Pasture growth and quality on West Coast dairy farms

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Abstract

Variation in rainfall, soil type and growing degree days across the West Coast creates wide variation in pasture growth rates. Farmers require pasture growth rate and quality information local to their environment to assist them with their on-farm decision making. Four farms in different geographical regions of the South Island's West Coast were monitored for four years to measure pasture growth rate (weekly, plate meter), nutrient composition (fortnightly, pre-grazing) and soil temperature (weekly, 10 cm depth). Average monthly pasture growth rate varied between the farms, however the seasonal trends were similar in all regions. There was significant variation in average monthly growth rate between years for individual farms. Soil temperature explained some of the trends in pasture growth rate, particularly in winter and early spring. Pasture quality was lowest during the summer months when neutral detergent fibre concentrations were greater. Pasture crude protein concentration exceeded 25% in 63% of the samples collected. Information reported will allow dairy farmers and their advisors to develop feed budgets and assess the appropriateness of the stocking rate and calving date of the farm relative to the annual pasture growth patterns. Times of year when the greatest variability occurs have now been identified for each sub-region.

Keywords: West Coast, pasture growth, pasture quality, dairy

Introduction

The West Coast dairy industry, in the South Island of New Zealand, operates in a distinctive environment with its own set of unique challenges. The area has relatively high rainfall and soils which are often poorly drained or may have an impermeable iron pan. The development of "humping and hollowing" and "flipping" practices has improved drainage on some existing farms and expanded the area of land suitable for dairy farming. Despite the West Coast being an important region for milk production, there is a scarcity of basic information on pasture growth and quality for dairy farms in the Buller, Grey and Westland districts (northern, central and southern regions of the West Coast, respectively). Previously reported growth rate information was measured at three sites during the 1970s and 1980s (Radcliffe 1975; Morton & Paterson 1982). Variation in rainfall, soil type and growing degree days across the West Coast has the potential to create a wide variation in soil temperature and pasture growth rates. Morton & Paterson (1982) reported average annual growth rates of 8.1 and 9.4 t DM/ha for Kowhitirangi (Westland) and Ahaura (Grey), respectively. In both regions pasture growth rates peaked during late November, declined in December, remained at a reasonably constant level until the end of March, and then further declined through April and May to a low level from June to September.

Despite the West Coast being an important region for milk production, there has been no further monitoring of basic information on pasture growth and quality for dairy farms in the region since the project of Morton & Paterson (1982). Such information is critical for annual feed budgeting, farm system setup (e.g., calving date, stocking rate) and for weekly farm management decisions, especially as dairying expands into new regions. Farmers are looking for new information more local to their environment that will assist them with their decision making.

In August 2008 a 4-year project commenced to gather data in a controlled and systematic way from four regions of the South Island's West Coast. Reliable pasture growth rate information for the regions and data on pasture quality changes will give farmers more confidence in making feeding decisions and help them to evaluate the applicability of research from other regions for their situation.

Materials and Methods

Rainfall, topography and soil type information were used to identify geographically different regions within the Westland, Grey and Buller districts of New Zealand. The four regions selected were Westport (WEST), Ikamatua (IKAM), Kotuku (KOT) and Kowhitirangi (KOWH). Four monitor farms were selected according to size, location, stocking rate, farming system, record keeping, soil type and willingness of the farmer to be involved and use the information generated. Details of the farms are reported in Table 1.

Pasture growth rates were determined by weekly assessment of the pasture height in every paddock on

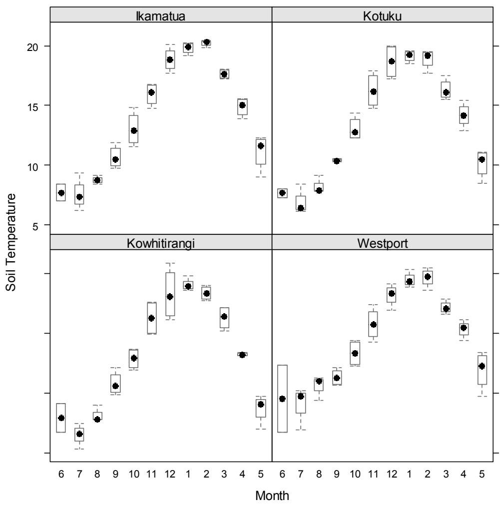

Figure 1. Average monthly soil temperature (°C; 10 cm depth at 10 am) for four sites across the Westland, Grey and Buller districts from August 2008 to May 2012.

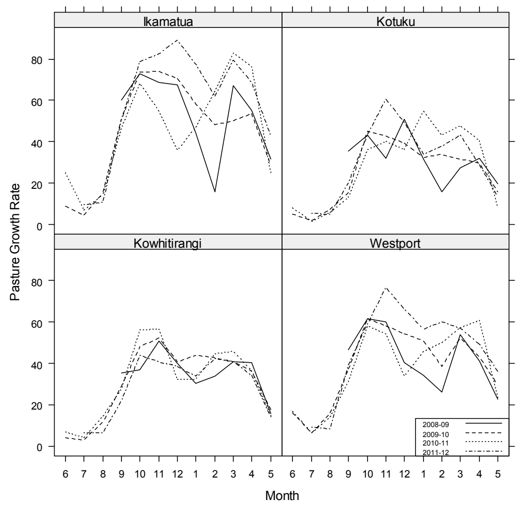

Figure 2. Average monthly pasture growth rate (kg DM/ha/day) for four sites across the Westland, Grey and Buller districts from August 2008 to May 2012.

Table 1. Farm location, size, number of cows milked and average annual nitrogen (N) fertiliser application for the four farms involved in the study.

	District	Area (effective ha)	No. Cows	Rainfall (± s.d.) (mm/annum)	Average N use (± s.d.) (kg/ha/yr)
Westport	Buller	85	245	1926 (66.5)	179 (62.3)
Ikamatua	Grey	280	680	1849 (75.6)	286 (23.3)
Kotuku	Grey	410	1080	3104 (116.4)	223 (44.8)
Kowhitirangi	Westland	95	230	3802 (147.8)	120 (22.8)

Table 2. Average (s.d.) monthly maximum and minimum temperature (°C) and daily global radiation (MJ/m²) recorded at the closest NIWA climate stations to the four monitor farms (Westport – Westport Airport, 6 km; Ikamatua – Reefton, 22 km; Kotuku – Pigeon Creek, 17 km; Kowhitirangi – Hokitika, 23 km)

	Average maximum temperature (°C)				**Average minimum temperature (°C)**				**Average daily global radiation (MJ/m2)**			
	WEST	IKAM	KOT	KOWH	WEST	IKAM	KOT	KOWH	WEST	IKAM	KOT	KOWH
Jan	20 (1.9)	23 (3.4)	20 (2.7)	19 (2.1)	13 (2.4)	12 (2.7)	12 (2.8)	12 (2.7)	23 (8.2)	22 (7.9)	18 (8.3)	22 (8.6)
Feb	21 (1.8)	24 (3.2)	21 (2.4)	20 (1.7)	13 (2.4)	13 (3.0)	12 (2.7)	12 (2.5)	19 (7.0)	19 (6.4)	15 (6.6)	18 (7.1)
Mar	20 (1.9)	22 (3.1)	19 (2.7)	18 (2.0)	11 (2.4)	9 (3.1)	9 (3.0)	10 (2.5)	16 (5.5)	16 (5.7)	12 (5.6)	15 (5.8)
Apr	18 (1.9)	18 (2.5)	17 (2.1)	17 (1.6)	10 (2.7)	7 (3.7)	8 (3.6)	9 (3.3)	10 (4.7)	10 (4.5)	8 (4.5)	10 (4.8)
May	16 (2.2)	14 (2.9)	14 (2.6)	15 (2.4)	8 (3.2)	5 (4.0)	5 (3.9)	6 (3.5)	7 (2.8)	6 (2.4)	5 (2.7)	7 (2.8)
Jun	14 (1.9)	11 (3.2)	11 (2.3)	13 (1.9)	6 (2.9)	2 (3.8)	3 (3.9)	4 (3.2)	5 (2.3)	5 (1.9)	4 (2.0)	5 (2.2)
Jul	13 (1.5)	10 (2.3)	10 (1.8)	12 (1.7)	5 (2.4)	1 (3.4)	2 (3.5)	3 (2.7)	6 (2.6)	7 (3.7)	5 (2.4)	6 (2.5)
Aug	14 (1.7)	13 (2.9)	12 (2.6)	13 (1.9)	6 (2.9)	3 (3.5)	4 (3.7)	5 (3.2)	8 (3.6)	8 (3.3)	7 (3.4)	8 (3.6)
Sep	14 (1.3)	14 (2.8)	13 (2.1)	13 (1.6)	7 (2.6)	4 (2.9)	5 (3.1)	6 (3.0)	12 (5.5)	10 (4.8)	10 (5.2)	12 (5.7)
Oct	16 (1.6)	17 (3.5)	15 (2.8)	15 (1.8)	8 (2.7)	5 (3.0)	6.3 (2.9)	7 (3.0)	17 (6.5)	17 (5.8)	14 (6.9)	17 (7.2)
Nov	17 (1.8)	19 (3.8)	17 (3.0)	16 (1.7)	10 (2.6)	8 (2.9)	9 (2.8)	9 (2.7)	21 (8.8)	20 (8.0)	16 (8.3)	19 (8.6)
Dec	19 (1.7)	22 (3.4)	20 (2.9)	18 (1.7)	12 (2.5)	11 (2.9)	11 (2.8)	12 (2.7)	21 (9.3)	22 (8.6)	17 (9.4)	20 (9.6)

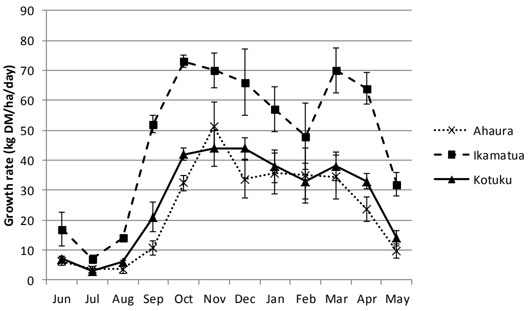

Figure 3. Average monthly pasture growth rate (±s.d.; kg DM/ha/day) for the Ikamatua and Kotuku monitor farms and Ahaura (Morton & Paterson 1982).

each farm using a rising plate meter (Thomson *et al.* 2001). Pasture mass (kg DM/ha) was estimated using the rising plate meter equation, (height × 140) + 500, throughout the season. Farm walks were undertaken by the same person each week. Growth rate was calculated using the Pasture Coach Software (Version 5.0, AgSoft Solutions), excluding data from paddocks that had been grazed in the previous 7 days. Grazing date and post-grazing residual pasture mass were not recorded in the software during the growth rate calculations. Nitrogen (N) fertiliser applications were recorded for each farm. Each fortnight, two pasture samples were collected to estimated grazing height from the next two paddocks to be grazed on each farm. These samples were analysed for nutrient composition by near infrared reflectance spectroscopy (NIRS; ARL Labs, Ravensdown). Soil temperature (at 10 cm depth) was recorded at 10 am on the day of the farm walk at a single site in two adjacent paddocks using a portable soil temperature probe (Digital Pocket Thermometer ISM group B; Dick Smith Electronics). Climatological data for each farm was sourced from the closest NIWA climate station to each of the four monitor farms (Westport – Westport Airport, 6 km; Ikamatua – Reefton, 22 km; Kotuku – Pigeon Creek, 17 km; Kowhitirangi – Hokitika, 23 km).

Results and Discussion

Soil temperature trends were very similar between the regions (Figure 1) with average temperatures of less than 8°C being recorded in June and July and above 18°C recorded through December, January and February. The regions differed in average annual rainfall ranging from 1849 ± 75.6 mm/annum at Ikamatua to 3802 ± 147.8 mm/annum at Kowhitirangi (Table 1). Ikamatua recorded the highest average maximum temperature and the lowest average minimum temperature (Table 2). The highest and lowest solar radiation was recorded at Westport and Kotuku, respectively (Table 2).

There was considerable variation in pasture growth rate between regions and also between years within a region (Figure 2). All regions had reasonably predictable growth rates through late winter and early spring when soil temperatures were below 8°C, however late spring and summer growth rates were more variable between years. The region with the least variability in pasture growth was Kowhitirangi, which together with Kotuku consistently recorded the lowest monthly growth rates. In 2 of the 4 years that were monitored, periods of low growth occurred between November and March in several of the regions (Figure 1); these periods were dry with no significant rainfall recorded over an extended period. The areas most affected by the dry conditions were Ikamatua and Westport. In 2008/09 the low growth period occurred during February, whereas in 2010/11 it was earlier in the season during December. In 2011/12 growth rate

Table 3. Average (s.d.) monthly growth rate and annual pasture dry matter production (kg/ha) recorded from four monitor farms in Westport, Ikamatua, Kotuku, and Kowhitirangi from Aug 2008 to May 2012.

	Westport	Ikamatua	Kotuku	Kowhitirangi
June	17 (0.7)	17 (11.3)	7 (2.1)	6 (2.1)
July	7 (1.4)	7 (2.5)	3 (2.1)	5 (1.8)
August	13 (3.8)	14 (2.6)	6 (1.3)	11 (4.1)
September	39 (6.4)	52 (5.7)	21 (10.0)	28 (5.6)
October	60 (1.7)	73 (4.2)	42 (3.9)	46 (8.1)
November	62 (9.7)	70 (11.7)	44 (12.0)	50 (6.8)
December	49 (14.5)	66 (22.0)	44 (7.2)	38 (3.9)
January	47 (9.6)	57 (15.1)	38 (11.1)	35 (5.9)
February	44 (14.7)	48 (22.3)	33 (11.9)	41 (4.9)
March	55 (2.4)	70 (14.8)	38 (9.7)	42 (2.5)
April	49 (8.9)	64 (10.8)	33 (5.4)	37 (2.7)
May	28 (6.2)	32 (7.5)	14 (4.9)	16 (1.5)
Annual pasture DM (kg/ha)	14.2 (0.93)	17.2 (1.81)	9.7 (0.61)	10.6 (0.82)

was lower in all regions between January and March. In no one season did all farms have their best annual growth. The best growth season for IKAM, WEST and KOT was the 2011/12 season. For KOWH the highest pasture production year was 2010/11.

Estimated annual pasture dry matter (DM) production from the weekly farm walks ranged from 9.7 t DM/ha on the KOT farm to 17.2 ± 1.81 t DM/ha on the IKAM property (Table 3).

The average annual pasture growths recorded in the current project were higher than those reported by Morton & Paterson (1982) at Kowhitirangi and Ahaura using pasture cages harvested at 4-weekly intervals. No nitrogen fertiliser was applied in the study reported by Morton & Paterson (1982), one likely reason for the lower growth rates. At Kowhitirangi, estimated growth during the current monitoring was 30% higher than that reported by Morton & Paterson (1982). In only 1 of 6 years did the Kowhitirangi farm in the study of Morton & Paterson (1982) yield similar annual DM to the current KOWH farm. Morton & Paterson (1982) speculated that low spring growth in their study was the result of limited soil N levels. This would not have been the case in the current study where up to 40 kg N/ha was applied to 100% of the farm by mid-October.

Ahaura is mid-way between KOT and IKAM. Average annual DM production at KOT was similar to that reported from Ahaura (Figure 3), despite 223 kg N/ha being applied in the current study. The relatively recent conversion of this farm from native bush (2003) and the widespread use of humping and hollowing may have contributed to the lower growth on this farm during the monitoring period (Horrocks *et al*. 2010). In contrast, the IKAM farm grew 80% more pasture than that reported by Morton & Paterson (1982) (Figure 3). Improved pasture species, high rates of N fertiliser, gibberellic acid application and rotational grazing are all likely to have contributed to the higher growth rate at IKAM in the current study.

Average pasture DM content ranged from 12 to 22% with higher DM percentages (DM%) being observed during August on all farms (Table 4). The lowest average DM% was recorded during March on all the farms. KOWH had the least variation in pasture DM% of the four farms monitored, and had the lowest average DM% for most months. An average DM% below 15% was recorded for 9 months on the KOWH farm. Pasture DM below 15% has been implicated in reduced pasture intake due to the difficulty of harvesting sufficient DM during the grazing period (Clark & Woodward 2007).

Table 4. Average (s.d.) monthly pasture dry matter (DM%), crude protein (CP%), neutral detergent fibre (NDF%) and metabolisable energy (MJ ME/kg) from four monitor farms in Westport (WEST), Ikamatua (IKAM), Kotuku (KOT) and Kowhitirangi (KOWH) from Aug 2008 to May 2012. In July only one sample collected from each farm, so no s.d. is reported.

	Dry matter %				Crude protein (%)				NDF (%)				Metabolisable Energy (MJ/kg DM)			
	WEST	IKAM	KOT	KOWH	WEST	IKAM	KOT	KOWH	WEST	IKAM	KOT	KOWH	WEST	IKAM	KOT	KOWH
Jun	16	16	17	14	28	28	25	27	43	37	43	40	12.2	12.5	12.4	12.7
	(3.1)	(3.6)	(3.3)	(1.2)	(4.1)	(3.6)	(2.1)	(2.5)	(3.2)	(3.8)	(2.7)	(1.8)	(0.38)	(0.19)	(0.12)	(0.06)
Jul	17	13	13	14	29	32	22	30	41	40	52	42	12.3	12.7	11.4	12.7
Aug	22	20	20	17	22	22	20	24	45	42	43	39	12	12.4	11.8	12.5
	(3.6)	(3.2)	(0.1)	(0.8)	(2.0)	(2.7)	(1.2)	(3.3)	(0.5)	(3.4)	(1.0)	(2.5)	(0.12)	(0.50)	(0.32)	(0.21)
Sep	16	17	16	15	26	29	26	28	44	40	45	40	12.6	12.7	12.1	12.5
	(2.4)	(1.9)	(1.7)	(2.8)	(2.9)	(2.4)	(2.2)	(4.2)	(2.5)	(3.2)	(4.5)	(4.7)	(0.10)	(0.03)	(0.54)	(0.18)
Oct	15	17	15	14	27	25	25	25	46	42	44	44	12.3	12.5	12.4	12.2
	(0.5)	(0.1)	(1.0)	(0.9)	(1.2)	(3.4)	(2.8)	(2.1)	(1.8)	(2.1)	(3.7)	(5.2)	(0.24)	(0.37)	(0.31)	(0.30)
Nov	14	17	15	15	25	26	25	23	47	42	51	49	12.1	12.4	11.8	12.0
	(1.9)	(2.1)	(2.2)	(1.5)	(0.9)	(1.0)	(4.6)	(2.4)	(3.6)	(2.8)	(6.4)	(7.7)	(0.32)	(0.18)	(0.80)	(0.74)
Dec	18	20	15	16	23	22	22	22	50	44	50	50	11.7	12.4	11.7	12.0
	(0.5)	(2.9)	(2.3)	(0.8)	(1.8)	(2.9)	(2.1)	(1.5)	(1.9)	(3.1)	(3.2)	(2.8)	(0.56)	(0.61)	(0.62)	(0.18)
Jan	15	19	17	15	27	25	25	21	50	45	49	52	11.7	12.4	11.7	11.8
	(2.5)	(2.5)	(2.8)	(0.8)	(3.9)	(2.3)	(2.9)	(2.5)	(4.2)	(2.9)	(2.9)	(3.0)	(0.49)	(0.29)	(0.47)	(0.63)
Feb	16	18	16	13	28	27	26	28	46	45	49	44	11.4	11.9	11.2	11.5
	(2.0)	(2.8)	(2.3)	(0.8)	(2.9)	(5.2)	(2.2)	(3.3)	(4.0)	(3.9)	(6.6)	(3.7)	(0.86)	(0.68)	(0.51)	(0.47)
Mar	14	17	15	15	29	30	28	28	51	48	50	47	12.2	12.6	12.3	12.2
	(3.1)	(1.2)	(1.3)	(1.9)	(2.9)	(2.1)	(1.4)	(1.5)	(3.4)	(2.7)	(0.10)	(3.7)	(0.36)	(0.11)	(0.35)	(0.21)
Apr	15	16	15	13	30	29	27	29	44	42	44	43	12.5	12.5	12.4	12.2
	(1.4)	(1.3)	(0.9)	(1.3)	(1.6)	(2.1)	(2.3)	(3.0)	(2.0)	(3.3)	(0.5)	(3.0)	(0.30)	(0.31)	(0.33)	(0.48)
May	13	13	13	12	30	31	27	28	48	44	48	43	12.1	12.5	12.2	12.5
	(2.1)	(1.6)	(1.9)	(1.9)	(1.0)	(2.2)	(1.2)	(1.1)	(1.6)	(0.7)	(2.4)	(1.6)	(0.48)	(0.25)	(0.36)	(0.24)

There were large differences in pasture crude protein percentages (CP%) recorded between the farms and between months within a farm (Table 4). Average CP% ranged from 22% in KOT in December to 31% in IKAM in May. Sixty-three percent of the pasture samples collected had a CP% greater than 25, and 92% of the samples greater than 20% CP. Maximum dietary protein requirement for lactating cows is approximately 20%, indicating that a large percentage of the samples collected were supplying excess dietary protein. On all farms the trend was for pasture CP% to increase through the autumn period, most likely in response to the application of N fertiliser. Neutral detergent fibre concentrations (NDF%) were more variable, however on all farms NDF% increased from August to January/February, followed by a decline in autumn. IKAM pastures consistently had the highest metabolisable energy (ME) content, only dropping below 12 MJ/kg DM in February. In contrast, the ME content in pasture samples collected from the remaining three farms declined during late spring and summer to a low between 11.2 and 11.4 MJ ME/kg DM in February (Table 4).

Conclusions

Pasture growth rate and quality varied between regions and between years within a region making it difficult to predict annual pasture production reliably. However, the regions selected do represent the major dairying areas on the West Coast. While average regional data would be acceptable for farmers looking to set feed budgets and assess the stocking rate and calving date for their farms, for farmers wanting to optimise the pasture management on the farm weekly, monitoring of pasture cover on their own property is essential.

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