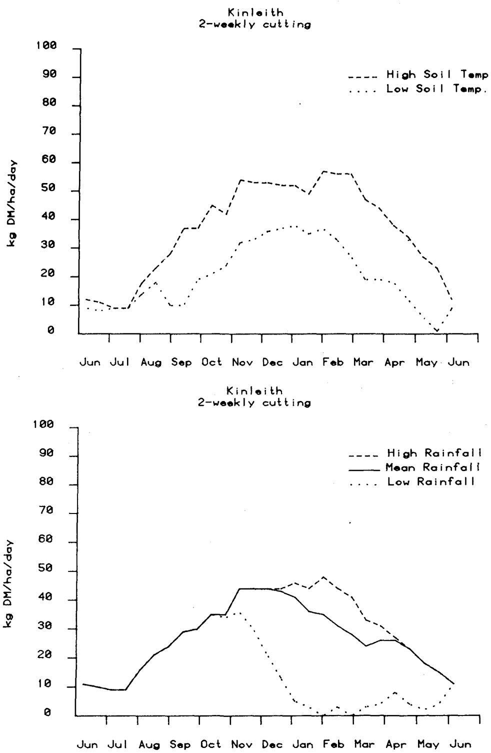

Figure 3: Seasonal variability in pasture growth patterns due to 10 cm soil temperature and rainfall (simulated for Kinleith: 1967-80).

Grazing management decisions on the basis of adjacent rate of growth trials are quite appropriate for a first appraisal of seasonal effects. On an individual farm basis however, it is essential for accurate feed budgeting to make regular estimates of growth rates for direct comparison with past years and to construct growth curves for representative areas of the farm. To overcome the limitations of fixed cutting intervals and defoliation heights with rate of growth data, the pasture model was used to calculate dry matter production for the management systems on the farm.

Implications of Pasture Growth Analyses

Fig. 4 shows the dry matter requirements of breeding ewes for the 1981 stocking rate on the property compared with seasonal growth patterns simulated for mean, high and low 10 cm soil temperature records for Kinleith. These analyses showed that a change in lambing date was necessary. The lambing date was changed from 30 August to 12 September.

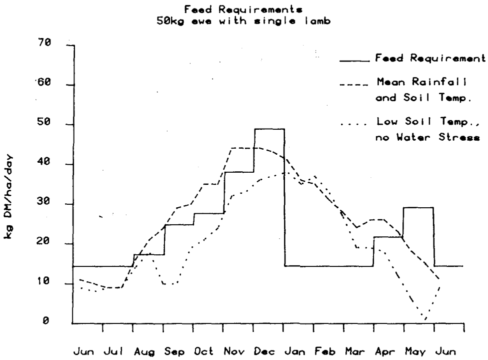

Figure 4: Seasonal pattern of pasture growth and of feed requirements of 17.5 ewes/ha with a mean lambing date of 30 August.

Another integral part of improved pasture management has been a change in conservation policy from hay to silage making. An earlier start in conservation is better timed to the strong late November peak in growth rates (Fig. 2). The importance of pasture control in spring and its beneficial effects on subsequent summer and autumn growth rates are well known (Sheath *et al.*, 1984; Korte, 1982; Baars *et al.*, 1981). Silage making also has a lower labour requirement and is much less weather dependent. Silage is also useful for flushing ewes in autumn (Hayman and Munro, 1983), as droughts in the pumice country can be of extreme severity (Baars *et al.*, 1975).

In addition, it was necessary to have effective control over a long-term winter management programme with set targets of pasture cover to be achieved by lambing and planning of the number and location of paddocks for lambing.

Bircham (1984) has derived functions which demonstrate the necessity at high stocking rates for herbage mass levels to be at least 1000 kg DM/ha at the beginning of lambing if the detrimental effects of prolonged periods of low herbage mass on both herbage and animal production are to be minimised.

The use of a pasture simulation model makes it possible to study the effects of different management practices on the seasonal pattern of dry matter production. In September 1981, before long-term planning was used, lambing was on extremely short pasture and cover was in the 800-1000 kg DM/ha region. At this cover, pastures grow at less than 20 kg DM/ha/day in this environment at this time. However at 1500 kg DM of standing dry matter, pastures grow at a rate of up to 40 kg DM/ha/day in the same period.

It was also decided to change rotation lengths in winter from 65 days in 1981 and 87 days in 1982 to 98 and 108 days in 1983 and 1984 respectively. The change in rotation length followed from the necessity for hard even grazing pressure in winter (to a residual dry matter of 4-500 kg DM/ha) to promote ryegrass growth and the spring cover target of 1500 kg DM/ha. As the average winter growth rate is about 10 kg DM/ha/day, it takes about 100 days to reach the desired levels in the lambing paddocks from a residual of 500 kg DM/ha.

Strict control over grazing intensity in winter has resulted in a dramatic change from browntop to ryegrass dominant pastures without the use of any pasture renewal or renovation techniques.

The improved knowledge of pasture productivity patterns in conjunction with continuous measurements of 10 cm soil temperature on the property showed that temperatures in winter/early spring were too low for any sizeable and reliable increases in dry matter production. For example, nitrogen was used in 1981 when 20 SU/ha were carried over the winter period. Responses were negligible because of low soil temperatures of 5.8 °C in July, 5.9 °C in August and 7.7 °C in September. Considering the high probability of low soil temperatures over the winter/early spring period in this environment, it was decided two years ago that control of grazing intensity should be one of the most important factors to increase animal production with minimal inputs of phosphate and nitrogen.

SIMPLE GROSS FEED BUDGETS

In the first stage of the planning of grazing management it is necessary to use appropriate pasture growth rate and stock data (numbers, feed requirements and amounts of supplements) in combination with residual dry matters (Milligan and Smith, 1984) for the different classes of stock to work out a policy which leads to a desirable cover over the farm by a certain date. This is done on a trial and error basis by using a computer programme which makes it possible to consider practical alternatives and changes in animal numbers and feeding levels in relation to the amount of supplements which is available. In the case of winter management systems, we are now aiming for a minimum cover of 1500 kg DM/ha in those paddocks receiving ewes for lambing.

Rams are harnessed at mating with the colours changed every 8 days so that the rotation is wound down as blocks of ewes are drafted off immediately prior to lambing for each group. It is thus only necessary to get the required number of paddocks that can accommodate each group to the minimum level rather than aim for that level over the entire area of the farm.

At the target cover levels, both herbage intake of lactating ewes and herbage growth rates will be at optimal levels for animal liveweight gain (Bircham, 1984).

The present simple gross feed budgeting program handles any periods and all input data can be saved to disk and easily changed. Cover is assessed by visual estimates using standard procedures (Parker, 1973) and checked against calibration cuts dried in a microwave oven and weighed on the farm.

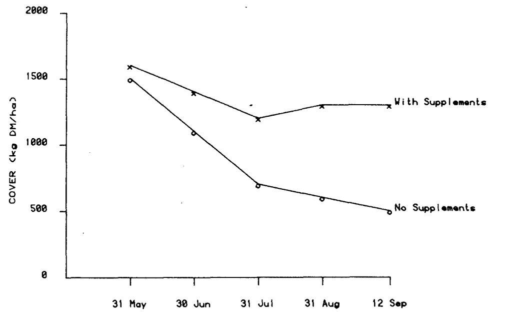

Figure 5: Simple feed budget winter 1984: changes in cover with and without supplements.

The results are presented in a graph (Fig. 5) so that it is possible to assess the pattern of change in cover over the farm over time easily. The aim of our grazing management is to maintain the average pasture cover over the whole farm within high and low ranges of 900-2000 kg DM/ha throughout the May to September period with the maximum in the remainder of the year well below 3000 kg DM/ha. Above this level, there will inevitably be much reproductive development in all grasses, particularly *Holcus* and *Poa* spp. and in early summer, browntop becomes rank and unpalatable, while inhibiting summer growth of white clover (Harris, 1974).

An example of tabular input and output data for 1984 is shown in Table 1. Fig. 5 shows the change in standing dry matter levels with a starting cover of 1650 kg DM/ha on 7 May, with and without supplements (in this case, silage) for lower than average growth rates for this area. As this target cover could be easily reached and the amount of silage available was well above 89 tons it was decided to accept a dairy herd for grazing from 24 May to 31 July. Feeding levels were set according to standard MAF recommendations.

With this simple feed budgeting program (written in BASIC) it is possible to investigate alternative grazing strategies before preparing total grazing plans for any given period. Contrary to many other feed budgeting programs, we felt that flexible periods and residual dry matters had to be considered in simple feed budgets.

TABLE 1: Simple gross feed budget for winter 1984 (main mob).

INPUT

Average cover at start: 1650 kg DM/ha
Period 1: 7 May — 31 May

	Number	Feeding level (kg DM/animal/day)	Supplement* (kg DM/animal/day)	RDM** (kg DM/ha)
1 Ewes	1220	1.3	0.5	500
2 Ewe hoggets	345	1.0	0.0	500
3 Friesian 2 year	40	6.0	0.0	500
4 Angus 2 year	70	6.0	0.0	500
5 Angus cows	40	5.5	0.0	500
6 Rams	18	1.2	0.0	500

Area: 110 ha
Pasture rate of growth: 20 kg DM/ha/day
Utilisation: 0.9

OUTPUT

For 7 May — 12 September 1984 (5 periods)
Total feed required: 212 505 kg DM/ha
Total dry matter production: 176 616 kg DM/ha
Supplement total: 89 437 kg DM
Cover: See Figure 5 with supplements

* For whole mob
** Residual dry matter

GRAZING MANAGEMENT PROGRAM USING MULTIPLAN

An accurate plan of paddock shifts and breaks over winter is prepared using an electronic spread sheet. An electronic worksheet like MULTIPLAN presents the user with a large work area marked off into 'cells' that are identified by column-row references. Each cell may contain either a value which can be text or numbers or a formula which manipulates such values. In our case, rows and columns have been labelled (by dates, paddock names and numbers, cover in, cover out, number of days in a paddock, likely residual dry matter, available feed, stock demand, deficits, and supplements required). The most important part is to relate parameters and values to each other and to other data that will be input.

After entering all the basic information it is possible to change values (e.g. pasture growth rates, visual assessments) or formulas and the program will automatically calculate the effects of any changes. This can be done quickly and over and over again until you have satisfactory results.

This way it is relatively easy to prepare a complete plan of paddock shifts. It specifies all essential information like the number of days each class of stock should spend in a paddock, the dates on which stock should come in and go out of a paddock, the amount of silage required for desired feeding levels etc. Table 2 shows the layout of part of the spreadsheet used to achieve a minimum cover of 1500 kg DM/ha in the lambing paddocks. It is part of the complete daily shift plan for ewes, hoggets, yearlings and rams which were grazed in one mob for most of the winter period in 1984.

TABLE 2: Layout of MULTIPLAN spreadsheet for individual paddock shifts and breaks for main mob of sheep and cattle: winter 1984.

Day	Date	Paddock No	Area (ha)	Cover Day	Cover Entry	Residual* dry matter	Feed** available	Demand** Total	Demand** Cattle	Deficit** Total	Deficit** Cattle	Silage** required
8	14 May	34	2.3	1300	1456	700	1478	1220	0	−258	−524	0
9	15 May	35	0.8	2000	2224	600	1036	1810	590	774	220	2200
10	16 May	35	0.8	1900	2140	600	1047	1810	590	763	254	2400
11	17 May	35	0.8	1700	1924	600	900	1810	590	901	340	2600
12	18 May	36	1.3	1600	1872	600	1406	1810	590	404	218	1200
142	25 Sep	25	0.6	1000	2231	400	934	933	933	−1	−81	0
143	26 Sep	25	0.5	1000	2266	400	793	288	288	140	−29	500

* kg DM/ha
** kg DM

The major advantage of this system is long-term planning. Using the above packages it has been possible to set an average target cover of 1200 kg DM/ha over the farm by lambing 1984, which was easily achieved. A separate sheet of actual changes in feed supply and feeding out requirements is also maintained. Projected and actual analyses indicated that it was possible to carry additional stock. For maximum profit, it was decided to accept a dairy herd for grazing over winter. This decision was consistent with the simple feed budgeting runs for an expectation of lower growth rates which showed that sufficient silage was available to reach the desired cover levels. A number of paddocks was set aside for the herd of 143 dairy cows and this second mob was fed according to their daily requirements using projected and actual planning sheets similar to the first mob. This has meant an effective carrying capacity of 30 stock units/ha over a large part of the winter period.

CONCLUSION

The development of simulation models of pasture and animal production has possibly reached a stage where a simple model can be applied to problem solving in commercial situations. This is now possible because of the increased availability of relatively low-cost microcomputer systems. For the field of pasture management and utilisation it is now possible to provide quantitative advice on different management options.

In the initial phase of this programme it has been possible to improve the carrying capacity by 50% by careful planning of grazing management without any additional increases in phosphate inputs and without the use of nitrogen.

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REFERENCES

Baars, J.A., Radcliffe, J.E., Brunswick, L. 1975. Seasonal distribution of pasture production in New Zealand. VI. Wairakei, pasture and lucerne production. *N.Z. Journal of Experimental Agriculture 3:* 253-258.

Baars, J.A. 1980. Development of a simulation model for pasture growth. *Proceedings Agronomy Society of N.Z. 10:* 103-106.

Baars, J.A., Jagusch, K.T., Dyson, C.B., Farquhar, P.A. 1981. Pasture production and sward dynamics under sheep grazing. *Proceedings N.Z. Society of Animal Production 41:* 101-111.

Bircham, J.S. 1984. Pattern of herbage growth during lactation and level of herbage mass at lambing: their significance to animal production. *Proceedings N.Z. Grassland Association 45:* 101-109.

Harris, W. 1974. Why browntop is bent on creeping. *Proceedings N.Z. Grassland Association 35:* 101-109.

Hayman, J.M., Munro, J.M. 1983. Silage for flushing ewes. *Proceedings N.Z. Grassland Association 44:* 196-202.

Korte, C.J. 1982. Grazing management of perennial ryegrass/white clover in late spring. *Proceedings N.Z. Grassland Association 43:* 80-84.

Milligan, K.E., Smith, M.E. 1984. Pasture allocation in practice. *N.Z. Agricultural Science 18:* 153-156.

MULTIPLAN manual. Electronic worksheet. Microsoft Corporation.

New Zealand Meteorological Service 1983. Summaries of Climatological Observations to 1980. Miscellaneous publication 177.

Parker, O.F. 1973. Precision feedbudgeting in practice. *Proceedings N.Z. Grassland Association 35:* 127-134.

Radcliffe, J.E. 1974. Seasonal distribution of pasture production in New Zealand. I. Methods of measurement. *N.Z. Journal of Experimental Agriculture 2:* 337-340.

Sheath, G.W., Webby, R.W., Pengelly, W.J. 1984. Management of late spring-early summer surpluses in hill country. *Proceedings N.Z. Grassland Association 45:* 199-206.