GRASSLAND AND FORAGE CONSERVATION

Effect of method of winter grazing management on pastures

Alternative methods of winter grazing have been investigated at Grange over the last 5 years. Break grazing – a method of rotational grazing used for sheep and young cattle in New Zealand during winter could potentially reduce the need for indoor feeding but have a negative impact on pasture growth during the following spring. The objective of the current study was to compare the effects of two methods of rotational grazing (‘standard’ and ‘break grazing’) on yield and utilisation of pastures from October to May.

Nearly 40 ha of pasture was divided into nine blocks, each block was divided equally into four paddocks and paddocks in each block were assigned at random to one of four grazing units (each 9.77 ha and nine paddocks). Each unit was stocked with one group of as many as 31 heifers and blocks were grazed in sequence (1 to 9) during each rotation from April to October 2008. Two methods were assigned randomly in duplicate to the four grazing units:

1. ‘Standard’ method: in rotation 1 (2 Oct. – 15 Nov.), paddocks were grazed in sequence (blocks 1 to 9) with heifers (n = 22 decreased to 14) before all heifers were housed on 15 November. In rotation 2 (23 Feb. – 14 Apr.), paddocks were grazed with a group of yearling bulls; the number of bulls was gradually increased: 10 on 23 Feb., 15 on 18 Mar., 21 on 24 Mar. and 31 on 30 March. Rotation 3 was completed on 10 May and the number of bulls in each group was increased to 37 on 15 April.

2. ‘Break grazing’ method: rotation 1 was the same as above until 28 Oct. when the remaining 14 heifers were housed after grazing block 5. Break-grazing was then applied on blocks 6 to 9 in rotation 1 (19 Nov. to 10 Jan.) and on blocks 1 to 6 during rotation 2 (10 Jan. to 20 Mar.) with 10 weanling bulls. During the last part of rotation 2, blocks 7 to 9 were grazed as normal and the number of bulls was gradually increased: 15 on 24 Mar. and 26 on 30 March. Rotation 2 was completed on 6 April. In rotation 3, the number of bulls in each group was 31 on 6 April and 37 on 15 April and the rotation ended on 6 May.

Preliminary results are summarised for duration of regrowth and grazing periods and compressed sward heights (Table 29), stocking density and rate (Table 30), pasture supply and yield (Table 31) and pasture composition (Table 32). Conclusions will be drawn once all results (including animal performance data) have been analysed.

Table 29: Effect on grazing variables

Grazing rotation	Grazing method	Start of rotation	Rotation length (days)	Previous regrowth period (days)	Grazing period (days)	CSH pre-grazing (cm)	CSH post-grazing (cm)
Pre-exp.	1	11 Aug.	52	40	5.7	12.4	4.8
	2	11 Aug.	52	40	5.7	12.3	4.6
1	1	2 Oct.	44	44	4.9	8.7	4.7
	2	2 Oct.	100	60	8.6	8.8	4.7
2	1	23 Feb.	50	141	5.6	7.4	3.9
	2	10 Jan.	86	101	7.7	6.1	3.7
3	1	14 Apr.	26	38	4.1	9.0	4.2
	2	6 Apr.	29	51	3.7	7.4	3.7

Duration of grazing rotation: number of days from when the cattle started grazing on the first paddock to when they had finished grazing on the last paddock.
Each grazing unit was 9.77 ha and 9 paddocks in rotations 0, 1 and 2, and 7.67 ha and 7 paddocks in rotation 3.
CSH: compressed sward height was measured with rising plate meter.

Table 30: Effect on stocking density and stocking rate

Grazing rotation	Grazing method	Number of cattle	Live weight (kg)	Stocking density		Stocking rate	
				(cattle/ha)	(kg/ha)	(cattle/ha)	(kg/ha)
Pre-exp.	1	29.2	521	27.1	14,100	3.0	1555
	2	29.2	519	27.0	14,010	3.0	1545
1	1	17.5	530	16.2	8,600	1.8	951
	2	15.7	441	61.8	22,660	1.6	762
2	1	18.6	416	17.4	7,340	1.9	802
	2	12.9	375	57.8	21,110	1.3	507
3	1	36.6	444	33.9	15,030	4.8	2120
	2	34.9	438	32.3	14,170	4.5	1995

Stocking density: mean number or weight of cattle on each paddock. Stocking rate: mean number or weight of cattle on each paddock divided by the total area grazed throughout a rotation.

Table 31: Effect on mean pasture supply, yield and average growth rate

Grazing rotation	Grazing method	Farm cover (kg DM/ha)	Post-previous grazing (kg DM/ha)	Pre-current grazing (kg DM/ha)	Yield (kg DM/ha)	Average growth rate (kg DM/ha/d)
1	1	960	550	1540	990	22
	2	920	480	1570	1090	21
2	1	620	500	1200	700	5
	2	480	490	860	370	4
3	1	710	300	1610	1310	36
	2	620	300	1210	910	21

Table 32: Effect on pre-grazing pasture composition (proportion of total pasture cover)

Grazing rotation	Grazing method	RGL	RGS	OGL	OGS	WC	W	D
1	1	0.533	0.005	0.208	0.010	0.119	0.013	0.112
	2	0.542	0.006	0.204	0.008	0.070	0.011	0.160
2	1	0.453	0.000	0.319	0.000	0.058	0.006	0.165
	2	0.498	0.000	0.260	0.000	0.029	0.015	0.198
3	1	0.451	0.005	0.364	0.006	0.098	0.031	0.046
	2	0.465	0.000	0.385	0.004	0.078	0.025	0.042

RGL: ryegrass leaf, RGS: ryegrass stem, OGL: other grass leaf, OGS: other grass stem, WC: white clover, W: weed and D: dead material.

Black, A.D. *RMIS No. 5919*

Effect of feeding brassicas and silage on growth of young bulls

Forage brassicas such as kale and swedes have been investigated as alternatives to indoor winter feeding. Research suggests that a fibre source such as silage, hay or straw aids rumen function and growth of stock grazing brassicas. However, feeding supplementary fibre to cattle grazing during winter has several practical limitations and it may not be necessary for young cattle, particularly if the grazing period is short (i.e. 6-8 weeks). If this hypothesis is true then growth of cattle from brassicas as the sole diet would be the same as for those on brassicas with silage, provided that the total daily feed allowance and energy supply is the same. The objective of this study was to compare the effect of brassica species (kale and swedes), silage supplementation (with or without) and indoor feeding on growth of young bulls during late winter (6 weeks).

A study was carried out at Grange during January-March 2009. Spring-born yearling continental bulls were assigned randomly to five groups (six bulls per group) to receive one of five diets: 1) kale as sole diet, 2) swedes as sole diet, 3) kale with 0.3 of total diet as silage, 4) swedes with 0.3 of total diet as silage and 5) indoors on silage with concentrate (1 kg/head per day). Preliminary results indicate the average daily gain of bulls feeding on kale and swedes as the sole diet was respectively 0.54 and 0.94 kg/day, 0.87 and 0.68 kg/day for those on kale and swedes with silage and 0.68 kg/day for those indoors on silage with concentrate. Yield and yield components for kale crops were 4790 kg DM/ha with 38% of total DM yield as green leaf, 52% stem, 6% dead and 4% weeds and 5190 kg DM/ha with 3% green leaf, 16% stem, 73% bulb, 1% dead and 8% weeds for swede crops.

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Effects of soil temperature and nitrogen fertiliser on spring pasture growth

Pasture responses to nitrogen (N) fertiliser in spring can be increased by applying the fertiliser when conditions are suitable for pasture growth. But in reality feed shortages on farms usually occur in early spring when conditions for growth are poor. Trials carried out to determine response to N fertiliser application date usually involve applying N to individual plots on a range of dates and measuring the yield obtained from each date. However, the optimum date to apply N fertiliser can be difficult to extrapolate beyond the site and year of investigation unless the associated influence of soil temperature is also measured. The plots may also need to be repeated on a number of pastures due to differences in soil fertility, pasture type and defoliation management within a grazing system. Therefore, the objective of this study was to understand how pasture growth rate is affected by date of N fertiliser application in spring, by examining the responses to N fertiliser relative to soil temperature for pastures with contrasting grazing regimes within a rotational grazing system.

The experiment was conducted at Grange. In six paddocks, N was applied at 57.5 kg/ha to 10 plots (each 1.5 m × 5 m) on 14 Feb., 27 Feb., 11 Mar., 26 Mar. and 9 Apr. as urea (46% N), along with a control (no N), in a randomised complete block design with two replicates. Pasture growth rate after each application date was measured weekly before grazing. Relationships between weekly pasture mass on each plot and days after N application were analysed to calculate average pasture growth rate. The association between average growth rates and average weekly soil temperature was analysed for each date of N application.

Average growth rate did not increase until average weekly soil temperature was above 5-6°C (about 26 March), regardless of N application date (Figure 7). Thus, N fertiliser applied when soil temperatures are below 5°C may have limited impact on pasture growth. Only when the average soil temperature was above 5-6°C did the N fertiliser have any measurable effect on pasture growth rate. The pasture response to N fertiliser for every °C increase in soil temperature between 5-6°C and 13.5°C (about 15 May) was in the range of 11 kg DM/ha per °C for the control plots (no N fertiliser) and 17 kg DM/ha per °C for the N fertiliser applied on 9 April.

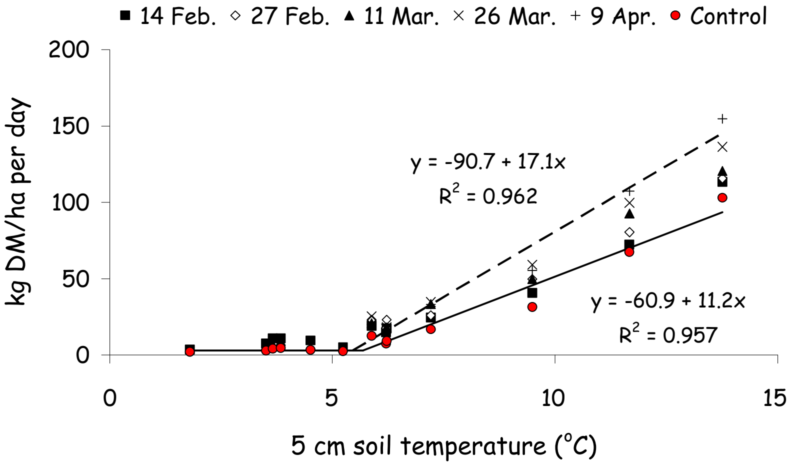

Figure 7. Association between soil temperature (5 cm) and the overall mean pasture growth rate for six sites in response to N fertiliser applied on five dates in spring, described by a 'broken-stick' model for the control plots and a linear model for N fertiliser applied on 9 April.

The results from this study suggest that soil temperature (5 cm) could be useful as an indicator of when to apply N fertiliser in spring. The pasture growth response to N fertiliser was greater when the fertiliser was applied at soil temperatures above 5-6°C within a year-round rotational grazing system for beef cattle at Grange.

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Effect of rate of nitrogen fertiliser on spring pasture growth

Nitrogen (N) fertiliser is used in spring to boost pasture growth and overcome feed deficits on farms. The magnitude of the response to N fertiliser depends on the current level of N deficiency, climatic conditions (e.g. soil temperature) and the growth potential of the pasture. For example, if leaf area is low then the response will be less than when leaf area is high enough for full light interception. Efficiency of N fertiliser can be improved by using the lowest rate possible to provide the feed required. Field plots can be used to assess soil N fertility and the N fertiliser response of a pasture. This usually involves applying a range of fertiliser rates to individual plots and measuring the yield increase obtained at each rate. Plots may need to be repeated on a number of paddocks due to differences in soil fertility, pasture type and defoliation management within a grazing system. Therefore, the objective of this study was to determine the response to five rates of N fertiliser applied in spring of pastures with contrasting grazing regimes within a rotational cattle grazing system.

The experiment was conducted at Grange. In six paddocks, N was applied on 11 March to 10 plots (each 1.5 m × 5 m) at 0, 28.8, 57.5, 86.3 or 115 kg/ha as urea (46% N) in a randomised complete block design with two replicates. Pasture yield after 11 March was measured before each grazing. Yields from each N rate were summed and related to the yields from the 115 kg N/ha level (100%). Data were described by an asymptotic (Mitscherlich) model $y = a + b(k^x)$ where y = relative yield and x is the rate of N fertiliser applied.

There was a positive pasture response to N fertiliser, which was significant ($P<0.05$) for four of the paddocks. Overall response was 32.0, 17.2, 17.3 and 15.3 kg DM/kg applied N for 28.8, 57.5, 86.3 and 115 kg/ha of N fertiliser, respectively. Relative yield response was described by the asymptotic model $y = 115.9 – 60.8(0.989^x)$ ($R^2 = 0.602$, $P<0.001$) (Figure 8).

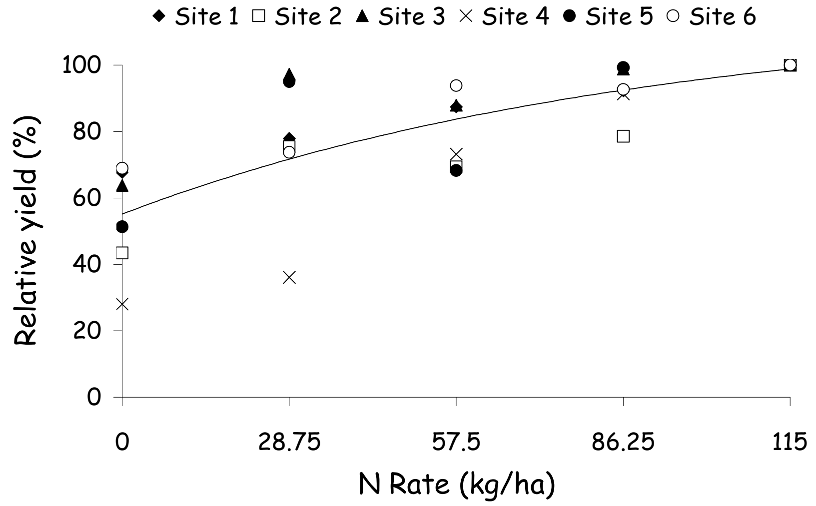

Figure 8. Pasture responses (relative yield) at each site to five rates on N fertiliser in spring, showing mean values for each site and a fitted model that described the overall mean response as $y = 115.9 – 60.8(0.989^x)$ ($R^2 = 0.602$, $P<0.001$).

The asymptotic relationship between the relative yield and N fertiliser rate suggests that average responses 70-80% of the maximum were obtained with 28.8 to 57.5 kg N/ha in spring, for pastures within a year-round rotational grazing system for beef cattle at Grange.

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Factors influencing the conservation characteristics of baled silage

Baled silage (BS) frequently differs from precision-chop silage (PS) in its ensilage characteristics. Studies with laboratory silos showed that field wilting and air infiltration during ensilage each had much larger impacts on conservation characteristics than forage chopping or compaction. This experiment compared the conservation characteristics of BS and PS made following three durations of wilting and, in the case of BS, investigated the interactions with the number of layers of plastic film in which the bales were wrapped and the duration of ensilage.

On 18 July, the 50 day regrowth of a *Lolium perenne* sward was cut with a rotary mower-conditioner. Representative herbage was immediately precision-chop harvested and ensiled in six clamps that were sealed beneath two sheets of 0.125 mm black polythene. Simultaneously, 42 cylindrical bales (each 1.2 m diameter and 1.2 m wide) were made, and 2 (6 bales) or 4, 6 or 8 (each 12 bales) layers of black polythene stretch film (25 µm film thickness; stretched by 70% at wrapping) were applied. The remaining herbage was wilted for 24 and 48 h (with appropriate tedding/rowing) and then harvested as above. The 18 clamps and 72 of the bales (18 bales each with 2, 4, 6 and 8 layers film) were stored for 7 months and the remaining 54 bales (18 bales each with 4, 6 and 8 layers film) were stored for 18 months. Data were collected and subjected to one- (all 24 treatments) and three- (BS after 3 durations of wilting, with 4, 6 or 8 layers film, and stored for 7 or 18 months) way analysis of variance.

The mean (s.d.) dry matter (DM) content for 0, 24 and 48 h wilted herbages among six PS clamps was 145 (13.6), 296 (31.6) and 530 (53.2) g/kg, respectively, with corresponding values for herbage among 42 bales of 142 (6.9), 291 (28.6) and 533 (54.7) g/kg. The fresh weight ensiled following 0, 24 and 48 h wilting was 4156 (295.2), 3548 (429.5) and 2970 (537.6) kg, respectively, across PS clamps, and 852 (54.3), 795 (84.6) and 581 (102.1) kg, respectively, across bales. The corresponding DM weight of bales was 121 (8.1), 231 (25.3) and 305 (41.3) kg. Wilting restricted ($p<0.001$) fermentation, increased ($p<0.001$) lactic acid as a proportion of fermentation products (FP) and reduced ($p<0.001$) in-silo losses. When BS was wrapped in 4-8 layers of film it generally did not differ ($p>0.05$) from PS in the extent or overall direction of fermentation, or in in-silo losses. Wrapping bales in only two layers of plastic film lead to extensive mould growth on the bale surface, and this was virtually eliminated by four or more layers of film (except for unwilted herbage stored for 18 months, in which case 6 layers of film were required to control mould growth). There was an improvement in most other indices of conservation by increasing the number of layers of film in which BS was wrapped from 2 to 4, but increasing the number of layers from 4 to 8 had no impact ($p>0.05$). Extending the duration of bale storage from 7 to 18 months reduced ($p<0.001$) the recovery rate of ensiled herbage, and increased ($p<0.001$) both pH and NH_3-N with 0 h wilted BS but not with 24 or 48 h wilted BS. It reduced ($p<0.001$) the content of FP in 0 and 24 h wilted BS but not ($p>0.05$) with 48 h wilted BS. There were no other interactions ($p>0.05$) for variables in Table 33.

It is concluded that differences between BS and PS were relatively small, whereas both field wilting and preventing air infiltration during ensilage (4-8 *vs.* 2 layers film) conferred benefits to the conservation characteristics of BS. Extending BS storage from 7 to 18 months disimproved the conservation characteristics mainly of 0 h wilted BS. Thus, the differences reported between BS and PS on farms are most likely due to differences in herbage DM content and the completeness of anaerobiosis during ensilage rather than to the chopping or storage system used.

Table 33: Silage fermentation and recovery characteristics

H[1]	W[2]	L[3]	D[4]	pH	LA[5]	AA[6]	PA[7]	BA[8]	ET[9]	FP[10]	L/FP[11]	D.LA[12]	Am[13]	Rec[14]	M[15]
BS	0	2	7	5.04	73	41	5.3	15.9	23	158	430	667	109	781	64.5
BS	0	4	7	4.37	99	35	4.7	11.9	29	180	545	677	82	875	0.2
BS	0	6	7	4.23	128	34	4.9	11.4	33	211	598	671	86	892	0.0
BS	0	8	7	4.24	125	26	2.5	11.0	32	197	632	675	82	894	0.0
BS	24	2	7	4.60	105	15	1.8	4.3	22	148	712	656	75	977	48.8
BS	24	4	7	4.21	127	16	1.4	2.2	26	173	736	657	66	990	0.9
BS	24	6	7	4.22	131	18	3.1	3.8	24	181	737	659	67	991	0.3
BS	24	8	7	4.23	128	12	0.8	3.4	25	169	756	655	68	984	0.6
BS	48	2	7	6.37	47	7	0.4	0.4	13	67	602	735	39	1027	49.3
BS	48	4	7	5.04	45	6	0.7	0.7	16	69	623	476	27	999	0.4
BS	48	6	7	5.21	44	5	0.1	0.1	12	63	641	356	21	982	0.5
BS	48	8	7	4.94	54	5	0.0	0.0	16	75	696	343	28	981	0.0
BS	0	4	18	4.44	75	24	2.6	8.9	16	126	603	525	95	844	33.1
BS	0	6	18	4.81	77	34	5.3	12.4	19	148	523	566	128	832	2.5
BS	0	8	18	4.72	69	39	8.2	13.7	25	155	436	516	107	835	0.0
BS	24	4	18	4.22	84	12	0.5	1.4	21	118	708	465	62	990	2.2
BS	24	6	18	4.24	73	11	0.4	1.0	21	107	684	503	57	982	1.1
BS	24	8	18	4.25	71	10	0.4	1.5	19	102	697	471	57	977	0.6
BS	48	4	18	4.86	37	5	0.1	0.0	9	51	674	482	14	1003	2.3
BS	48	6	18	4.89	63	4	0.1	0.0	8	76	750	410	23	984	0.3
BS	48	8	18	4.93	53	4	0.1	0.1	8	64	715	428	19	985	0.2
PS	0	-	7	4.45	99	51	8.7	6.0	25	189	513	690	79	822	-
PS	24	-	7	4.42	104	20	2.9	2.3	19	149	701	664	54	997	-
PS	48	-	7	5.28	76	6	0.9	0.7	6	91	842	629	67	978	-
SE[16]				0.211	11.2	2.8	0.96	2.16	1.9	12.7	50.5	22.0	6.9	17.4	7.76
Sig				***	***	***	***	***	***	***	***	***	***	***	***

[1]Harvester, [2]Wilt duration, [3]Layers of polythene film, [4]Duration of storage (months), [5]Lactic acid (g/kgDM), [6]Acetic acid (g/kgDM), [7]Propionic acid (g/kgDM), [8]Butyric acid (g/kgDM), [9]Ethanol (g/kgDM), [10]Fermentation products (lactic acid + volatile fatty acids + ethanol; g/kgDM), [11]Lactic acid/FP (g/kg), [12]D-Lactic acid (g/kg lactic acid), [13]Ammonia-N (g/kgN), [14]Recovery rate (g/kg), [15]Mould (% coverage of bale surface area) and [16]Standard error of the mean. ***=p<0.001

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The effect of dry matter concentration on the bacterial community composition of baled silage

Wilting is an integral part of baled silage production as it creates conditions more inhibitory to the activity of undesirable microorganisms. Furthermore, it also has practical benefits relating to the number of bales/ha, their individual weights and their ability to retain their shape during storage. This study investigated the effects of herbage dry matter (DM) concentration on bacterial community composition during ensiling, employing conventional methods of microbial analysis and culture-independent Terminal Restriction Fragment Length Polymorphism (T-RFLP).

Herbage was ensiled in cylindrical bales after both a 0 (185 ± 7.0 g DM kg^{-1}) and 48 (406 ± 29.8 g DM kg^{-1}) h wilt period. Triplicate bales at each DM were core sampled prior to ensiling (day 0) and after 2, 6 and 14 d ensilage. Specific bacteria were enumerated on selective media pre- and post-ensiling. Total bacterial DNA was extracted from all silage samples and the bacterial 16S small sub-unit rRNA gene was amplified using primer set F27 and R1492. A terminal restriction fragment (TRF) profile was created using endonuclease *Msp1* and TRF lengths were determined by electrophoresis using an automated sequencer

(Beckman Coulter, CEQ2000). Bacterial count data, pH and lactic acid concentration were subjected to two-way analysis of variance (2 x 4 factorial) using the GLM procedures of SAS, v.8.2. The gross similarity of TRF profiles between samples was examined using the Bray Curtis index as a measure of similarity. Bacterial community profiles were analysed using Primer software (Primer-E Ltd., UK), and used to create nonmetric multidimensional scaling (MDS) plots for the dataset. The greater the distance between samples on an MDS plot, the larger the dissimilarity relationship (i.e. difference in bacterial community composition) between the samples.

Although lactic acid bacteria (LAB) numbers were higher in the high DM compared to the low DM herbage on day 0, numbers were lower ($P<0.001$) for the high DM treatment at each subsequent stage of ensiling (Table 34). The decline in Enterobacteria numbers after day 2 was greatest ($P<0.01$) for the low DM herbage. Clostridia numbers increased ($P<0.01$) slightly in the low DM herbage during ensiling. Silage fermentation proceeded rapidly after ensiling as plant cells lysed under anaerobic conditions. Fermentation was more restricted in the high DM herbage as evidenced by the lower LAB numbers and higher Enterobacteria numbers. The low degree of clostridial activity in the high DM herbage reflects the inhibitory effects of high DM concentration on Clostridia. Figure 9 reveals a shift in bacterial community composition as the fermentation proceeded (e.g. between days 0 - 2 for the low DM herbage), but also a marked shift in response to DM concentration (low DM herbage located in top half of MDS plot). Bacterial composition for day 0 and day 2 of the high DM herbage are closely related suggesting a slower onset of fermentation.

It is concluded that herbage DM concentration has a major effect on silage bacterial composition and in turn on the outcome of preservation. While conventional methods of microbial analysis reveal differences in the numbers of bacteria present, T-RFLP can provide greater insight into the changes in bacterial community composition and can provide an overview of the whole community in one assay.

Table 34: Treatment effects on herbage pH, lactic acid concentration (g kg^{-1} DM) and bacterial composition (Log$_{10}$ colony forming units/g herbage)

				Bacterial composition			
DM	Time (d)	pH	LA	Lactic acid bacteria	Enterobacteria	Clostridia	Bacilli
Low	0	6.2	18	4.7	3.5	1.2	2.2
Low	2	4.6	47	8.3	6.0	0.6	1.8
Low	6	4.0	66	7.6	3.2	1.3	2.2
Low	14	4.1	83	9.3	0.5	2.3	1.8
High	0	6.4	2	5.7	4.5	1.2	2.0
High	2	5.8	12	6.7	4.2	1.3	1.5
High	6	4.8	14	7.1	3.5	1.2	1.6
High	14	4.8	15	7.6	2.0	1.4	1.6
	s.e.m.	0.11	3.78	0.20	0.36	0.18	0.19
Levels of significance							
DM		***	***	***	NS	NS	*
Time		***	***	***	***	**	NS
DM x Time		**	***	***	**	**	NS

DM = dry matter; LA = lactic acid; * = $P<0.05$, ** = $P<0.01$, *** = $P<0.001$, NS = not significant; s.e.m. relates to the interaction between DM and time.

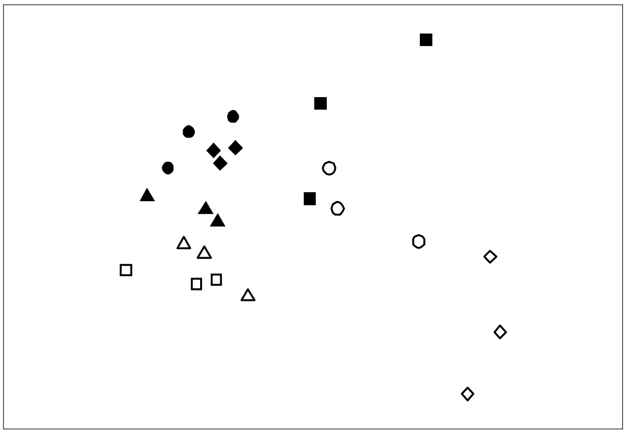

Figure 9. MDS ordination plot of T-RFLP data for low (full symbols) and high DM (empty symbols) herbages on days 0 (▲), 2 (■), 6 (♦) and 14 (●) of ensilage.
<u>Note</u>: Samples plotted close together represent herbages of similar bacterial community composition.

RMIS No. 5136

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Forage maize composition – interaction of harvest date, plastic mulch and cultivar

Maize can supply high yields of quality forage on some Irish farms. The variability in yield, quality and maturity at harvest reflects the responses to prevailing weather conditions, particularly temperature during April to September. The use of plastic mulch promotes higher yields of quality feedstuff and has permitted the crop to extend into geographical areas once considered unsuitable. The objectives were to compare two cultivars of forage maize that were grown with or without plastic mulch and to examine how composition altered between early September to early November. Two forage maize cultivars of different maturity characteristics (Tassilo: FAO 210 (early) and Benicia: FAO 270 (late)) were sown at Knockbeg, Co. Carlow either uncovered (NP – no plastic) or under complete cover clear polythene mulch (P; 6 micron; I.P. Europe Ltd). Each plot consisted of 4 rows (70 cm spacing) of 10 m length. Plots were sown in triplicate on 23 April using a Samco precision seed drill at 100,000 seeds/ha. Standard weed control (4.5 l atrazine/ha) and fertiliser (150 kg N, 50 kg P, 200 kg K/ha) were applied pre-sowing to all plots. Samples of 1 m length per plot were taken at ten day intervals from 10 Sept. to 9 Nov. and whole-crop samples were submitted to chemical analyses. Data were statistically analysed by repeated measures analysis of variance using a model that accounted for cultivar, plastic mulch, harvest date and their interactions. Whole-crop chemical composition results are summarised in Table 35. Starch content was increased ($P<0.001$) by sowing the crop under plastic mulch, and was higher ($P<0.001$) with Tassilo than Benicia. *In vitro* dry matter digestibility declined as harvest date was delayed, and was higher ($P<0.001$) with the earlier maturing Tassilo than the later maturing Benicia – this was especially evident at the earlier harvest dates ($P<0.01$). Plastic mulch increased ($P<0.001$) digestibility, mainly at the earlier harvests ($P<0.01$). It also increased digestibility more ($P<0.01$) with Benicia than with Tassilo. Both NDF and ADF declined with later harvesting, with the rate of decline being faster ($P<0.05$) with Tassilo than Benicia, and where plastic mulch was used ($P<0.01$). Ash concentration declined over time, and was particularly reduced ($P<0.01$) when the crop was grown under plastic mulch.

It is concluded that plastic mulch modified forage maize chemical composition in line with advancing its stage of maturity and this effect was most evident with the earlier maturing cultivar when harvested in September.

Table 35: Chemical composition of the whole-crop maize

Harvest date (H)	Cultivar (C)	Mulch (M)	Starch g/kg DM	DMD[1] g/kg	NDF[2] g/kg DM	ADF[3] g/kg DM	Ash g/kg DM
Sep-10	Tassilo	No	158	658	571	298	49
Sep-10	Tassilo	Yes	261	699	467	234	39
Sep-10	Benicia	No	42	641	624	361	57
Sep-10	Benicia	Yes	206	697	520	289	47
Sep-20	Tassilo	No	217	680	505	268	43
Sep-20	Tassilo	Yes	302	710	422	217	35
Sep-20	Benicia	No	103	616	629	366	47
Sep-20	Benicia	Yes	274	706	491	266	43
Sep-30	Tassilo	No	279	699	469	237	44
Sep-30	Tassilo	Yes	352	716	440	231	40
Sep-30	Benicia	No	201	682	544	308	54
Sep-30	Benicia	Yes	332	744	433	224	45
Oct-10	Tassilo	No	290	708	455	241	39
Oct-10	Tassilo	Yes	339	725	414	222	34
Oct-10	Benicia	No	197	697	523	297	43
Oct-10	Benicia	Yes	335	746	410	228	39
Oct-20	Tassilo	No	299	717	463	246	39
Oct-20	Tassilo	Yes	343	723	414	214	33
Oct-20	Benicia	No	252	718	502	273	43
Oct-20	Benicia	Yes	331	733	440	235	40
Oct-30	Tassilo	No	318	718	443	227	38
Oct-30	Tassilo	Yes	352	730	414	223	32
Oct-30	Benicia	No	264	710	474	265	40
Oct-30	Benicia	Yes	328	722	446	243	40
Nov-09	Tassilo	No	344	735	415	225	29
Nov-09	Tassilo	Yes	361	755	407	220	27
Nov-09	Benicia	No	274	700	495	284	34
Nov-09	Benicia	Yes	359	737	420	230	35
s.e.m H			3.03	3.65	3.4	3.62	1.51
C			1.53	1.26	2.1	1.87	1.01
M			1.53	1.26	2.1	1.87	1.01
H x C			4.28	5.16	4.8	5.12	2.13
H x M			4.28	5.16	4.8	5.12	2.13
C x M			2.16	1.78	2.97	2.65	1.43
H x C x M			6.06	7.29	6.79	7.23	3.02
Sig.[4] H			***	***	***	***	***
C			***	**	***	***	**
M			***	***	***	***	**
H x C			***	***	***	***	NS
H x M			***	***	***	***	NS
C x M			***	***	***	***	NS
H x C x M			**	**	***	**	NS

[1] Dry matter digestibility; [2] Neutral detergent fibre; [3] Acid detergent fibre; [4] NS = non-significant; *P<0.05; **P<0.01; ***P<0.001.

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Alternative conservation strategies for high-moisture barley grain

Purchased feed grain can comprise a major cost on grassland farms involved in ruminant production. Alternative options for purchasing grain at harvest as well as for storing and processing it on the farm may provide an opportunity to reduce these costs. The objectives were to quantify the conservation characteristics of barley grain harvested at different stages of ripeness and stored anaerobically following contrasting processing and additive treatments.

Plots of barley (20 m × 3 m; *Hordeum vulgare* L., cv. Regina; sown 18 October; 181 kg inorganic N/ha) were managed as for commercial grain production. There were four harvest times (H1 to H4; based on target grain dry matter (DM) concentrations) and four replicate blocks. At each harvest, unprocessed or processed (using a Murska 350S crimper-roller) grains were ensiled (15°C for >100 days) in laboratory silos (4 kg grain DM/silo) with the following additive treatments: (1) no additive (NA), (2) Crimpstore 2000 (Kemira Chemicals (UK) Ltd.; formic acid, ammonium formate, propionic acid, benzoic acid and ethylbenzoate mixture) at 6 l/t (A1), (3) Graintona (FSL Bells Ltd., UK; acetic acid, isobutyric acid mixture) at 8 l/t (A2), (4) NuGrain (Hydro Nutrition, Hydro Agri (UK) Ltd.; urea solution) at 50 l/t (U) and (5) Biograin (Biotal Ltd., Wales; *Lactobacillus buchneri*) at 10 l/t (B1).

Mean (s.d.) grain DM concentrations at H1 to H4 were 557 (2.2), 643 (5.4), 726 (2.6) and 821 (1.7) g/kg, respectively. The recovery of grain DM was lower ($P<0.001$) for the two earlier harvests (984 g/kg) than for the later harvests (993 g/kg) but was not affected ($P>0.05$) by processing. There was a lower ($P<0.001$) recovery with B1 (979 g/kg) than with the other additives (992 g/kg). Aerobic deterioration post-ensilage was not linearly related to stage of ripeness at harvest, and was not affected by processing ($P>0.05$). Compared to NA, B1 reduced ($P<0.05$) aerobic deterioration whereas A2 increased ($P<0.001$) it. Table 36 summarises treatment effects on preserved grain chemical composition. Later harvesting (and thus higher DM content in the preserved grain) reduced ($P<0.001$) WSC, lactic acid, acetic acid and ethanol contents. Rolling resulted in increased ($P<0.001$) crude protein, WSC, lactic acid, acetic acid and ethanol contents but decreased ($P<0.001$) DM and starch contents, OMD and pH. Compared to NA, A1 increased WSC content and decreased ethanol content and pH while A2 increased pH and reduced lactic acid, ethanol and ammonia-N contents. Urea increased crude protein, lactic acid, acetic acid and ammonia-N contents and reduced WSC and ethanol, while B1 increased acetic acid content and reduced DM and WSC contents, and pH.

It is concluded that high moisture barley grain stored anaerobically for durations in excess of 100 days can undergo efficient conservation with relatively small quantitative and qualitative losses. Such conservation can be conducted over a wide range of stages of ripeness with whole or rolled (i.e. crimped) grain. Grain conserved satisfactorily without additive, and the contrasting additives used had different effects. Caution is required if extrapolating these results to what might happen at a farm scale due to the greater challenges associated with rapidly achieving and maintaining anaerobiosis on farms.

Table 36: Harvest date, processing and additive treatment effects on grain composition post storage

H[1]	P[2]	A[3]	DM[4]	CP[5]	OMD[6]	Star[7]	WSC[8]	pH	LA[9]	AA[10]	Eth[11]
H1	W	NA	561	100	854	615	49.5	4.7	6.6	1.1	14.8
H1	W	A1	574	100	815	615	54.6	5.2	4.1	0.4	6.7
H1	W	A2	574	96	831	624	50.3	5.4	3.0	1.0	5.1
H1	W	U	562	154	852	613	16.8	9.0	4.2	5.9	5.2
H1	W	B1	528	102	810	606	24.2	4.2	8.0	12.1	15.1
H1	R	NA	539	104	799	537	100.0	4.1	17.5	3.7	9.6
H1	R	A1	542	107	810	532	83.6	3.8	30.8	6.0	6.1
H1	R	A2	551	98	818	580	94.1	5.1	5.4	2.9	5.9
H1	R	U	527	221	810	560	22.1	5.0	34.0	21.7	15.4
H1	R	B1	499	110	771	575	16.1	4.0	11.7	33.6	13.1
H2	W	NA	662	100	815	628	30.1	5.2	4.0	1.1	17.3
H2	W	A1	676	101	833	629	47.1	4.8	1.8	0.3	2.0
H2	W	A2	671	97	825	598	36.7	5.7	2.2	0.7	6.2
H2	W	U	667	125	853	623	17.5	7.3	7.4	2.5	5.1
H2	W	B1	580	103	822	621	32.1	4.3	5.7	7.0	11.7
H2	R	NA	639	102	820	633	27.8	4.1	19.0	9.0	9.7
H2	R	A1	652	103	812	595	67.9	4.1	8.9	3.7	3.3
H2	R	A2	645	99	829	602	51.6	5.1	3.5	3.3	6.9
H2	R	U	633	136	841	601	23.5	5.2	36.7	10.9	20.8
H2	R	B1	520	110	777	588	15.0	4.2	13.9	30.4	8.9
H3	W	NA	744	102	829	650	21.4	5.9	1.8	1.0	19.4
H3	W	A1	756	101	840	621	28.5	4.0	1.6	0.1	0.5
H3	W	A2	746	98	826	606	29.5	6.0	2.9	0.8	7.3
H3	W	U	737	132	818	588	32.0	9.1	3.4	2.4	0.5
H3	W	B1	578	104	820	587	31.5	4.3	16.9	6.1	10.2
H3	R	NA	724	103	835	618	24.9	4.7	11.3	4.8	15.4
H3	R	A1	727	102	835	612	37.5	4.3	3.9	6.4	3.6
H3	R	A2	725	102	826	608	29.1	5.5	4.4	3.7	10.0
H3	R	U	699	134	782	585	32.1	9.2	4.9	9.0	6.3
H3	R	B1	538	107	802	545	15.8	4.2	14.9	27.1	7.5
H4	W	NA	852	102	835	588	29.8	6.9	1.7	0.6	3.2
H4	W	A1	857	104	819	597	27.5	3.6	1.7	0.5	0.4
H4	W	A2	856	100	828	576	29.1	5.4	1.1	0.7	3.3
H4	W	U	848	140	842	575	12.4	8.7	3.4	3.5	0.5
H4	W	B1	754	105	818	571	18.2	4.0	8.7	8.3	4.1
H4	R	NA	838	104	838	566	28.6	5.9	3.4	2.7	8.4
H4	R	A1	837	110	806	564	28.8	3.8	4.0	1.1	1.0
H4	R	A2	840	103	828	575	30.4	5.9	7.0	0.3	4.4
H4	R	U	820	167	815	560	2.0	7.2	13.8	10.2	10.9
H4	R	B1	719	112	787	547	12.3	4.8	2.1	26.7	6.6
sem		HxPxA	1.6	1.5	4.4	11.1	2.47	0.14	2.16	11.08	0.71

[1]Harvest number; [2]Processing; [3]Additive treatments (see explanation of abbreviations in Materials and Methods text); [4]dry matter (g/kg); [5]crude protein (g/kgDM); [6]*in-vitro* organic matter digestibility (g/kg); [7]Starch (g/kgDM); [6]water soluble carbohydrates (g/kgDM); [9]Lactic acid (g/kgDM); [10]Acetic acid (g/kgDM); [11]Ethanol (g/kgDM)

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The impact of cow genotype on the profitability of grassland-based beef production in Ireland

Due to the increased proportion of suckler beef cows in the Irish national cow herd and the increased use of high production Holstein strains in the dairy herd, beef cross heifers from the dairy herd suitable for suckler beef production is becoming increasingly limited. The sourcing of replacement heifers from outside of suckler herds is also undesirable from a herd health perspective. The result has been an increased retention of replacements from within the suckler herd. This breeding policy has important implications for cow energy requirements and milk production potential. As a consequence of lower milk intake and loss of heterosis, progeny weaning weights and carcass weights are reduced. The objective of this study was to examine the effect of beef cow genotype and replacement policy on the profitability of grassland-based suckler beef systems. Since a change in genotype may have implications for the fertility of the suckler herd, the impact of replacement rate was also explored.

The Teagasc Farm Systems Model (TFSM) is a bioeconomic model of Irish grassland-based suckler beef systems. The model is structured as a whole farm budgetary simulation model formulated in an Excel spreadsheet. The primary farm activities of a typical Irish suckler beef farm are specified. Feed intake requirements for each animal category are calculated. The forage sub-model specifies the herbage availability throughout the year and when coupled with the animal sub-model, the stocking rate is determined.

In this study the effect of suckler cow genotype, replacement policy and replacement rate on the profitability of suckler beef systems was examined. The systems analysed were spring-calving with the objective of maximising grazed grass as a proportion of the total feed budget and minimising the feeding of concentrates. Two beef cow genotypes were examined; beef cross heifers from the dairy herd (Beef-Friesian; BF) and replacements retained from within the suckler herd (Charolais; CH). The impact of beef cow breed was modelled by matching the production coefficients of interest to breed type. The coefficients modelled were dam milk production and liveweight changes and progeny pre-weaning and post-weaning performance and carcass characteristics.

Replacements are assumed to be purchased as calves in the BF scenarios and retained from within the herd in the CH scenarios. Two replacement rates, 20 percent (standard; S) and 33 percent (high; H) were examined. A number of coefficients within the model reflected the varying effects of altering the replacement rate of the herd. For *primiparous* cows, birthweight and liveweight gain of progeny were reduced whilst calving difficulties and calf mortality at calving were increased compared to mature cows. Liveweight and milk yield *post-partum* were both reduced substantially for *primiparous* cows compared to mature cows. The model assumptions used are presented in Table 37. In all scenarios, stocking rate and inorganic nitrogen application rate was limited by the Nitrates Directive. In the suckler-to-weanling scenarios progeny were sold at 8 months of age whereas in the suckler-to-beef scenarios steers and heifers were sold at 24 and 20 months of age, respectively.

Table 37: Assumptions used in model scenarios

Area farmed	50 ha
Mean calving date	24 March
Grass silage harvest date	5 June
Grass silage quality (dry matter digestibility)	676 g kg^{-1}
Weanling steer price	€2.10 kg^{-1} liveweight
Weanling heifer price	€1.85 kg^{-1} liveweight
Beef price (U3 steer)	302c kg^{-1} carcass
Beef price (R3 heifer)	299c kg^{-1} carcass
Finishing concentrate price	€265 Mg^{-1}
CAN price	€250 Mg^{-1}
Replacement calf price	€150 $head^{-1}$

The results for the calf-to-weanling systems are presented in Table 38. Stocking rates were similar for all scenarios. However, since replacements were sourced from within the herd in the CH scenarios, the numbers of weanlings sold were fewer. Weaning weights were also lower in the CH scenarios and hence gross output and net profit was lower than for the BF scenarios. Higher replacement rates resulted in lower cow numbers, fewer calves sold and a modest reduction in weaning weights. However, the additional output in the form of cull cows overcame any potential reduction in gross output. Therefore, the net margin for the standard and high replacement rate scenarios were similar.

Table 38: Technical and financial results of the suckler-to-weanling scenarios

Scenario[1]	BF-S	CH-S	BF-H	CH-H
Stocking rate (L.U. ha^{-1})	1.87	1.89	1.78	1.82
Cows calving (head)	94.4	97.2	89.7	93.9
Weanlings sold (head)	88.8	73.6	84.3	61.9
Weaning weight (kg $head^{-1}$)[2]	303	283	298	279
Financial results (€ ha^{-1})				
Gross output	1,400	1,296	1,409	1,300
Variable costs	509	481	524	484
Gross margin	891	815	885	816
Net margin	437	354	435	356

[1] BF = Beef-Friesian genotype; C = Charolais genotype; S = standard replacement rate (20 percent); H = high replacement rate (33 percent)

[2] Average of steer and heifer weanlings

The results of the calf-to-beef scenarios are presented in Table 39. As for the weanling systems, stocking rates were similar but greater animal sales and carcass weights in the BF scenarios relative to the CH scenarios resulted in higher profit in the BF scenarios particularly in the high replacement rate scenarios where net profit was 14 percent greater than the CH scenario. Similar to the suckler-to-weanling scenario, increasing replacement rate had a modest effect on net margin.

Table 39: Technical and financial results of the suckler-to-beef scenarios

Scenario[1]	BF-S	CH-S	BF-H	CH-H
Stocking rate (L.U. ha^{-1})	1.58	1.64	1.53	1.61
Cows calving (head)	59.5	64.8	57.7	65.8
Weanlings sold (head)	55.3	48.4	53.5	42.8
Weanling weight (kg $head^{-1}$)[2]	336	329	333	327
Financial results (€ ha^{-1})				
Gross output	1,396	1,345	1,397	1,340
Variable costs	539	521	543	524
Gross margin	858	824	854	816
Net margin	421	379	421	369

[1] BF = Beef x Friesian genotype; C = Charolais genotype; S = standard replacement rate (20 percent); H = high replacement rate (33 percent)

[2] Average of steers and heifers

It is likely that sourcing heifer replacements from within the suckler herd will predominate as the availability of suitable beef cross heifers from the dairy herd becomes increasingly limited. However, this study demonstrated that for suckler farmers, sourcing replacements from the dairy herd results in greater profitability due to higher output; a consequence of heavier liveweights at sale and greater numbers of animals sold. Heavier weights obtained for the BF genotype are a result of higher pre-weaning weights due to the greater milk production of this genotype. Despite the CH genotype having a higher killing out percentage, the lower finishing liveweight is not entirely mitigated and carcass weights remain lower than the BF genotype. The lower animal output in the CH scenarios is a result of the replacement policy employed; replacing from within the herd reduces potential animal sales. There was a modest effect of replacement rate on net margin. In general, the reduction in progeny sales was largely offset by the increase in cull cow sales.

RMIS No. 5404

Crosson, P.

The economic impact of calving date and turnout date to pasture in spring of suckler cows

Irish suckler beef systems are predominantly spring-calving with 42% of calvings in 2007 in March and April. Early turnout to pasture is one strategy for reducing the production costs of these systems by increasing the proportion of grazed grass in the annual feed budget. In spring-calving systems, turnout of suckler cows to grass is typically delayed until after calving and, therefore, earlier calving provides the opportunity for earlier turnout. The objective of this analysis was to investigate the impact of calving date and turnout date of the suckler cow herd on the profitability of spring-calving systems.

A simulation model of suckler beef production systems, the Teagasc Farm Systems Model (TFSM), was used to investigate the impact of calving date and turnout date. This is a whole-farm budgetary simulation model which simulates the primary activities which occur on suckler beef farms. The input parameters used for this analysis are presented in Table 40.

Table 40: Input parameters used in the TFSM

Area farmed	50 ha
Beef price (R4L steer)	330 c kg^{-1}
Concentrate price	210 € t DM^{-1}
Urea price	450 € t^{-1}
Calcium Ammonium Nitrate price	375 € t^{-1}
Replacement calf price	200 € $head^{-1}$

Steer and heifer progeny were taken through to finish at 24 and 20 months of age, respectively, in integrated calf-to-beef systems. Three mean calving and suckler cow herd turnout dates were modelled, 23 February, 18 March and 8 April resulting in 6 scenarios in total; February calving and turnout (Ff), February calving and March turnout (Fm), February calving and April turnout (Fa), March calving and turnout (Mm), March calving and April turnout (Ma), and April calving and turnout (Aa). All scenarios were modelled at high (225 kg organic nitrogen (N) ha^{-1}) and low (170 kg organic N ha^{-1}) stocking rates. Yearling progeny were turned out to grass in early March in all scenarios. Housing date was in early and late November for suckler cows and weanlings, respectively. Corresponding dates for heifer and steer yearling progeny were mid-August and early November, respectively.

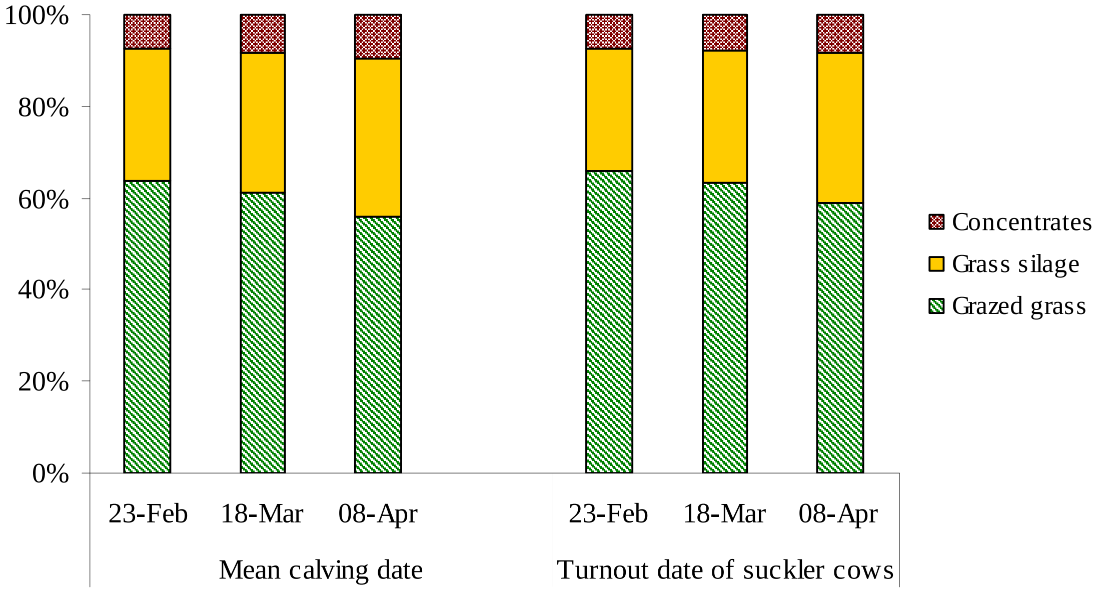

Figure 10. Impact of calving and turnout date on percentage grazed grass, grass silage and concentrates in the annual feed budget of spring-calving calf-to-beef systems.

Mean calving date and turnout date had considerable impacts on net margin with earlier calving and turnout dates associated with higher margins (Table 41). When analysed across all systems, February calving systems had €25 ha^{-1} and €80 ha^{-1} higher net margins relative to March and April calving systems, respectively. Corresponding values for suckler cow turnout date were €32 ha^{-1} and €86 ha^{-1}, respectively. The impact of advancing calving date and turnout date by one day was to increase net margin by €1.75 ha^{-1} (€1.41 cow^{-1}) and €1.90 ha^{-1} (€1.54 cow^{-1}), respectively. Over all scenarios, margins were €16 ha^{-1} higher for the high intensity systems relative to the low intensity systems.

It is apparent that earlier calving and turnout is associated with lower grass silage requirements and higher proportions of grazed grass in the annual feed budget (Figure 10). Consequently, the key underlying difference between the systems revolved around feed and slurry handling costs. Where soil and weather conditions are suitable and where there is an adequate herbage supply, this analysis has shown that earlier calving and turnout date to pasture can lead to greater profitability in suckler beef systems by reducing slurry handling and feed costs.

Crosson, P., McGee, M. and Drennan, M.J. *RMIS No. 5404*

Table 41: Impact of calving and turnout date on the financial performance of spring-calving calf-to-beef systems (€/ha)

Scenario[1]	**Ff**		**Fm**		**Fa**		**Mm**		**Ma**		**Aa**	
System intensity	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Gross output	1435	1906	1436	1902	1438	1900	1439	1910	1437	1906	1446	1917
Variable costs	737	1117	760	1145	799	1193	771	1164	803	1208	837	1248
Gross margin	698	789	676	758	639	708	668	746	634	699	609	669
Fixed costs	403	462	403	461	404	461	404	462	404	462	410	470
Net margin	295	327	272	297	235	247	264	284	230	237	199	199

[1] F = February calving; M = March calving; A = April calving; f = February turnout; m = March turnout; a = April turnout

The economic impact of turnout date to pasture in spring of yearling cattle on suckler beef farms

Cattle on the majority of Irish farms are turned out to grass in mid-March to mid-April. Turnout date is largely dependent on soil, weather and grass growing conditions on individual farms. Extending the grazing season is often advocated as a method of reducing production costs by replacing a portion of the grass silage in the diet with grazed grass and reducing slurry handling costs. Furthermore, earlier turnout to grass results in improved animal performance although, compensatory growth of cattle turned out to grass later largely offsets this advantage by the time of slaughter. The objective of this analysis was to investigate the impact of turnout date of yearling cattle on the profitability of spring-calving suckler beef systems.

A simulation model of suckler beef production systems, the Teagasc Farm Systems Model, was used to investigate the impact of turnout date of yearlings. This is a whole-farm budgetary simulation model which simulates the primary farm activities which occur on suckler beef farms. The input parameters used for this analysis are presented in Table 42.

Table 42: Input parameters used in the TFSM

Area farmed	50 ha
Beef price (R4L steer)	330 c kg^{-1}
Concentrate price	210 € t DM^{-1}
Urea price	450 € t^{-1}
Calcium Ammonium Nitrate price	375 € t^{-1}
Replacement calf price	200 € t^{-1}

Steer and heifer progeny were taken through to finish at 24 and 20 months of age, respectively, in integrated calf-to-beef systems. Three turnout dates for yearling progeny were simulated; 23 February, 18 March and 8 April. All scenarios were modelled at low (170 kg organic nitrogen (N) ha^{-1}) and high (225 kg organic N ha^{-1}) stocking rates. It was assumed that there was full compensatory growth for yearling progeny turned out on the later dates relative to the earlier dates. Thus, carcass weights for steer and heifer progeny were the same for all animal groups. Mean calving date for the suckler cow herd was 18 March. Suckler cows were turned out to grass in mid-March and housed in early November. Weanling progeny were housed in mid-November.

Table 43 presents the financial results of the scenarios modelled. Due to the effects of compensatory growth, gross output values for the three turnout dates were similar. However, later turnout dates were associated with higher production costs, with March and April turnout incurring €18 ha^{-1} and €44 ha^{-1}, respectively, higher production costs than February turnout. Higher production costs were due to higher feed and slurry handling costs. The proportion of grazed grass in the annual feed budget was reduced from 62% in the February turnout scenario to 58% in the April turnout scenario. The analysis indicated that advancing turnout to grass of yearling cattle by one day increased net margin by €1.17 ha^{-1} (€0.95 cow^{-1}). When analysed across all turnout dates, the high intensity systems had €15 ha^{-1} higher net margin than the low intensity system. Increasing stocking rate had a greater impact on net margin for earlier turnout dates.

Table 43: Impact of turnout date of yearlings on the financial performance of spring-calving suckler beef systems (€/ha)

Turnout date	23 February		18 March		8 April	
System intensity	Low	High	Low	High	Low	High
Gross output	1441	1911	1439	1900	1438	1898
Variable costs	763	1152	781	1169	803	1198
Gross margin	679	760	659	731	634	700
Fixed costs	404	462	405	462	405	462
Net margin	275	298	254	269	230	238

A companion study investigated the impact of turnout date of suckler cows on the economic performance of calf-to-beef systems and demonstrated that net margin was increased by €1.90 ha^{-1} for each day turnout was advanced. In this study the impact of turnout date is more modest due to a combination of lower feed intake and slurry production of yearlings relative to suckler cows. Nevertheless, the results suggest that earlier turnout reduces production costs and increases net margin on suckler beef farms.

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Bioeconomic modelling of pasture responses to nitrogen fertiliser on the financial performance of suckler beef systems

Suckler beef production systems in Ireland are largely based on spring-calving as it provides good synchrony between seasonal herd feed demand and pasture growth. The winter feeding component of this system is expensive and, with average family farm incomes excluding all subsidy and premia payments in 2007 of -€182 ha^{-1}, suckler beef producers must seek to lower feeding costs.

Farm profitability is increased by maximising the proportion of grazed pasture in the total farm feed budget. Extending the grazing season by turning cows, which are housed in winter, out to pasture earlier in spring reduces the requirement for expensive conserved feeds and concentrates and also reduces slurry handling costs. It has been shown that net margin per cow on suckler beef farms was increased by €1.41 and €1.90 for each day calving and turnout to pasture in spring, respectively, was advanced for suckler cows. However, this analysis was predicated on the assumption that adequate pasture was available to facilitate earlier turnout. Nitrogen fertiliser may be necessary in early spring to increase pasture supply. However, the pasture dry matter (DM) response to spring N fertiliser can vary from one farm to another, which may influence the turnout date and, therefore, may also affect the overall financial performance of suckler beef systems.

The objective of this study was to investigate the effects of pasture responses to spring N fertiliser on the profitability of suckler beef systems with different spring-calving and turnout dates to pasture.

A simulation model of suckler beef production systems, the Teagasc Farm Systems Model (TFSM), was used to investigate the impact of calving date and turnout date. This is a budgetary simulation model and operates as a biophysical model in a standard spreadsheet format. The primary farm activities of a typical Irish suckler beef farm are specified. Thus, suckler cow, calf, yearling, finishing and replacement categories are described. A number of options must be selected at the input stage. These include; month of calving, finishing strategy, forage strategy and price variables. The model then tracks the physical movement of cattle through the production system from calving through to slaughter. The net energy system is used to calculate animal feed requirements and based on this the forage intake requirement is calculated. The forage sub-model specifies the herbage availability throughout the year and when coupled with the animal sub-model, the stocking rate is determined. Where forage in the form of grazed grass or grass silage is unable to meet the animals' energy requirements within the animals' intake capacity limitation, supplementary concentrates are included in the diet to correct the deficit. Livestock performance and forage yield data are primarily taken from Irish research experiments. Prevailing costs and prices are used to facilitate economic analysis.

Date of calving and turnout to pasture in spring

Three calving and turnout dates to pasture in spring of suckler cows at successive three week intervals were evaluated: 24 February, 17 March and 7 April. Additionally, it was assumed that turnout of cows was delayed until after calving e.g. March calving cows were not turned out in February. The stocking rate for all scenarios was 225 kg organic N ha^{-1}. Yearling progeny were turned out in early March and housed as the finishing regime required. Steers were finished at 24 months of age and heifers at 20 months of age. Suckler cows and weanlings were housed in early November and mid-November, respectively.

Pasture response to spring N application

Date of autumn closing and early spring N application are the two most important factors influencing the supply of grass in spring. Spring response to N is dependent on soil temperature and therefore, varies greatly among years and locations. Pasture response rates ranging from 5.6 to 15.6 kg pasture per kg N applied have been found on free-draining soils in the south of Ireland. Thus, for this analysis three pasture response rates to applied N were modelled: 5, 10 and 15 kg pasture per kg N applied.

The impact of calving date and turnout date of suckler cows to pasture in spring on the proportion of grazed grass, grass silage and concentrates fed on a total farm basis is presented in Figure 11. Delaying calving and turnout by six weeks from 24 February to 7 April reduced the proportion of grazed grass in the annual feed budget by 7 percentage units in both cases. Grazed grass was primarily replaced with grass silage. Delaying calving and turnout to pasture also increases the volume of slurry to be handled. The volume of slurry handled was increased by 14% for April calving systems relative to February calving systems. The corresponding value for turnout date to pasture was 26%.

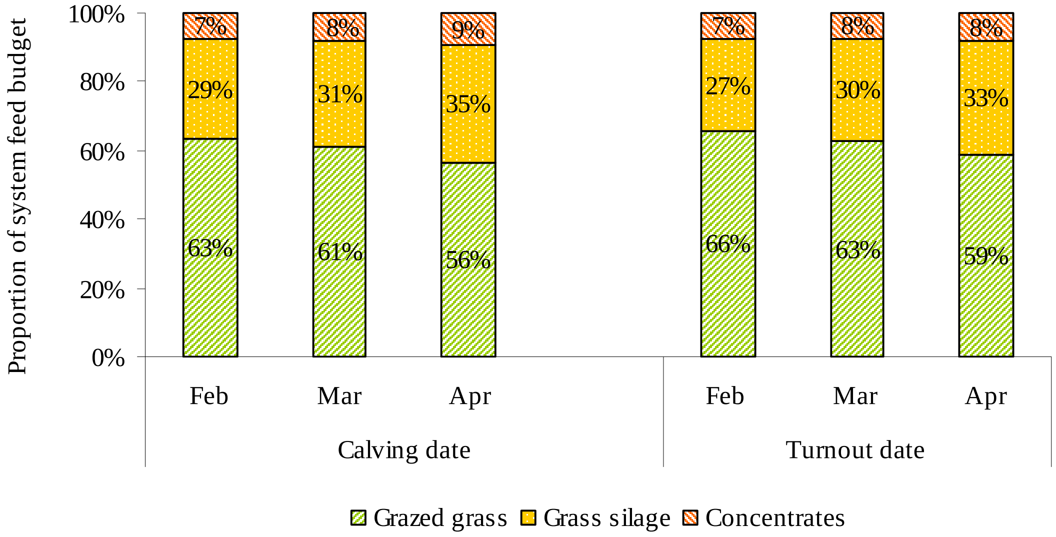

Figure 11. The effect of calving date and turnout date to pasture in spring of suckler cows on the proportion of grazed grass, grass silage and concentrates in the total system feed budget.

Figure 12 presents the impact of spring pasture response to applied N on farm net margin at the three turnout dates and the three calving dates modelled. It is apparent that pasture response to applied N had a considerable impact on farm net margin. Across all turnout and calving dates, farm net margin from a pasture response of 15 kg DM kg N^{-1} was 35% and 7% higher than from responses of 5 and 10 kg DM kg N^{-1} response rates, respectively. This was primarily due to higher N application rates required where pasture response was lower. Where pasture response to applied N was 5 kg DM kg N^{-1}, March calving and turnout was more profitable than February calving and turnout. This was in contrast to the scenarios where pasture response to applied N was 10 kg DM kg N^{-1} and 15 kg DM kg N^{-1} where February calving and turnout was most profitable. In all scenarios, April calving and turnout was less profitable than March calving and turnout.

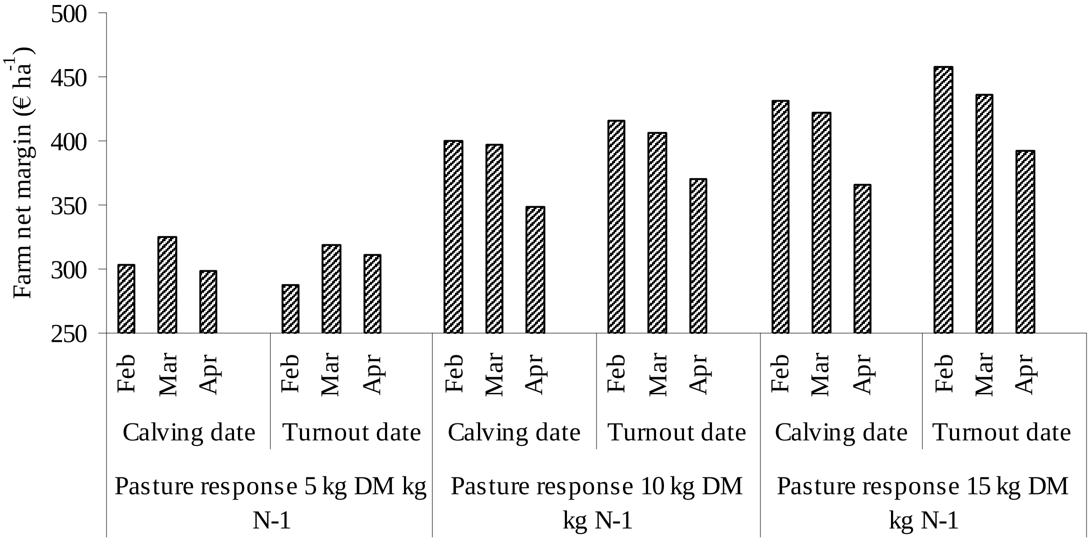

Figure 12. The effect of spring pasture response to applied N on farm net margin at three turnout dates of suckler cows to pasture in spring and three calving dates.

These results have important implications for optimal calving and turnout dates on Irish suckler beef farms. In general, earlier calving and turnout improved farm net margins by reducing the proportion of more expensive grass silage and concentrates in the annual feed budget and replacing it with cheaper grazed grass. Furthermore, slurry handling costs were greater where turnout was delayed. However, the capacity of earlier calving and turnout to increase farm net margin was dependent on the pasture response to applied N in spring. Where responses were poor (5 kg DM kg N^{-1}), March calving and turnout improved net margins relative to February calving and turnout. Overall, the results suggest that turnout should be as early as conditions and pasture availability allow. Whilst grazing conditions are largely dependent on soil, climatic and weather conditions and is therefore, largely outside the farmer's control, farmers can have an influence on pasture availability by appropriate autumn grassland management and judicious application of N fertiliser. The modelling approach used was budgetary, bioeconomic simulation. This methodology provided a significant degree of flexibility in relation to the range of scenarios that could be modelled and also facilitated a "predictive" approach i.e. the system under investigation was described precisely and the model "predicted" the biophysical and financial performance. The approach was also largely empirical with performance data taken primarily from Irish research experiments used to describe model coefficients. A limitation of the approach used is that it does not provide for the further understanding of the biological components of the system under investigation.

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