Milksolids production and farm profitability from different combinations of perennial ryegrass and white clover cultivars: Progress report 2001-2003

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Abstract

2001/2002 and 2002/2003 were the final two seasons of a replicated dairy farm systems trial designed to evaluate the effects of progress in perennial ryegrass and white clover breeding programmes on whole farm productivity and profitability (Economic Farm Surplus, EFS). All the pastures were sown in late autumn 1998. There were four treatments with all combinations of 1980's (80R), and late 1990's (98R) ryegrasses, and 1960's (60C) and late 1990's (98C) white clovers, each replicated two times in a randomised block design giving eight 4 ha, self-contained farmlets stocked with three Friesian cows/ha and rotationally grazed. In agreement with the first two years of the trial, the last two seasons have demonstrated no major benefit in terms of either milksolids (MS) production or EFS to sowing different combinations of perennial ryegrass and only a small advantage in one season (2001/2002) to sowing new (98C) white clover cultivars. There were no effects of ryegrass or clover cultivar type on total dry matter (DM) production during the last two seasons but, as observed during the first two seasons of the trial, there were differences in the distribution of pasture growth through the year with old ryegrass (80R) treatments having more pasture growth during spring. During 2001/2002 and 2002/2003 the clover content of the swards was determined more strongly by clover type than by the type of companion ryegrass, in contrast to events during the first two seasons of the trial. Thus clover type, rather than a ryegrass x clover interaction, had a small effect on MS production and EFS during 2001/2002, but not 2002/2003, due to significantly higher clover content in both the new clover (98C) treatments than the old clover (60C) treatments. Any differences between ryegrass or white clover cultivars in terms of lower DM production at certain times of the year, and consequent small differences in total DM production and pasture quality caused only minor differences in EFS between treatments because effective farm management decisions compensated for these effects.

Keywords: cultivars, dairying, economic farm surplus, milksolids, perennial ryegrass, white clover

Introduction

A whole-farm systems trial designed to evaluate the effects of genetic progress in perennial ryegrass and white clover breeding programmes on milksolids (MS) production and whole (dairy) farm profitability (Economic Farm Surplus, EFS) was established on Dexcel's Scott farm near Hamilton in April 1998. Prior to the establishment of this trial there had been no measurement of whether use of new (recently released) cultivars increased MS production or EFS. Farmlets (Table 1) based on combinations of different perennial ryegrass and white clover cultivars that were released on to the market either recently (designated 98R, 98C) or at least 15 years ago (designated 80R, 60C) have allowed progress in the perennial ryegrass and white clover plant breeding programmes to be evaluated in rotationally grazed dairy production systems, where the effects of any differences in agronomic characteristics, and resultant impacts on animal production could be monitored. Laidlaw & Reed (1993) warn, however, that a major difficulty of systems trials is that inadequate control and management can result in the interaction between

Table 1 Details of the perennial ryegrass and white clover cultivars used in the four farmlet treatments.

Treatment name	Description
80R/60C	1980's ryegrass plus 1960's white clover
98R/60C	1998 ryegrass plus 1960's white clover
80R/98C	1980's ryegrass plus 1998 white clover
98R/98C	1998 ryegrass plus 1998 white clover
	Cultivars used
1980's ryegrass	Yatsyn 1, Grasslands Nui, Ellett
1998 ryegrass	Bronsyn, Aries HD, Grasslands Samson
1960's clover	Grasslands Pitau, Grasslands Huia
1998 clover	Grasslands Sustain, Grasslands Challenge

management and herbage production either masking or enhancing any actual differences that may exist between cultivars.

Pasture characteristics, MS production, and farm profitability for the 1999/2000 and 2000/2001 years of this trial were reported to the 2001 Grassland Association Conference in Hamilton (Eerens *et al.* 2001; Woodward *et al.* 2001). At that stage of the trial there were differences in botanical composition and spring grass growth rates between the cultivar mixtures. For example, pastures on the old ryegrass (80R) treatments had higher white clover contents (averaging 20% clover) than the new ryegrass (98R) treatments (averaging 15% clover) during these first two years. Tests for ryegrass endophyte carried out immediately after sowing suggested the differences in botanical composition may have been the result of differences in endophyte infection level of the seed mixes. Although seedling densities (ryegrass and clover) were similar across all treatments at the start of the trial, the lower endophyte infection level (69%) of the old ryegrass (80R) cultivar mix than in the new (98R) mix (92%) allowed predation of endophyte-free plants and tillers by Argentine stem weevil. The resultant lower tiller density in the old ryegrass (80R) treatments from late summer of the first year onward opened up the swards at an opportune time for clover expansion, which the new clover cultivars (98C), in particular, exploited. Total pasture dry matter (DM) yields over the 1999/2000 and 2000/2001 seasons were similar in the 98R/60C, 98R/98C, and 80R/98C treatments (15.2 t DM/ha), and 14.3t DM/ha in the 80R/60C treatment. However, the old ryegrass (80R) treatments had a greater spring pasture surplus requiring more pasture conservation than the new (98R) treatments, which tended to have a more even pasture growth distribution over the year.

Milksolids production was unaffected by either ryegrass or clover cultivar type, but there was a significant ryegrass x clover cultivar interaction reflected in higher MS production on the 80R/98C treatment than on the 98R/98C treatment in 1999/2000. This was a result of the higher clover content in the 80R/98C pastures. Although the difference in clover content was still present in 2000/2001, a wetter summer/autumn resulted in better quality ryegrass and the additional clover had no effect on MS production. There were also no main treatment effects on Economic Farm Surplus (EFS) in either season, but there was a significant ($P<0.05$) ryegrass x clover interaction in 1999/2000 shown as a higher EFS on the 80R/98C treatment than on the 98R/98C treatment.

This paper presents agronomic characteristics and pasture performance results for the various cultivar combinations and reports the impacts on MS production and EFS across the farmlets during the last two years of the trial (2001/2002 and 2002/2003 seasons).

Methods

Details of trial establishment, management protocols and measurements are given in Eerens *et al.* (2001) and Woodward *et al.* (2001).

Trial design

The trial was established in April 1998 at Dexcel's Scott Farm near Hamilton, on a mixture of silt loam and peaty silt loam soils (Stiles & Singleton 1997). The four treatments (Table 1) were comprised of two perennial ryegrass mixtures and two white clover mixtures in a 2 x 2 factorial design, with each treatment now (since June 2001) replicated twice in two randomised blocks giving a total of eight self-contained 4 ha farmlets.

Cows

All farmlets were stocked with three multiparous Holstein-Friesian cows per hectare and were rotationally grazed. Cows were allocated to farmlets at the start of the 1999/2000 season, so that herds were balanced for age, expected calving date, breeding worth, condition score, liveweight and, where available, previous MS production. In each subsequent season all farmlets had a 25% replacement rate.

Management

Management decisions, typical of management on commercial, pasture-based dairy farms, were made using written decision rules (Macdonald & Penno 1998) designed to avoid compromising either the objectivity of each farmlet's management or expression of any treatment differences. These rules determined management of grazing rotation length, pasture silage conservation and feeding, target cow condition score and liveweight, drying-off of cows, and use of bought-in maize silage supplement on an individual farmlet basis. The decision rules ensured that bought-in maize silage was only fed as a supplement on farmlets to maintain the condition score of dry cows at the minimum target level once pasture silage had been used up. Thus use of maize silage supplement did not have any direct effect on MS production but rather ensured that trial management met animal ethics requirements. Application rates for maintenance fertiliser (potassic superphosphate and lime) and nitrogen fertiliser (maximum of 100 kg N/ha/y) were the same across all farmlets.

Table 2 Botanical composition during 2001/2002 and 2002/2003 for the four treatments.

	Treatment	Botanical composition (% total DM)					
		Vegetative ryegrass	Reproductive ryegrass	Other grass	Clover	Weed	Dead
2001/2002	80R60C	57.2	1.8	3.3	21.2	9.8	6.6
	98R60C	68.7	1.5	1.5	15.3	6.9	6.1
	80R98C	54.8	1.3	2.9	29.0	5.6	6.3
	98R98C	56.6	1.8	1.7	27.4	6.8	5.8
	$LSD_{0.05}$	3.3	n.s.	0.6	4.3	1.5	n.s
	Treatment	Vegetative ryegrass	Reproductive ryegrass	Other grass	Clover	Weed	Dead
2002/2003	80R60C	64.2	3.7	5.5	14.1	6.4	6.0
	98R60C	68.4	4.7	3.0	11.9	5.9	6.1
	80R98C	59.6	4.1	3.6	20.3	5.8	6.5
	98R98C	65.6	3.3	3.0	17.0	5.7	5.3
	$LSD_{0.05}$	n.s.	n.s.	n.s.	4.5	n.s.	n.s

Measurements

Pasture growth rate (kg DM/ha/day) and herbage accumulation (kg DM/ha) were derived monthly from weekly visual assessment of herbage mass in every paddock on each farmlet, calibrated by cutting and weighing pasture samples (Eerens *et al.* 2001). Pre-grazing botanical composition was also determined weekly, and ryegrass tiller density determined monthly on each farmlet as described by Eerens *et al.* (2001).

Individual cow milk yields and milk composition were measured on one day per week throughout lactation and these measures were used to calculate MS yield (milkfat plus milk protein yield; kg MS/cow). Cow liveweight and body condition score were measured fortnightly.

Economic farm surplus (EFS) was calculated on each farmlet for both seasons as described by Woodward *et al.* (2001). Costs of inputs and expenses were based on data from a current economic survey of New Zealand dairy farms (Dexcel Limited 2003) and EFS figures calculated according to Dexcel guidelines (see Dexcel Farm Facts 7-3 2000/2001). Two separate EFS figures were calculated for each farmlet using different MS payout figures ($3.60/kg MS and $5.30/kg MS) that represented the extremes of Fonterra's MS payout during the 2001/2002 and 2002/2003 seasons.

All pasture, cow and EFS data were averaged on a farmlet basis and were analysed as a factorial, randomised block design using Genstat 5.

Results and discussion

Dry matter production, pasture cover and botanical composition

Ryegrass and clover cultivar type had no significant effects on total DM yields which averaged 18.0 t DM/ha in 2001/2002 (Table 3) and 16.8 t DM/ha in 2002/2003 (Table 4). Pre-grazing pasture mass averaged 2500 kg DM/ha across all treatments and both years. As in 1999/2000 and 2000/2001 (Eerens *et al.* 2001; Woodward *et al.* 2001), the old ryegrass (80R) treatments had higher average pasture mass on farmlets during spring than the new ryegrass (98R) treatments. In 2001/2002 a favourable spring climate meant high pasture growth rates on all farmlets. Ryegrass type had a significant ($P<0.10$) effect on the amount of silage cut with treatments ranging from 280 kg DM/cow on the 98R/98C treatment to 472 kg DM/cow on the 80R/98C treatment (Table 3). In 2002/2003 cool spring temperatures meant poor pasture growth on all farmlets and so silage conservation across all farmlets was considerably less than in the previous season. Amounts of silage made ranged from 38 kg DM/cow on the 80R/60C treatment to 191 kg DM/cow on the 80R/98C treatment with one of the farmlets on the 80R/60C, 98R/60C and 98R/98C treatments having no silage cut. Neither ryegrass nor clover cultivar type had any significant effect (Table 4).

Ryegrass tiller densities in the new ryegrass (98R) treatments were 4350 tillers/m^2 averaged over both seasons. This density is very close the values recorded at the end of the 2000/2001 season (Eerens *et al.* 2001) which indicates that ryegrass densities were stable in these treatments. There was, however, a small increase in ryegrass tiller densities in the old ryegrass (80R) treatments compared with 2000/2001 (3490 vs. 2900 tillers/m^2). This increase suggests that these old ryegrass (80R) swards were still recovering from the loss of endophyte-free plants by Argentine stem weevil predation early in the trial. Endophyte

Table 3 2001/2002 season total DM production, pasture silage conserved, total silage fed (pasture silage plus bought-in maize silage), milk production, milk composition, cow liveweight and condition score (CS) at drying off, and Economic Farm Surplus (EFS; calculated assuming payouts of $3.60/kg MS and $5.30/kg MS) of the perennial ryegrass/white clover treatments. Figures are the means of the two replicate farmlets.

Ryegrass/white clover	80R/60C	98R/60C	80R/98C	98R/98C	SED	P_{rye}	P_{clover}
DM production (t DM/ha/y)	18.7	16.6	18.3	18.6	1.1	n.s.	n.s.
Pasture silage made (kg DM/cow)	416	339	472	280	53	†	n.s.
Total silage fed (kg DM/cow)	574	345	374	341	48	*	n.s
Days in milk (DIM)	256	246	249	258	6	n.s.	n.s.
Milk (kg/cow)	4081	4121	4375	4666	189	n.s.	†
Fat concentration (%)	4.42	4.26	4.16	4.23	0.16	n.s.	n.s.
Protein concentration (%)	3.41	3.31	3.29	3.34	0.08	n.s.	n.s.
MS per cow (kg/cow)	319	312	325	352	13	n.s.	†
MS per ha (kg/ha)	958	934	976	1057	38	n.s.	†
MS per DIM (kg/cow)	1.25	1.27	1.31	1.36	0.03	n.s.	*
Liveweight at drying off (kg)	534	515	522	512	15	n.s.	n.s.
CS at drying off	4.40	4.45	4.25	4.20	0.20	n.s.	n.s.
EFS ($/ha) at $3.60/kg MS	1233	1262	1342	1727	119	n.s.	*
EFS ($/ha) at $5.30/kg MS	2861	2850	3000	3523	180	n.s.	*

Significance of ryegrass or clover main effects:
ns= no significant difference.
† = a significant (P<0.10) ryegrass or clover main effect.
* = a significant (P<0.05) ryegrass or clover main effect.

Table 4 2002/2003 season total DM production, pasture silage conserved, total silage fed (pasture silage plus bought-in maize silage), milk production, milk composition, cow liveweight and condition score (CS) at drying off, and Economic Farm Surplus (EFS; calculated assuming payouts of $3.60/kg MS and $5.30/kg MS) of the perennial ryegrass/white clover treatments. Figures are the means of the two replicate farmlets.

Ryegrass/white clover	80R/60C	98R/60C	80R/98C	98R/98C	SED	P_{rye}	P_{clover}
DM production (t DM/ha/y)	15.8	17.8	16.8	16.8	1.5	n.s.	n.s.
Pasture silage made (kg DM/cow)	38	70	191	128	39	n.s.	n.s.
Total silage fed (kg DM/cow)	177	190	182	192	12	n.s.	n.s.
Days in milk (DIM)	255	254	253	252	4	n.s.	n.s.
Milk (kg/cow)	4897	4893	4921	5145	111	n.s.	n.s.
Fat concentration (%)	4.55	4.37	4.37	4.35	0.16	n.s.	n.s.
Protein concentration (%)	3.60	3.47	3.51	3.49	0.05	n.s.	n.s.
MS per cow (kg/cow)	397	380	386	399	14	n.s.	n.s.
MS per ha (kg/ha)	1189	1140	1157	1196	41	n.s.	n.s.
MS per DIM (kg/cow)	1.56	1.50	1.53	1.58	0.05	n.s.	n.s.
Liveweight at drying off (kg)	536	526	512	530	18	n.s.	n.s.
CS at drying off	4.50	4.35	4.65	4.70	0.21	n.s.	n.s.
EFS ($/ha) at $3.60/kg MS	2219	2005	2039	2175	144	n.s.	n.s.
EFS ($/ha) at $5.30/kg MS	4241	3942	4005	4208	214	n.s.	n.s.

Significance of ryegrass or clover main effects:
ns= no significant difference.
† = a significant (P<0.10) ryegrass or clover main effect.
* = a significant (P<0.05) ryegrass or clover main effect.

infection rates were very similar to those previously recorded – 98 % infection in the new ryegrass cultivars (98R) and 91% in the old ryegrass cultivars (80R).

There were significant cultivar treatment effects on the clover content of the pastures but no other effects on botanical composition of the swards (Table 2). In both years the clover content was significantly higher (Table 2) in pastures sown with the new clover cultivars (98C). During 1999/2001, reductions in ryegrass tiller densities in the old ryegrass (80R) treatments caused by Argentine stem weevil resulted in higher clover content in mixtures sown with these ryegrasses and both the old (60C), and new clover cultivars (98C) (Eerens *et al.* 2001). Over the last two seasons, clover content of the swards was determined more closely by clover type, than by the type of companion ryegrass. Both Sustain and Challenge white clovers (98C) were bred for improved stolon production (Caradus & Woodfield 1997; Cooper *et al*. 1997) compared with older white clover cultivars. This characteristic seems to have conferred an agronomic advantage on these cultivars in rotationally grazed dairy pastures.

Milksolids production

MS production for the 2001/2002 season ranged from 911 kg MS/ha/yr on one of the 98R/80C farmlets to 1095 kg MS/ha/yr on one of the 98R/98C farmlets (Table 3). Production in the 2002/2003 season was higher and ranged from 1112 kg MS/ha/yr on one of the 98R/80C farmlets, to 1250 kg MS/ha/yr on one of the 80R/80C farmlets (Table 4). The higher MS production on all farmlets in the second season was due largely to the higher DM production over the second half of lactation than in 2001/2002 as a result of more rain during summer-autumn of 2003. However, the difference in summer-autumn pasture mass between the two seasons resulted in a lower than expected difference on overall MS production due to the greater availability of pasture silage and therefore greater amounts of pasture silage fed to cows in 2001/2002 (Tables 3 and 4). Production levels on all farmlets from both seasons were above the Waikato region's average for commercial dairy farms of 853 kg MS/ha/y (2001/2002) and the national average of 824 kg MS/ha/y (Livestock Improvement 2003).

There was no significant effect of ryegrass type on total MS production per cow or per ha in either season. There was, however, a significant clover effect ($P<0.10$) on total MS production per cow and per hectare in the 2001/2002 season (Table 3) as evidenced by the significantly higher production on the new clover (98C) treatments. Clover type also had a significant effect ($P<0.10$) on MS production per days in milk (DIM) in 2001/2002 (Table 3). This trend became apparent after October (Figure 1A) and was most likely related to the higher clover content in the new clover (98C) treatments than the old clover treatment (60C) and the consequent higher nutritive value of the pasture (Harris *et al*. 1997). White clover has most effect on milk production during summer-autumn, when the difference in nutritive value between clover and ryegrass is maximum (Rogers & Robinson 1984). In 2002/2003 ryegrass and clover type had no significant effect on MS production (Table 4). Although the clover content of the new clover (98C) treatments was still higher than the old clover (60C) treatments in 2002/2003 the difference was not as great as in the previous season (Table 2) which probably accounts for clover type having no significant effect on milk production.

The decline in MS production over summer-autumn is a common feature of pastoral-based dairy farms in New Zealand and is usually due to reduced pasture growth rate and lower pasture quality as ryegrass becomes reproductive and the proportion of dead material in the sward increases (Thom 1991). This post-peak decline in MS production on all farmlets was more marked in 2001/2002 (Figure 1A) than 2002/2003 (Figure 1B) due to the lower summer-autumn rainfall.

Milk composition

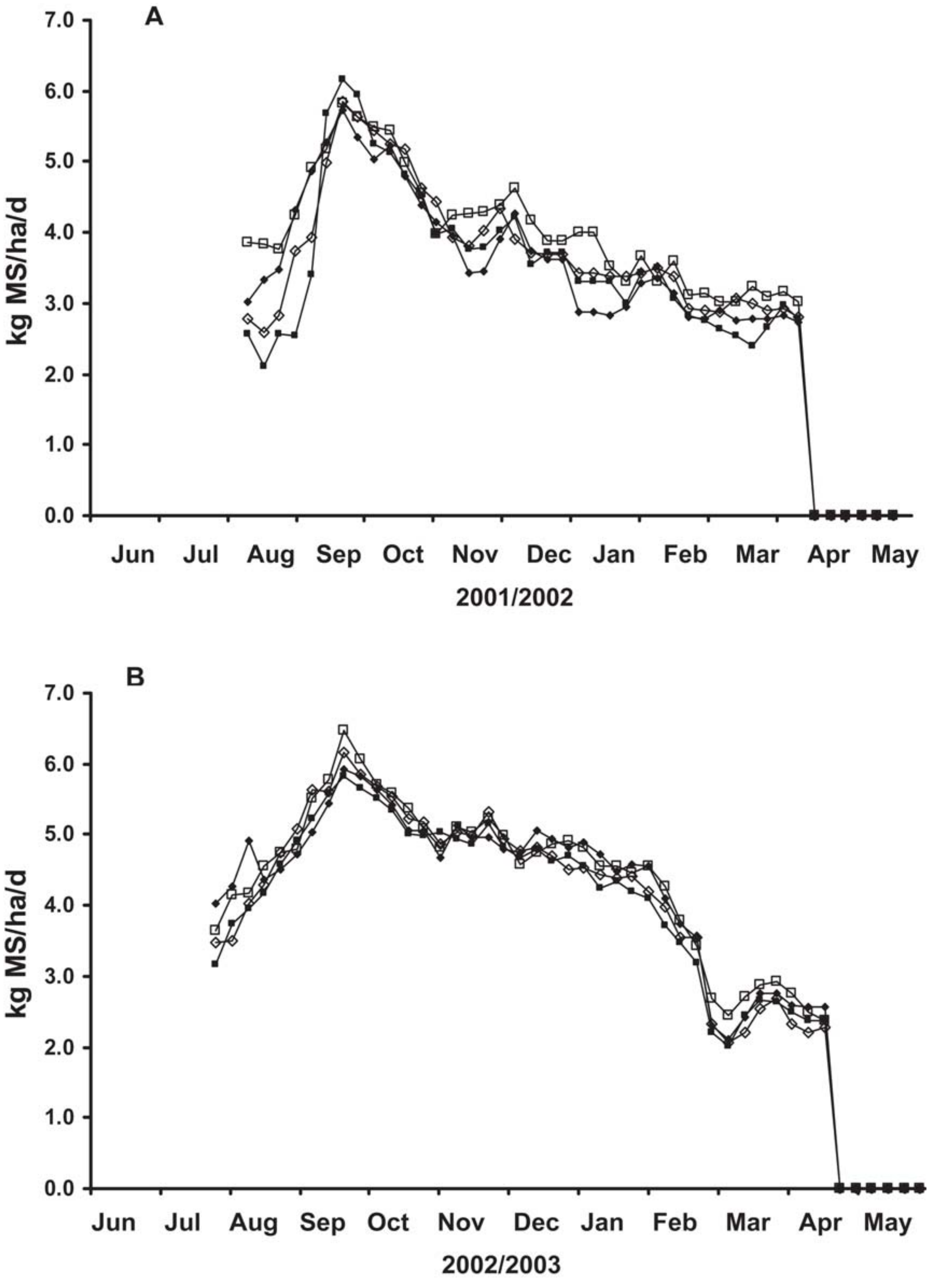
The trend in MS production was due solely to increased milk yield – there were no treatment effects on the concentrations of either milkfat or milk protein in either season (Tables 3 and 4). Harris *et al.* (1997) also reported that the proportion of perennial ryegrass or white clover in the diet had no effect on milk composition.

Lactation length, drying off, condition scores and liveweight of cows

Ryegrass and clover type had no significant effect on lactation length in either season, and days in milk were similar across all treatments (Tables 3 and 4). Also, despite different reasons for drying cows off in 2001/2002 and 2002/2003, lactation length was similar in both seasons (Tables 3 and 4). In 2001/2002 the decision to dry cows off in mid April was determined primarily by a decline in pasture mass on farmlets in late summer-early autumn due to low rainfall. Pasture silage was fed to cows on the 80R60C farmlets from mid January until drying off, and to cows on the other farmlets from early March until drying off to supplement available pasture and help maintain milk production. Following drying off the supplementation of pasture silage and maize silage (once all available pasture silage had been used) continued on all farmlets until the end of the season to help increase pasture mass. In 2002/2003, however, a decrease in cow condition score was the main factor leading to the decision to dry cows off in mid April. Although autumn rainfall in 2002/2003 was higher than in 2001/2002, a drier summer in 2002/2003 and little available pasture silage to use as supplement meant cows had lost considerable condition over summer. Despite an increase in pasture availability during autumn, cows did not regain condition and therefore had to be dried off.

After mid-March individual cows were dried off on the basis of low body condition score or low milk yield in accordance with the decision rules. Because drying-off decisions were made in order to maintain

Figure 1 Milksolids production per hectare during **(A)** 2001/2002 and **(B)** 2002/2003 for the 80R/60C (◆), 98R/60C (■), 80R/98C (◇) and 98R/98C (□) treatments averaged over three replicate farmlets.



condition score above predetermined targets in accordance with the decision rules, there were no significant differences between treatments in either cow condition score or liveweight at drying off. In both seasons silage (pasture silage and bought-in maize silage) was supplemented to all herds following drying-off (mid-April) to assist with reaching pre-calving (mid-July) cow condition score targets and the building up of farm pasture DM over winter.

Economic farm surplus

Income arising from MS production (at \$3.60/kg MS and \$5.30/kg MS) was the only source of income to differ between farmlets in both seasons except for the 80R/98C farmlets which in both seasons also had income from unused pasture silage. Costs associated with the making and feeding of pasture silage, and the buying of additional supplement (maize silage) were the only expenses to differ across farmlets in both seasons. Although these sources of income and expenses differed between farmlets, ryegrass type had no significant effect on EFS in either season. Clover type had a significant effect ($P<0.05$) on EFS in 2001/2002 as evidenced by the significantly higher EFS on the new clover (98C) treatments (Table 3), but not in 2002/2003 (Table 4). EFS was higher on all farmlets in 2002/2003 than in 2001/2002 (Tables 3 and 4). This difference was due to increased income from a higher overall MS production and lower expenses due mainly to the lower amounts of pasture silage made during 2002/2003.

Summary

The last two seasons of this dairy farm systems trial suggest that the effects of genetic progress in perennial ryegrass and white clover breeding programmes have resulted in little increase in whole farm productivity and profitability. Perennial ryegrass cultivar type had no significant effect on total DM yield, MS production and EFS despite differences between the old (released on to the market at least 15 years ago) and new (recently released on to the market) ryegrass cultivars in monthly pasture growth rates. The lack of an effect of ryegrass type on farm production and profitability is the same as that reported for the first two seasons (1999/2000 and 2000/2001) of this trial (Woodward *et al.* 2001).

The presence of new white clover cultivars in the pasture mix had no significant effect on total DM yield in 2001/2002 and 2002/2003, but did result in higher MS production and farm profitability (EFS) during 2001/2002. This clover type effect on MS production and EFS was due to a higher clover content in pasture on both the new (98C) clover treatments. However, as in the first two seasons of the trial (Woodward *et al.* 2001), clover type had no effect on MS production and EFS during 2002/2003.

During the 1999/2000 season there was a significant ryegrass x clover interaction effect on MS production and EFS but this effect was not present in 2000/2001 (Woodward *et al.* 2001) or during the last two seasons (2001/2002 and 2002/2003). In 1999/2000 the higher MS production and EFS on the 80R/98C treatment than on other treatments was due to a higher clover content than on other treatments (Eerens *et al.* 2001) and consequent higher pasture nutritional quality (Woodward *et al.* 2001). Over the last two seasons, clover content in pastures was determined more closely by clover type than by the type of companion ryegrass. Thus clover content was higher in both new clover (98C) treatments treatments during 2001/2002 and 2002/2003 rather than just in the 80R/98C treatment (Woodward *et al.* 2001).

Many previous small plot type evaluations have demonstrated a genetic improvement in perennial ryegrass and white clover cultivars over time in terms of increased DM yield (Easton *et al.* 2001; Woodfield *et al.* 2001) which could be expected to result in increased MS production and profitability at a whole farm level. However, this farm systems trial has demonstrated no such improvements as a result of perennial ryegrass breeding programmes, and only inconsistent improvements as a result of white clover breeding programmes. The different results gained from small plot evaluations and this farm systems trial could be due to the greater number of component factors operating in the farm systems and the more complex nature of interactions between these factors. This would tend to dilute any differences between treatments in performance indicators such as DM yield and MS production. For example, effective farm management, such as the conservation of excess pasture as silage and the use of this silage as a supplement when pasture covers are low, can compensate for any differences in pasture production at certain times of the year and thus reduce any potential differences in MS production. In contrast, any differences between cultivar types are more likely to be expressed in the small plot trials where the component factors that affect DM yield are more controlled, and because these small plot evaluations are usually made on monocultures rather than in mixed pastures. A small plot trial could therefore be viewed as a more ‘controlled scientific’ environment in which to evaluate genetic improvement in pasture species but may therefore be overestimating the impact of ryegrass and white clover breeding programmes on farm production and profitability. A similar view was expressed by Brock & Hay (2001). However, a farm systems trial is a more complete and realistic evaluation of perennial ryegrass and white clover cultivar performance, particularly from the farmers' perspective. Development of more appropriate farm management systems (eg. the use of white clover sown separately from perennial ryegrass and under cutting rather than grazing management) may, in the future, allow potential benefits of new cultivar types that are exhibited in small plot trials to be fully captured at the whole farm level.

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