Land Research Services Client Report

Client: United Fisheries Ltd

The Effect of Bio Marinus Liquid Fish Fertiliser on Pasture Growth in Canterbury: Preliminary Trials

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Summary of Trial Results

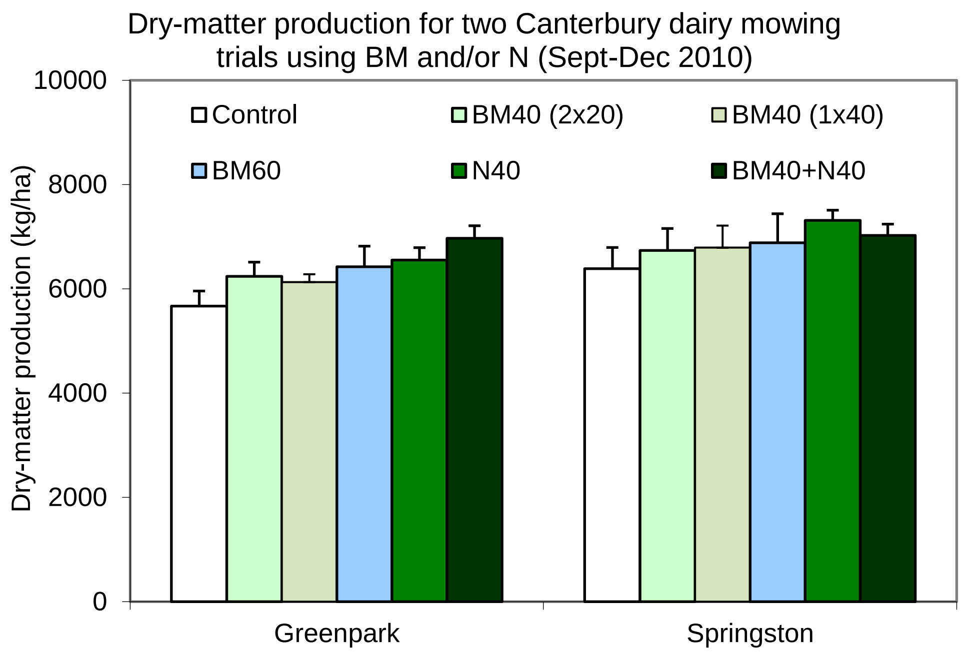
Trial sites were set out on two Canterbury dairy farms on a heavy silt (slow-draining) and a sandy loam (free-draining), respectively, to measure the performance of Bio Marinus (BM), a new liquid fish product (BM) developed by United Fisheries. Pasture growth was measured on each trial plot during August-December 2010. Nine treatments including a control were applied as follows:

1. Control (no BM or N applied)
2. 2x applications of BM at 20 L/ha (BM40); applied Aug/Oct
3. 1x application of BM at 40 L/ha (BM1x40); applied
4. 4x applications of BM at 15 L/ha (BM60); applied monthly
5. 2x applications of N (as urea) at 20 kg N/ha (N40); applied Aug/Oct
6. 2x applications of both BM at 20 L/ha and N at 20 kg N/ha (BM40+N40); applied bimonthly
7. Dairy farm effluent (DFE) 2x 20 L/m2; applied Aug/Oct
8. DFE 2x 20 L/m2 + BM 2x 20 L/ha; applied Aug/Oct
9. 2x applications of BM bone-in at 20 L/ha (BMB40); applied Aug/Oct

Each treatment had five replicates and four cuts were taken for dry matter yield and nutrient content (N, P and K) analysis approximately one month after each application.

Results (see figure) showed that there were increases in DM production from 6-15% due to BM application, similar to using urea at 2x 20 kg N/ha. Overall, the DM increases due to BM were significant at the 5% level (i.e. there was less than a 1-in-20 chance these results were coincidental). Further trials are planned over 2011/12 to investigate these responses more thoroughly.

Nutritional assessment of the mixed herbage from the four cuts was remarkably similar but showed a tendency towards slight N deficiency across all treatments. There were no noticeable differences in N, P, K, S or brix content in mixed pasture between treatments but given the short-term nature of this first trial series this is not surprising.



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1 Introduction

United Fisheries Ltd has developed a new fish liquid fertiliser product (Bio Marinus) from the waste by-product of fish processing. Analysis of its composition (Table 3) shows that it comprises useful amounts of N, P K, S and trace minerals. The producers promote Bio Marinus as a biological aid to soil micro-organisms and soil health as well as a naturally-based fertiliser product.

Land Research Services (LRS) Ltd was contracted to make some preliminary tests of the performance of Bio Marinus (hereafter referred to as BM) in two, separately-located trials on Canterbury dairy pastures located on impeded and free-draining soils, respectively, from August-to-December 2010. Measurements were of dry-matter growth and composition.

2 Material and methods

2.1 Field site and soils

The two trial sites were located on dairy farms in the Springston and Greenpark areas on pastures consisting of a dominant perennial ryegrass/white clover.

The Springston site is the dryer of the two sites, being on an Eyre soil (Immature Pallic). These soils are generally shallow sandy-to-silt loams although this site is relatively stone-free and moderately deep (NZDSIR,1968).

The Greenpark site is on a Taitapu soil (Gley Recent). These are mostly silt loams but these soils are generally wet in winter and poorly-drained as a general rule. In summer, they require less irrigation, at least initially but will dry out in summer and require irrigation to maintain growth (Hewitt 1993).

Chemical properties for the two soils are shown in Table 1.

Table 1. Pre-trial soil test results for select soil chemical properties

Trial Site	pH	Ols-P *(mg/L)*	SO_4-S *(mg/kg)*	CEC *(me/100g)*	Ca *(QTU)*	Mg *(QTU)*	K *(QTU)*	Na *(QTU)*	BS Total *(%)*
Greenpark	5.9	45	25	21	14	64	3	24	86
Springston	5.9	20	6	14	8	32	5	11	63

The low potassium values for the two sites initially meant that we added split dressing of potash through the trials to maintain and improve K status. A dressing of superphosphate was also applied to the Springston trial (300 kg/ha).

Table 2. Site rainfall and temperature for the trial period with long-term averages (1975-2000) for Lincoln

	Aug-Dec 2010	*Aug-Dec 1975-2000*
Rainfall	270 mm	280 mm
Avg air temp	11.7° C	11.5° C
Avg max temp	17.3° C	17.6° C
Avg min temp	7.2° C	6.2° C
Avg 10 cm soil temp	13.2° C	10.3° C

Table 3. Approximate nutrient content of the Bio Marinus (BM) fish fertiliser.

Macronutrients (%)						
N	**P**	**K**	**S**	**Ca**	**Mg**	
2.4	1.8	0.35	0.24	0.3	0.04	
Micronutrients (mg/L)						
Fe	**Mn**	**B**	**Cu**	**Zn**	**Mo**	**Co**
350	144	8	36	15	19	1.4

2.2 Treatments

A series of treatments were applied to the tow trials comparing different rates of Bio Marinus (BM) with and without nitrogen fertiliser (1 rate at 2x 20 kg N/ha), in randomized block design with five replications. The treatments were as follows:

1. Control (no BM or N applied
2. 2x applications of BM at 20 L/ha (BM40); applied Aug/Oct
3. 1x application of BM at 40 L/ha (BM1x40); applied Sept.
4. 4x applications of BM at 15 L/ha (BM60); applied monthly
5. 2x applications of N (2x 20 kg N/ha; N40); applied Aug/Oct
6. 2x applications of BM at 20 L/ha and N at 20 kg N/ha (BM40+N40); applied Aug/Oct.
7. Dairy farm effluent (DFE) 2x 20 L/m^2; applied Aug/Oct
8. DFE 2x 20 L/m^2 + BM 2x 20 L/ha; applied Aug/Oct
9. 2x applications of BM bone-in at 20 L/ha (BMB40); applied Aug/Oct

2.3 Harvesting

Harvests were conducted approximately 1 month later after each application with four harvests in total. DM yields were measured from each plot whilst nutrient content was measured in the dry-matter from composite samples for each treatment. Brix or soluble solids content (sugar) was also measured from grass samples taken in the field.

3 Results and Discussion

3.1 Dry matter yields

Total dry-matter production for the 4-month period for the BM and/or N treatments and the DFE and/or BM treatments are shown in Figures 1 and 2, respectively. Overall there was a significant increase in DM production using BM as shown by the LSD bar in the graphs that was similar but slightly less overall than the N40 treatment (2x 20 kg N/ha). Individual harvests and totals for each treatment are shown in Table 4 together with percentage differences from the control for each treatment total. The highest response was recorded in the BM40+N treatment for the Greenpark trial (23%) but for the Springston, it was the N treatment alone (15%). This variation shows the difficulty of trials with small numbers of replicates. Overall, BM produced increases from 6-15% while N-alone was 13-15%. Applying BM monthly (BM60) maintained a more consistent response and BM60 treatments were slightly ahead of the BM40 and BM1x40 treatments overall but not significantly different (Figure 1). DM response to BM was generally greater for Greenpark rather than the Springston site but again this varied from harvest to harvest. Adding BM to dairy farm effluent (DFE) did not produce any added response over DFE alone, nor were, apparently, the BMB40 treatments (BM bone-in) different overall from the BM40 treatments (Figure 2).

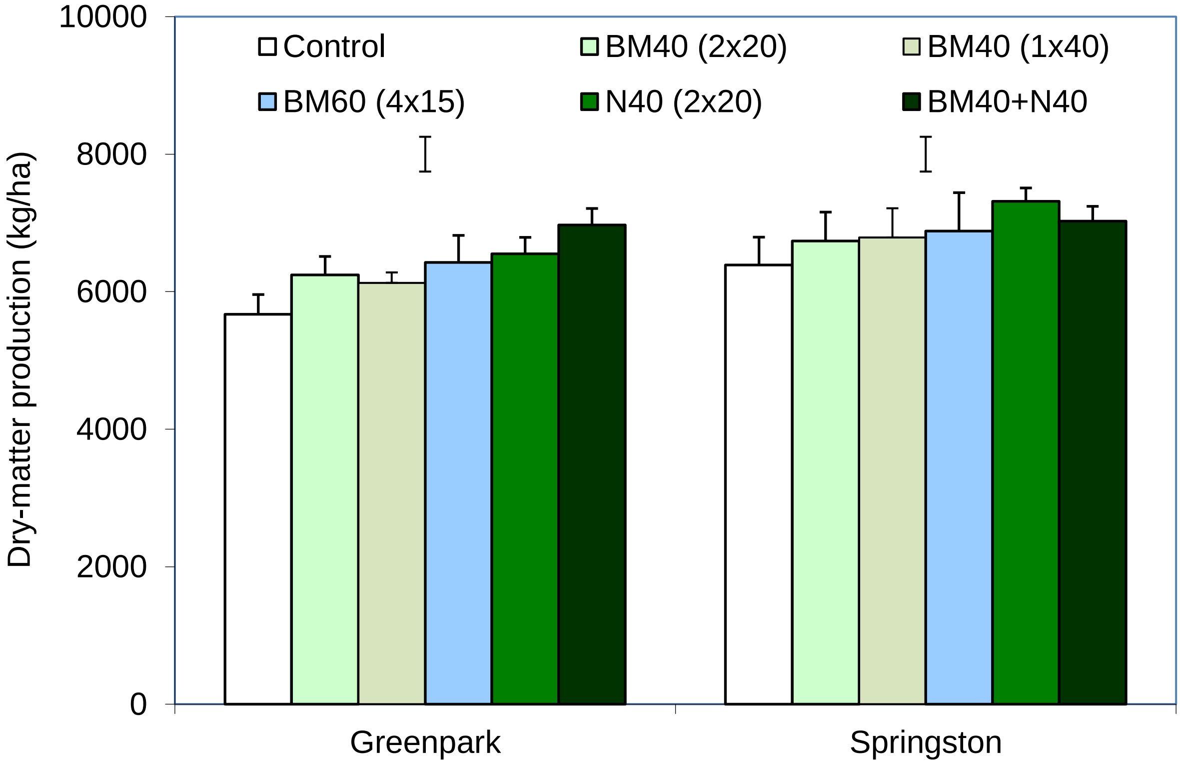

Figure 1. Total DM production for two Canterbury dairy mowing trials using BM and/or N (Sept-Dec 2010). LSD bars shown above each trial indicate where differences between columns are significant at 5% level.

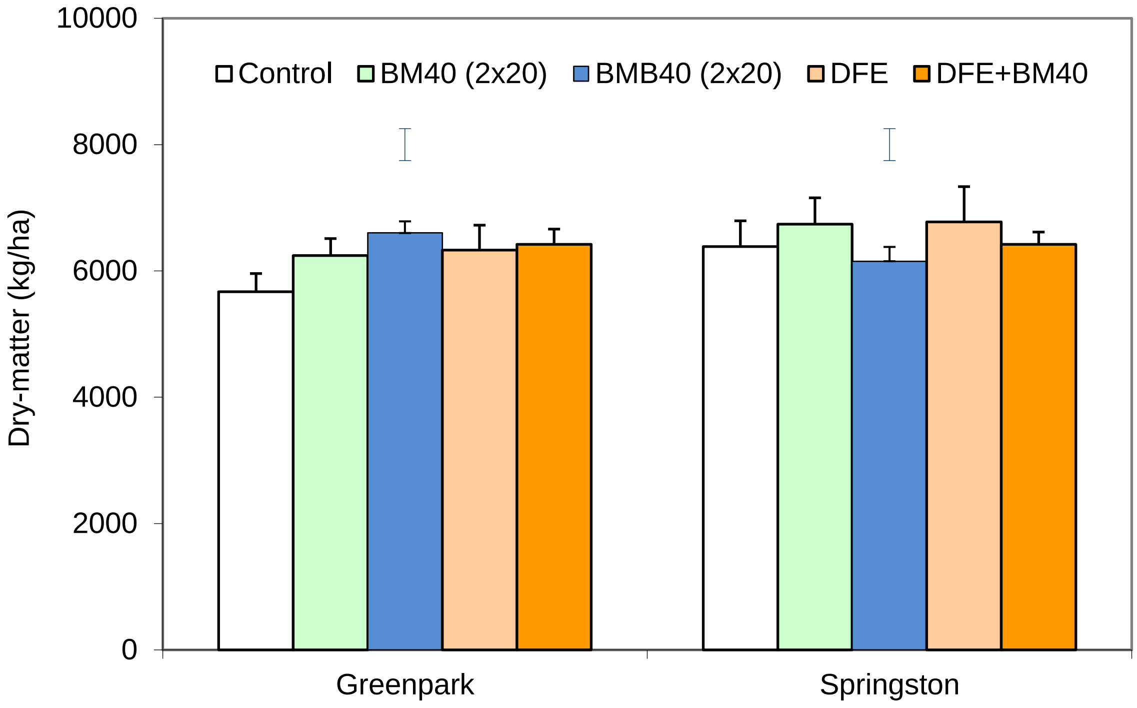

Figure 2. **Total DM production for Greenpark and Springston mowing trials comparing Bio Marinus treatments with and without dairy farm effluent (DFE). LSD bars shown above each trial indicate significant differences between bars at 5% level.**

Table 4. **Individual and total DM production values for Greenpark and Springston sites for all treatments and percentage difference from control.**

	Greenpark					
Treatments	**Harvest 1**	**Harvest 2**	**Harvest 3**	**Harvest 4**	**Total**	**% diff.**
Control	1530	1715	1490	936	5672	**-**
BM40	1602	1954	1672	1015	6242	**10%**
BM60	1750	2048	1372	1257	6427	**13%**
BM1x40	1607	2160	1281	1081	6130	**8%**
N40 (2x20)	1850	1849	1783	1068	6550	**15%**
BM40+N40	2302	1812	1854	1000	6969	**23%**
DFE	1611	1738	1817	1165	6332	**12%**
DFE+BM40	1802	1837	1658	1125	6423	**13%**
BM+Bone	1966	1832	1713	1090	6601	**16%**
	Springston					
Control	1457	1732	1087	2110	6386	**-**
BM40	1704	1738	1261	2035	6738	**6%**
BM60	1653	1903	1203	2125	6883	**8%**
BM1x40	1824	1915	907	2144	6790	**6%**
N40 (2x20)	1754	1840	1371	2347	7313	**15%**
BM40+N40	1814	1817	1506	1888	7026	**10%**
DFE	1470	1838	1277	2193	6777	**6%**
DFE+BM40	1393	1742	1142	2142	6420	**1%**
BM+Bone	1434	1766	1072	1882	6155	**-4%**

Although we found a statistical increase due to BM use, there is some uncertainty around this difference due to the ANOVA statistical technique used to cope with a trial design where the treatments were not orthogonally balanced. Because these trials were designed to test a range of possible application scenarios, and what typical responses might be obtained, increasing replication numbers was not a priority at this stage. However, evidence to date shows further trial work is justified and statistical balance and design will be addressed more fully in these trials.

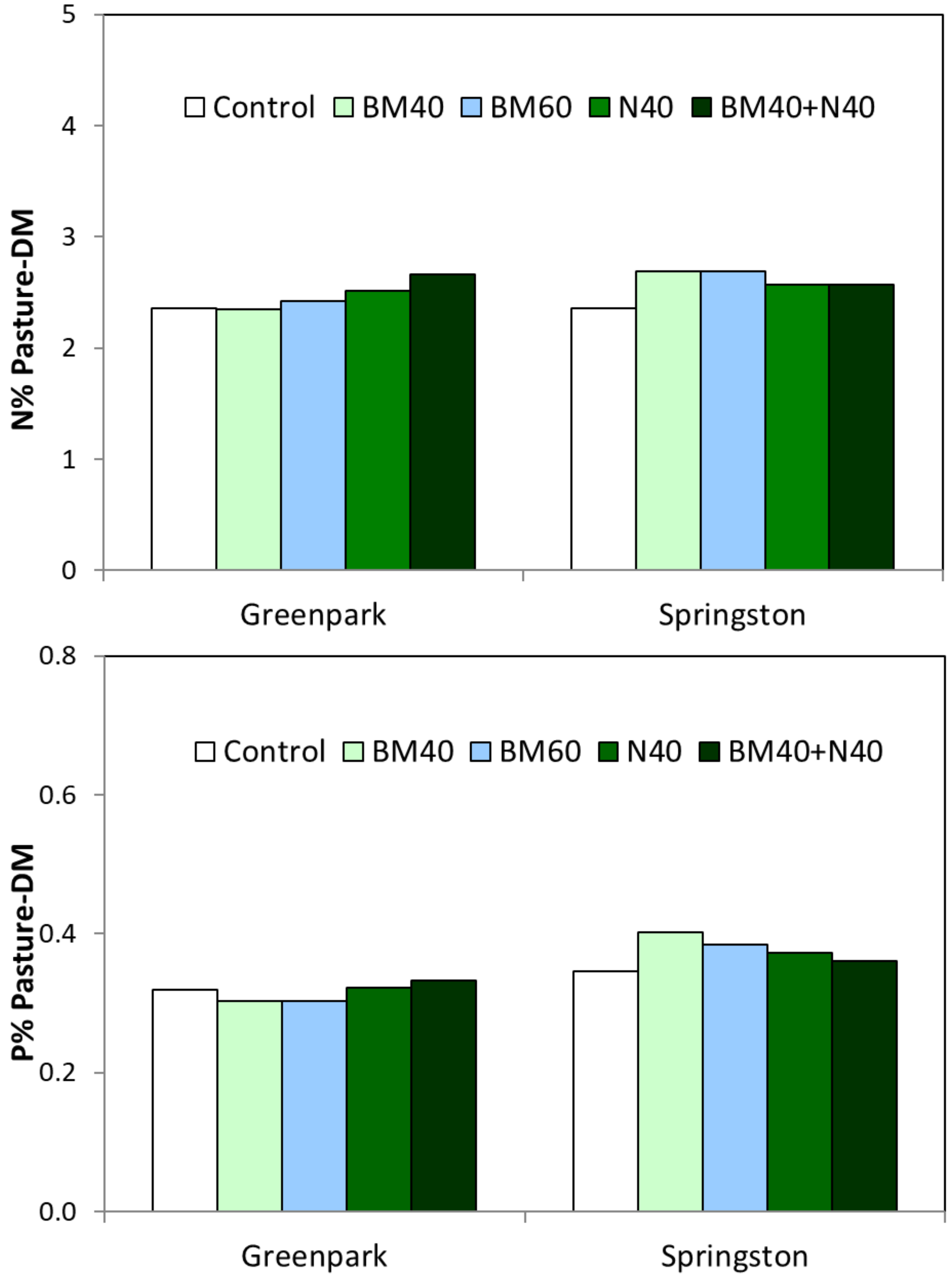

Figure 3. Nitrogen (N) and phosphorus (P) content (%) in harvested herbage for Control, Bio Marinus and N treatments.

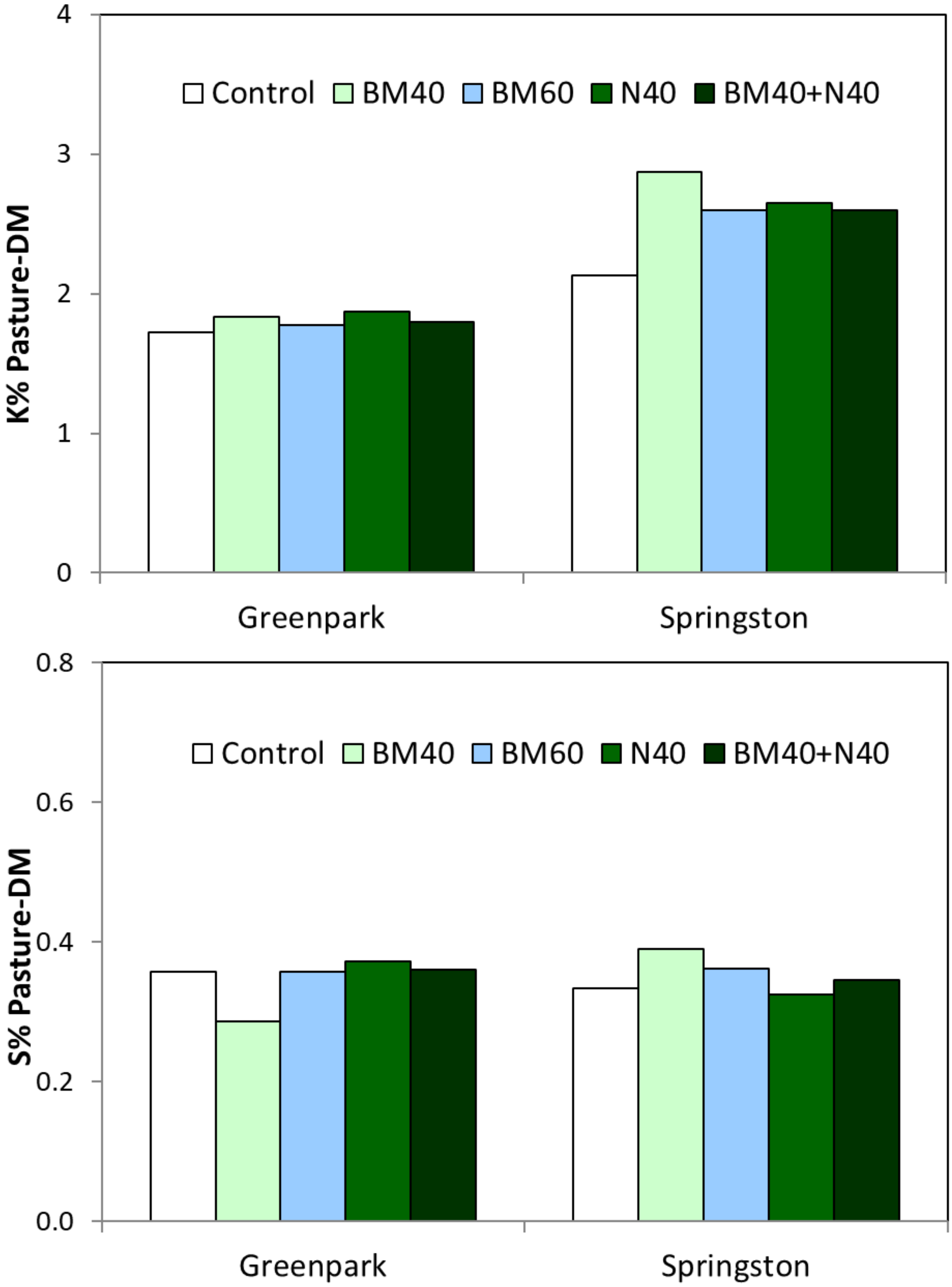

Figure 4. **Potassium (K) and sulphur (S) content (%) in harvested herbage for Control, BM and N treatments.**

3.2 Nutrient content of mixed pasture

Nutrient contents of the dry-matter from each harvesting were averaged over the four cuts and these are presented in Figures 3 and 4. There was surprisingly little difference overall between the applied treatments for the main nutrients, nitrogen (N), phosphorus (P), potassium (K) and sulphur (S), with most being slightly greater than the control. Nitrogen, the main nutrient of interest, ranged from 2.0-3.8, but there was no consistent difference for either greater or lesser N content in the BM treatments than the N treatments suggesting that N uptake was similar. However, N values overall were lower than might be expected so there may be a slight N deficiency over both sites that wasn't fully satisfied by our treatment program. P, K and S content varied between treatments but not in any consistent trend, with most within the range for nutrient contents for mixed herb (Crush and Evans 1989; Metson and W.M.H. 1978) with the possible exception of K for the Greenpark trial.

As BM is an organic fertiliser rather than a conventional chemical fertiliser, its effect might be more long term as the nutrients contained in organic forms are broken down by soil micro-organisms. However, the amounts applied are not large and the major nutrients contained (N, P, K and S) are probably broken down fairly quickly and readily utilized by the pasture.

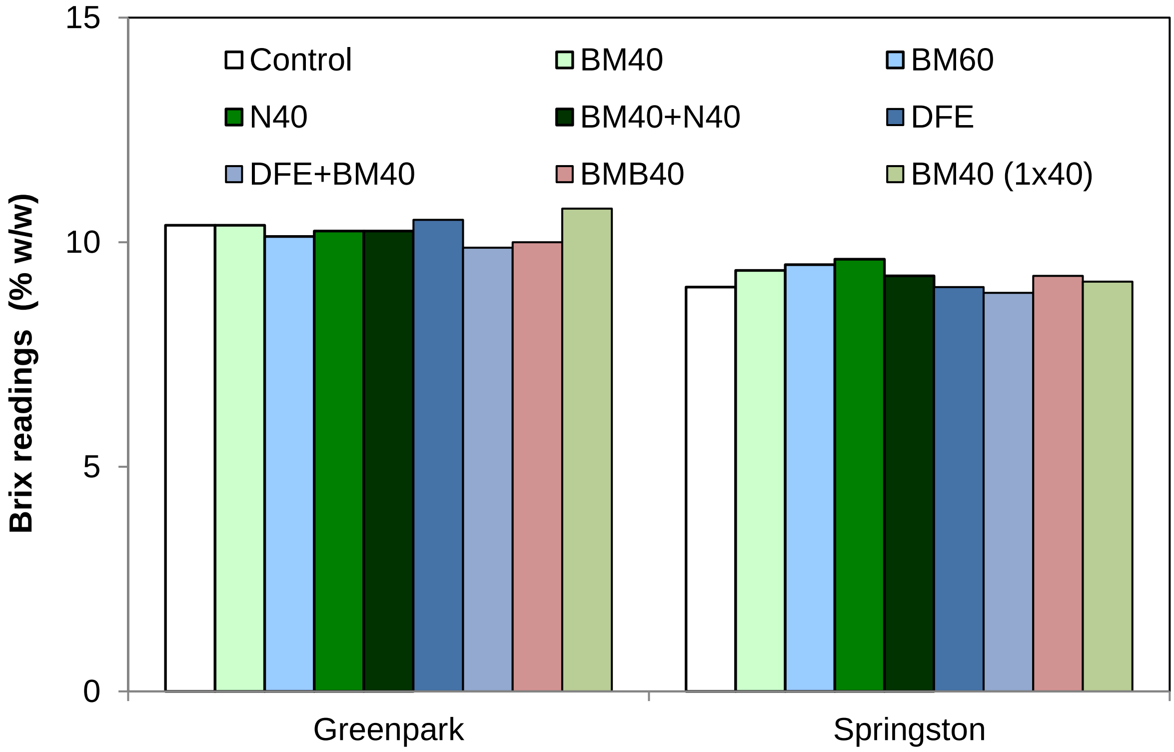

Figure 5. Mean soluble carbohydrate (Brix) content in field pasture for Greenpark and Springston trials.

3.3 Carbohydrate content of mixed pasture

Brix sugar content of the mixed pasture analysis showed no particular trends between treatments (Figure 5). However, given the short duration of these trials this is probably not surprising as any changes are unlikely to occur rapidly and only anecdotal evidence is available to show that pasture quality is improved by BM use. We'll continue to monitor pasture quality in future trials to see if any differences occur.

4 Summary

Two small Canterbury mowing trials showed pasture DM increases of between 6-15% using BM at rates of 40-60 L/h over Spring 2010. This was similar to the response from application of N at 40 kg N/ha. Overall, the DM increases due to BM were significant at the 5% level (i.e. there was less than a 1-in-20 chance that it was by accident).

Nutrition assessment of the mixed herbage from the four cuts was remarkably similar but showed a tendency towards slight N deficiency across all treatments. There were no noticeable differences in N, P, K, S or brix content in mixed pasture between treatments but given the short-term nature of this trial series it is unlikely large differences would be apparent at this stage.

Further trials are planned for 2011/12 over a full growing season to more fully investigate pasture growth response to BM use and to optimise its performance in conjunction with N.

5 References

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