WHITE CLOVER CONTENT IN NEW ZEALAND DAIRY PASTURES AFFECTS MILKSOLIDS PRODUCTION

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ABSTRACT
As a preliminary experiment to measuring milksolids (fat plus protein) production of dairy cattle grazing swards containing different levels of white clover (*Trifolium repens* L.) nine Jersey and nine Friesian cattle housed indoors during late lactation and fed diets containing either 20, 50 or 80% white clover with the balance perennial ryegrass (*Lolium perenne* L.). During the first 10 day measurement period cows were fed *ad libitum* and during the second 10 days feeding was restricted to 75% of metabolisable energy requirement. Milk yields of cows fed 50 and 80% clover were 18% and 10% greater than for cows fed 20% clover during periods 1 and 2 respectively, but there was no difference between yields under 50 or 80% clover. Increased yields were due to the increased nutritive value of the herbage and increased intakes as a result of higher clover content. Clover content had no effect on milk composition so increased milksolids yields were directly due to higher milk yields.

KEYWORDS
Clover content, herbage intake, milk yield, milksolids, milk composition, nutritive value

INTRODUCTION
Australian (Rogers et al., 1982; Rogers and Robinson, 1984) and British (Thomson et al., 1985) research has clearly shown the benefit of pure white clover over pure perennial ryegrass for milk production. The higher nutritive value of clover (Thomson, 1984), and the higher voluntary intakes of cattle eating clover (Rogers et al., 1982) contribute to the increased milk production. However, pure clover pastures are unrealistic for NZ dairy farms due to the lower annual dry matter production of pure clover swards, the higher bloat risk and difficulties in maintaining such swards. In addition there is an energy cost for the cow associated with metabolising high protein (high clover) feeds (Danfaer et al., 1980). Therefore, mixed ryegrass / white clover pasture may prove more advantageous than pure swards although the clover component needs to be higher than the average 15-20% currently found in NZ dairy pastures. British researchers suggest clover content must be at least 30% to have any significant effect on animal performance (Thomson, 1984). This paper reports on the first in a series of experiments investigating the effect of clover contents on milk production with the aim of determining an optimum clover content for dairy pastures.

MATERIALS AND METHODS
The experiment was conducted in April 1996 in the last month of lactation. Nine Jersey and nine Friesian dairy cows, housed indoors, were fed *ad libitum* diets containing either 20, 50 or 80% (of total dry matter (DM)) white clover (three Jersey and three Friesian cows per diet) with the balance being perennial ryegrass over a 10 day period. During a second 10 day measurement period one cow of each breed remained on the same clover diet while the other two went to one of each of the other diets. During period 2 all cows were fed a restricted dry matter allowance calculated as 75% of their metabolisable energy (ME) requirement based on the calculation of Holmes and Wilson (1987). Before the experiment all cows were offered the same ryegrass / white clover diet for 3 weeks and milk samples collected during this time used for covariate analysis of data.

Clover and ryegrass were cut twice daily from pure swards and diets mixed by hand. The chemical composition of the herbage was analysed using near-infrared spectroscopy (NIRS). Daily herbage intakes of individual cows were calculated by subtracting the dry weight of the refused herbage from the allowance. On *ad libitum* diets cows left approximately 1 kg DM at each feeding but there were usually no refusals on the restricted diet. Cows received bloat drench (50 mls 1:6 Bloatenz 2 in1 (Ecolab Ltd, NZ)). Milk yields were measured over the final 5 days of each measurement period and milk samples collected for composition analysis (fat, protein and lactose) so allowing calculation of milksolids (fat plus protein) yield.

RESULTS AND DISCUSSION
Increased clover content in the diet resulted in higher crude protein, *in vitro* digestibility, carbohydrate and ME levels and lower fibre levels (Table 1). These factors are considered to increase the nutritive value of the diet and so increase milk production (Thomson 1984). Despite this, the ryegrass component of the diet was also of comparatively high nutritive value.

During period 1, when all cows were fed *ad libitum*, daily herbage intakes for cows fed 50 and 80% clover were 11% higher than for cows fed 20% clover (Table 2). However, there was no significant difference in intakes between 50 or 80% clover treatments. As expected intakes during period 2 were not significantly different but were lower than during period 1 due to the restricted diets.

Despite milk yields being relatively low since cows were near the end of lactation and the ryegrass being of comparatively high nutrient value, milk yields for cows fed 50% clover were 18% greater than yields for cows fed 20% clover during period 1 and 10% greater during period 2 (Table 2). During both periods, however, there was no significant difference in yields for cows fed 50 and 80% clover. The increase in milk yield during period 1 in response to clover content was likely due to a combination of higher intakes and increased nutritive value of the diet. The increased yields during period 2 however could only be due to the nutritive value of the clover since intakes were similar and hence differences in milk yield were smaller. Regression analysis showed that, under both *ad libitum* and restricted feeding, milk production per MJ ME intake was higher for cows fed 50 and 80% clover than for cows fed 20% clover. This suggests a trend of increased efficiency of conversion of herbage to milk the higher the clover content although differences between clover treatments were not significant.

Similar results were reported by Rogers et al., (1982) comparing diets of pure ryegrass and pure clover at *ad libitum* and 60% *ad libitum* allowances. They found milk yields of cows eating clover were 25% higher under *ad libitum* allowance and 13% higher under 60% *ad libitum*. They also found higher conversion efficiencies when feeding clover than when feeding ryegrass to lactating cows.

Milk composition (fat, protein and lactose %) was not affected by clover content during both period 1 (Table 2) and 2. The increased fat, protein and lactose yields for cows fed 50 and 80% clover were therefore directly due to the increased milk yields. Milksolids production, therefore, was significantly greater when cows were fed 50 and 80% clover than when they were fed 20% clover during both measurement periods. Rogers et al. (1982) report a similar result for milk composition of cows fed pure clover or pure ryegrass.

The results of this experiment indicated a threshold type response of milk yield to clover content in the diet. In this experiment cows fed 80% clover had the same intakes and milk yields as cows fed 50% clover diets. The intake response may have been due to gut fill effects and the inability of cows to consume any more herbage at each feeding since cows on 50 and 80% clover were consuming 50-60 kg fresh weight of pasture at each feeding. The milk yield response was probably due to a combination of the similar intakes under 50 and 80% clover and the energy costs involved in metabolising high protein diets. Although further experiments, including grazing trials, are necessary these results suggest an optimum clover content for milk production of between 30 and 50%.

Table 1
Chemical composition (analysed using NIRS) of clover diets.

Clover content	20%	50%	80%
Dry matter (%)	15.57	14.18	13.09
Crude protein (g/100g DM)	21.50	22.62	23.82
Fibre: ADF[a] (g/100g DM)	27.73	26.39	25.46
NDF[b] (g/100g DM)	49.85	45.64	41.27
Available carbohydrate (g/100g DM)	8.15	8.65	9.29
In vitro digestibility (%)	68.95	70.21	70.93
Estimated ME (MJ/kg DM)	10.27	10.46	10.57

[a] Acid detergent fibre

[b] Neutral detergent fibre

Table 2
Herbage intakes, milk yields and milk composition of cows fed different levels of clover under ad libitum or 75% ME requirement (restricted) allowances.

Clover content	20%	50%	80%	SEMa
Intake: ad lib. (kg DM/cow/d)	10.85^{x}	12.15^{y}	12.02^{y}	0.41
Intake : restricted (kg DM/cow/d)	8.98^{x}	9.24^{x}	9.29^{x}	0.42
Milk yield: ad lib. (ℓ/cow/d)	8.48^{x}	9.98^{y}	9.82^{y}	0.27
Milk yield: restricted (ℓ/cow/d)	5.96^{x}	6.55^{y}	6.27^{y}	0.26
Fat %: ad lib.	5.88^{x}	5.73^{x}	5.65^{x}	0.10
Protein %: ad lib.	3.84^{x}	3.76^{x}	3.83^{x}	0.09
Lactose %: ad lib.	4.71^{x}	4.72^{x}	4.69^{x}	0.07
Milksolids yield: ad lib. (kg/cow/d)	0.80^{x}	0.93^{y}	0.93^{y}	0.02

[a] Standard error of the mean (6 observations per mean)

[x, y] Values on the same line with different superscripts are significantly different, P<0.05

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