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INCORPORATION OF MATUA PRAIRIE GRASS INTO GRAZINGSYSTEMS

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Abstract

The inclusion of Matua prairie grass (*Bromus willdenowii* Kunth) as a pure sward into grazing systems involving dairy, bull beef and integrated dairy bull beef systems is investigated using a linear programming model. The ability to test in the model alternative animal production patterns and therefore intake of dry matter throughout the year has allowed definition of the most profitable systems for Matua. The results highlight the need to consider animal production patterns and pasture management objectives which combine to give the best profitability rather than the inflexible animal requirements based on traditional management concepts.

Keywords: linear programming

INTRODUCTION

Most grazing management systems in New Zealand rely on the control of both animal intake and pasture quality. These systems, based on the use of perennial ryegrass, require modification for the use of other pasture species such as Matua prairie grass, which has a different seasonal pattern of dry matter production to ryegrass and a problem of persistence if not given a recovery period following grazing (Anon 1985).

Matua was sown at No. 4 Dairy Farm at Massey University in 1982. This 137 ha. farm carried 400 seasonal supply dairy cows. Experimentation with various grazing management systems on this farm has shown that for Matua pastures a compromise between very lax grazing (leading to low utilisation), and intense grazing (which can give high utilisation but may also remove young tillers and contribute to the death of mature plants) is required. (Ridler 1986).

Seedhead formation by Matua occurs over much of the year, but as stock readily eat the seedhead, the need to control such growth by intensive grazing to maintain vegetative growth is of less importance than with perennial ryegrass. It is still important to maintain leafy growth with Matua, however, as high levels of seedhead formation will result in poorer quality (older) herbage.

Based on monitoring data (rising plate meter) and experience at No. 4 Dairy and on another commercial dairy farm (McCallum 1987) limits for pre and post grazing levels of pasture dry matter (D.M.) were established (Table 1). These levels allow survival of new tillers and young seedlings and result in acceptable levels of utilisation. The grass growth rate figures shown in Table 1 have been measured using these management criteria. The above data formed the basis for a more objective investigation of the potential profitability of Matua in grazing systems, rather than merely considering Matua to be just another form of the traditional ryegrass-white clover pasture management systems which prevail throughout New Zealand.

METHOD

A linear programming (LP) model was used to investigate the likely effects of incorporating Matua as a pure sward in varying proportions (0, 25, 50, 75 and 100%) into each of the following systems:

- A seasonal dairy system, rearing 20% replacement of the herd number as replacement stock each year.
- An integrated dairy-bull beef system with 0.45 bull calves per cow and 20% of the herd number as replacement stock each year.
- A bull beef system where calves are purchased at 80 kg L.W. and sold when they reach a liveweight of 440-490 kg.

Table 1: Model Input — Pasture growth rats and grazing limit constraints (Data are averaged from 26 14 day periods)

	Matua Prairie Grass				Ryegrass			
Month	Growth Rate kg DM/ha/day	Residual DM (Cows)	Residual DM (Bulls)	Maximum Pregrazing kg DM	Growth Rate kg DM/ha/day	R.D.M. cows	R.D.M. Bulls	Maximum Pregrazing kg. DM
July	37	1800	1600	4000	20	700	1000	3200
August	60	1900	1900	4200	26	1200	1100	3500
September	60	2000	2000	4500	42	1300	1300	4000
October	72	2500	2400	5000	67	1600	1600	4700
November	96	2600	2700	5500	68	1600	1600	5000
December	a2	3200	3200	6000	45	1500	1500	4300
January	56	2600	2600	6000	30	1400	1400	3900
February	45	2300	2300	4800	17	1300	1300	3700
March	42	2200	2200	4600	17	1300	1300	3500
April	40	2200	2200	4500	20	1200	1200	3300
May	39	1800	1600	4000	20	700	1000	3000
June	35	1800	1600	4000	18	700	1000	3000

Model input includes stock feed requirements and associated performance levels. Thse are based on published ARC relationships (ARC 1980). The cows modelled were Friesian-Jersey crossbreeds calving in either August or September (Miller 1982). Milk fat was priced at $4.00/kg milk fat (MF). Bulls were raised to a target liveweight of 440 kg by the end of December and sold at $2.25/kg carcass weight (CW). A 50 dressing out figure was applied.

Three patterns of liveweight gain representing three possible choices based on pasture growth constraints were specified for both bulls and young stock:

(i) Constant rate of growth throughout

(ii) Maintenance during winter.

(iii) Maintenance during summer.

The model selects the combination of liveweight gains and lactation patterns which maximise total gross margin, i.e. returns from milk fat and/or beef silage costs (9c/kg DM made and fed on the farm), over a single year. In doing this, the management strategy is determined which makes best use of feed resources, subject to stock requirements and other constraints including pre and post grazing limits being satisfied. This strategy defines the optimal combinations of calving date and liveweight gain patterns together with the corresponding pattern of pasture DM allocation over the year.

RESULTS

Increasing the proportion of Matua is likely to lead to increases in the profitability of all systems. While increased annual dry matter production is a contributory factor, it is also apparent that the return per kg DM grown increases with the proportion of Matua in both the dairy and the integrated dairy-beef systems as defined by the c/kg DM column (Table 2).

Matua performs well in both the drier summer and cooler winter periods (Table 1). It is this more even seasonal pattern of growth that give Matua a much greater flexibility in terms of management strategies that allow for higher stocking rates whilst reducing or eliminating the need to provide supplements (Table 2). The results of 15 solutions are summarised in Table 2.

The number of stock carried and the animal production patterns chosen are shown in Table 3. As the proportion of Matua on the farm increases so does the percentage of

Table 2. Model Output Stocking rate and production from varying proportions of pure Matua pastures (Based on 100 ha farm)

Production system	% Pure Matua pastures	No. cows	NO. bulls	No. replace-ments	Annual kg DM grown/ hectare	Annual pasture consumed/ hectare (kg DM)
Dairy	0	270		54	12236	11405
	25	326		66	14266	13967
	50	384		76	16296	16296
	75	437		87	16326	18326
	100	466		97	20356	20356
Dairy/Beef	0	219	98	44	12236	11714
	25	266	120	53	14266	14266
	50	310	140	62	16236	16296
	75	352	158	70	18326	18326
	100	392	176	78	20356	20356
Bull beef	0		508		12236	12236
	25		579		14266	14266
	50		644		16296	15674
	75		704		18326	17091
	100		758		20356	18555

Production system	Silage made & fed kg DM	Total milkfat (kg)	Total carcass Weight (kg)	Gross margin ($)	MFx100 /kg DM	CWx100 /kg DM	Gross margin/ kg DM grown (c)
Dairy	56226	43516		169005	3.6		13.8
	17949	52851		209790	3.7		147
	-	61777		247107	3.8		152
	-	70390		261558	3.6		15.3
	-	76341		313363	3.9		15.4
Dairy/Beef	35475	35223	21659	186431	2.9	1 80	15.2
	-	42845	26346	230659	3.0	1.65	16.2
	-	49967	30737	269106	3.1	1.69	16.5
		56636	34827	304912	31	1.90	16.6
	-	63066	38792	339623	31	1.91	16.7
Bull Beef	-		111658	251230		9.13	20.5
			127352	286541		8.92	20.1
	40615		141572	314883		8.69	19.3
	80615		154870	341202		6.45	18.6
	117604		166865	364862		8.20	17.9

September calving cows. Similarly, young stock are for the most part fed to maintenance levels in the summer months, as are the bulls in the integrated dairy-beef system.

In the bull beef system the optimal return/kg DM grown decreases as the proportion of pasture sown in Matua increases. This suggests that patterns of liveweight gain other than those analysed may suit the Matua systems better.

The LP analysis gives 'shadow prices' (the marginal return) for increasing energy supply (or equivalently, of decreasing energy demand) in each two week period throughout the year. Intuitively at least, high shadow prices in some periods and low shadow prices in other periods, suggest that overall returns might be increased by a pattern of liveweight gain that decreased feed demand in high shadow price periods and increased feed demand in low shadow price periods.

A further exercise was therefore undertaken in an attempt to find patterns of bull liveweight gain better suited to the Matua pasture growth patterns. Livestock energy requirements were decreased in high shadow price periods and correspondingly increased in tow shadow price periods, while maintaining a target carcass weight of 245 kg. This intuitive approach was repeated to find more efficient (though not necessarily optimal) patterns of bull liveweight gain for systems based on Matua. Preliminary results indicate that liveweight gain patterns which better use the Matua are obtainable from this approach with fewer periods of maintenance or near maintenance feeding occurring.

Table 3: Livestock production patterns with change in Matua area (Based on 1 DO ha farm)

		Cows		Replacements		Bulls		
Production system	% Matua	Calving August	Calving Sept.	Maintenance Winter	Maintenance Summer	Constant gain	Maintenance Winter	Maintenance Summer
Dairy	0	270			54			
	25	246	82		66			
	50	309	75	38	39			
	75	377	60		a7			
	100	356	130	43	54			
Dairy/Beef	0	219			43		60	38
	25	209	57		53		60	60
	50	239	71		62			140
	75	261	91		70			158
	100	97	295		78			176
Boll beef	0						269	239
	25					95	484	
	50					226	418	
	75					378	326	
	100					582	176	

NB: In no solution were replacements on a constant pattern of liveweight gain selected.

DISCUSSION

Models such as the one described in this paper have the potential to explore in detail the management related aspects of new technology such as Matua. Traditional concepts of pasture and animal production patterns and levels, based on existing grazing management practices, may be inappropriate for new pasture species such as Matua.

The use of models in the manner described also, however, allows managers who have confidence in their ability to control on-farm outcomes, to analyse changes required in their system and to optimise new inputs. For example, experience over four years on No. 4 Dairy Farm indcates that traditional animal production patterns which involve periods of maintenance feeding during winter can lead to severe persistence problems with Matua. Establishing specific management guidelines to overcome this problem and then investigating alternatives by way of systems models should provide animal production patterns better suited to specific pasture management, whilst at the same time allowing better understanding of the relationships important for optimising particular farming systems.

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