GrassCheck 5 – Grass growth monitoring and the provision of information to improve grassland utilisation efficiency

End of Project Report to AgriSearch

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STRUCTURE OF REPORT

This report begins with an Executive Summary which briefly highlights the background to the project, the methods used to undertake the work and the key findings.

The main body of the report highlights the grass growing conditions at each of the monitored sites during each of the three years of the project, and a summary of the other information collected during the project.

The report finishes with a list of presentations/publications which have been outcomes of the project to date.

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EXECUTIVE SUMMARY

- The project monitored grass growth and quality over three years, namely 2013, 2014 and 2015.
- Measurements were taken at five sites across Northern Ireland during these years.
- Sites were at Hillsborough (x2), Greenmount (x2) and Downpatrick
- Grass growth was estimated from nine plots at each site, with a set of three plots cut each week in a three-week cycle, thus simulating grass growth under a rotational grazing situation.
- The grass growth and quality data collated within this project were released in a weekly 'bulletin' to the farming press and published on the AFBI and RURAL PORTAL websites during the main grazing season (March to October).
- In addition to reporting actual grass growth on a weekly basis, grass growth predictions for one and two weeks ahead were also published. During the three years of this project, the predictions were presented separately for north, south, east and west regions of Northern Ireland. In order to allow these projections to be generated, actual weather data was collated from a network of weather stations (managed by CAFRE Greenmount) and regional weather forecasts were downloaded weekly.
- To aid the interpretation of the grass growth data, additional grassland information was added to the weekly bulletin. This information was generated from dairy herds around Northern Ireland and included key grassland management data (grass covers, grass demand, grass growth, grass feed wedge) and animal performance data (milk yields, milk quality, levels of supplementary feeding).
- The highest annual herbage yield during the project was recorded at Greenmount in 2015 (13.7 t DM/ha), while annual herbage yields of 9.8t DM/ha or below were recorded at all sites in 2013 (Table A).
- The average annual herbage yields recorded during 2013, 2014 and 2015 across the sites were 9.3, 11.2 and 12.2 t DM/ha, respectively.

Table A. Total annual herbage production at each of the sites during the three years of the project

	Total annual herbage production (t DM/ha)		
	2013	2014	2015
Hillsborough	9.8	12.8	12.8
	*	13.5	12.1
Greenmount	9.1	10.7	13.6
	9.6	10.3	13.7
Downpatrick	8.6	8.8	8.6
Average	**9.3**	**11.2**	**12.2**

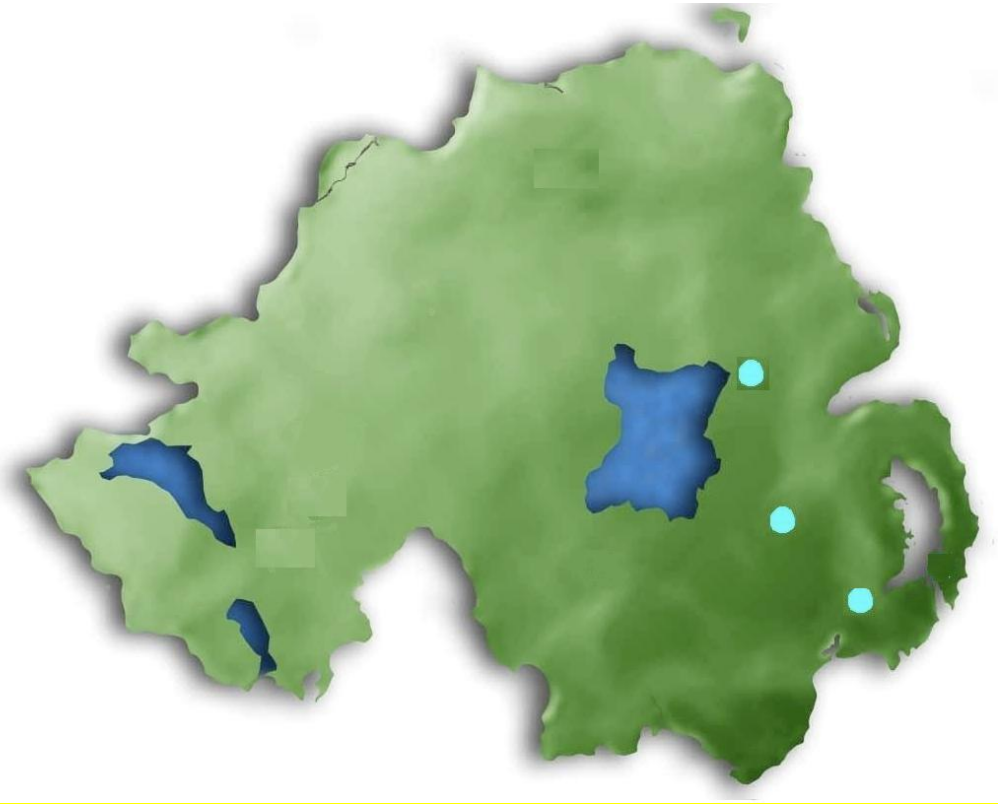
- The growth data collected within the project reiterates the variability of growth between years and also between sites within years, which presents a practical challenge for farmers when trying to optimise the utilisation of grass within their farming systems.
- This highlights the need for grassland farmers to have access to local and accurate grass growth information to allow confident and timely grassland management decisions to be made throughout the grazing season.

GrassCheck – Grass growth data and weekly output during 2013, 2014 and 2015

This project involved the measurement of grass growth and quality throughout 2013, 2014 and 2015. Measurements were taken at five sites in these years. At each site nine grass plots were established (1.5 m x 5.0 m), with a series of three plots cut each week during the main grazing season (March to October). Thus each series was cut at three-weekly intervals to simulate grass growth under a 21-day rotational grazing situation.

The sites were located at AFBI Hillsborough, CAFRE Greenmount, and on a commercial dairy farm in Downpatrick (Figure 1). There were two sets of plots located at both Hillsborough and Greenmount, with the exact location of these plots within both these farms changing during the project. During all three years, total fertiliser nitrogen (N) input was 270 kg/ha, with fertiliser applied to the plots in early spring and at each cut from March to mid September. The application pattern for the full year is given in Appendix 1.

Figure 1 The location of the sites used within the project during 2013, 2014 and 2015.

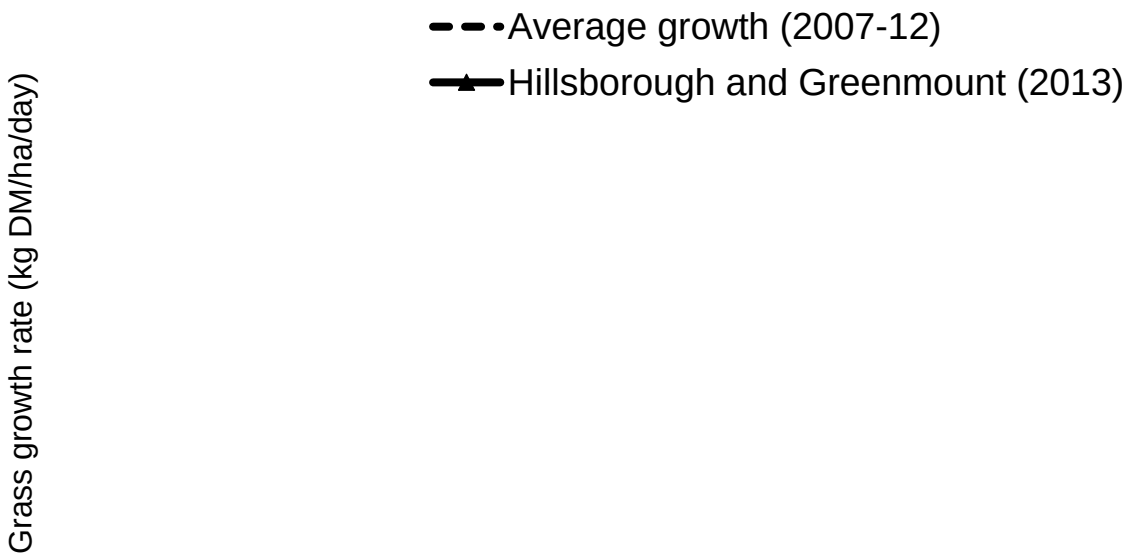


2013 grass growth and grass quality information

Grass growth

While every grazing season brings its own challenges, the 2013 season will certainly be remembered for its extremes, with the weekly growth recorded at each site listed in Appendix 2. The season began with a prolonged spell of cold weather which continued through March and April, and into May. While grass growth during early May in most 'normal' years exceeds 80 kg dry matter per hectare per day, growth rates this year were less than half that level (32 kg per day). Indeed, growth remained well below average until late May, as shown in Figure 2. These poor growing conditions had a dramatic effect on first cut silage yields, with yields considerably lower than normal, even with much later cutting dates.

Figure 2 Average grass growth measured at Hillsborough and Greenmount during 2013, compared to the average grass growth measured during the previous six year period.

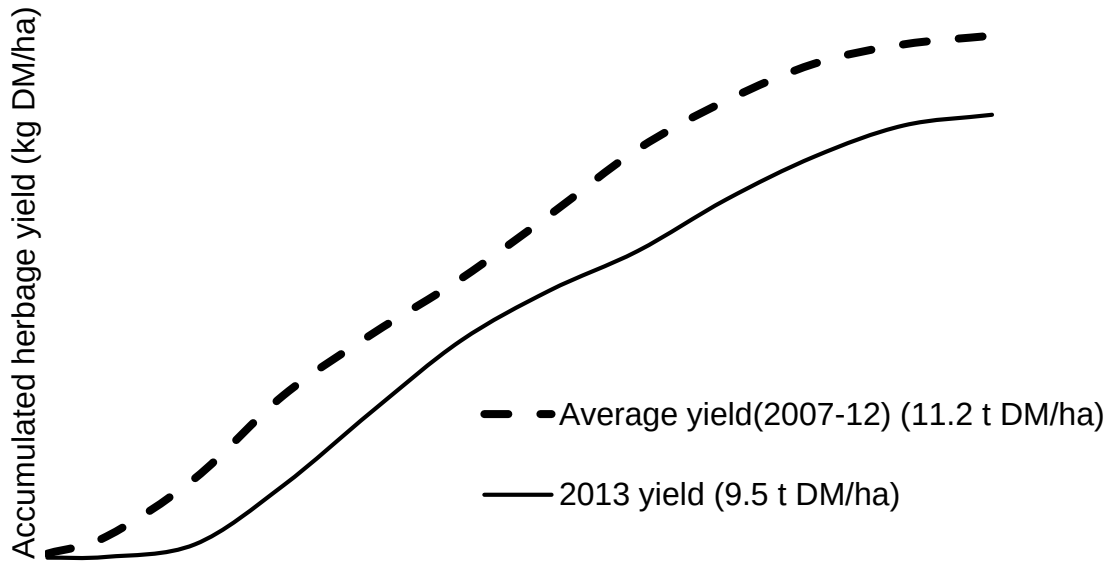


Grass growth eventually exceeded the seasonal average during late May and June, with temperatures increasing throughout this period. However, temperatures continued to climb, exceeding 25^{o}C on a number of occasions during July. This extreme heat, together with a lack of moisture, had a detrimental effect on grass growth, with growth rates falling below average during early July, and remaining below average until mid August. Soil moistures recorded at all sites are listed in Appendix 10.

While below average growth rates continued into September on the drier farms in the east, growth recovered more quickly on farms in the north and west when the warm showery weather arrived. Furthermore, during this period ground and grazing conditions were excellent allowing high levels of utilisation to be achieved.

These excellent growing and grazing conditions continued throughout late August, September and indeed well into October. Grass supplies were good throughout this period, with surplus grass across the country proving a valuable addition to winter feed stocks. Whilst the addition of extra silage was welcome, the ability to keep the majority of animals grazing well into October has also improved the balance of winter fodder supplies. Despite an excellent supply of grass on many farms, the grazing season for many dairy herds came to an abrupt end in late October, with over 2.5 inches (63 mm) of rainfall recorded during the third week of October.

Figure 3 Accumulated herbage yield measured during 2013, compared to the average cumulative yield during the previous six year period



Total annual production

The extremes in growing conditions experienced during 2013 have had a dramatic effect on the quantity of grass grown over the year as a whole. Figure 3 highlights that up until mid May the total grass grown was almost 2.0 tonnes dry matter per hectare less than the long term average. Thereafter, and despite periods of above average growth during mid summer and during the autumn, the total quantity of grass grown

remained below the seasonal average. For example, while the long term average annual yield of grass grown is 11.2 tonnes dry matter per hectare, annual yields at Hillsborough and Greenmount during 2013 were 9.8 and 9.4 tonnes per hectare. Nevertheless, the excellent grazing conditions during large parts of 2013, and the associated high levels of grass utilisation, have lessened the impact of these overall lower grass growth rates.

Grass quality

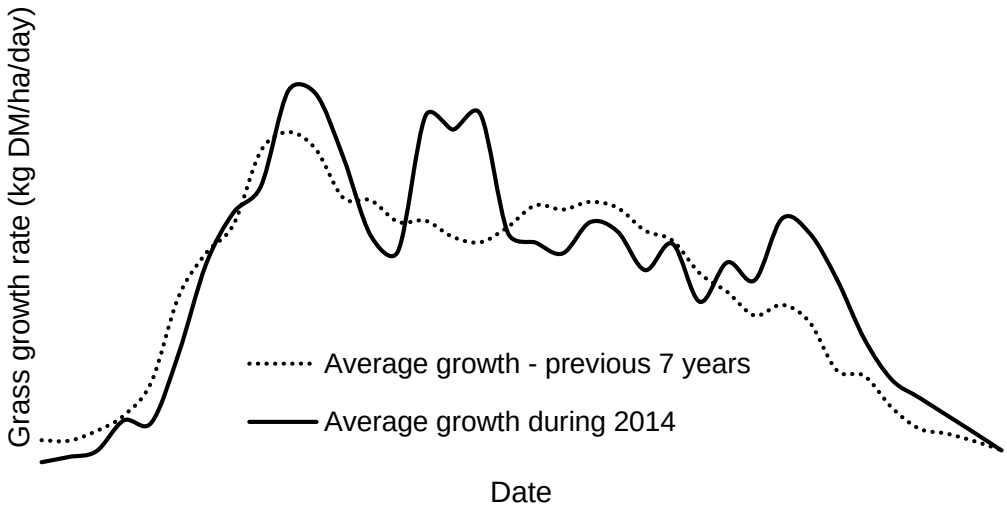
A fresh grass sample from each site each week was analysed by Near Infrared Reflectance Spectroscopy (NIRS), to estimate quality. During 2013 the average metabolisable energy content of the grass harvested at was 11.7 MJ/kg DM, with the average crude protein being 20.8% DM. The average weekly grass quality recorded at the sites over the duration of the growing season is shown in Appendix 3.

2014 grass growth and quality information

Grass growth

Whilst most grazing livestock were enjoying plentiful supplies of high quality grass and near perfect grazing conditions in early October, a period of very wet weather during early November brought the grazing season on most farms to an abrupt end. The 2014 growing season will be remembered as a very good grass year following a number of difficult seasons, with weekly growth recorded at all sites listed in Appendix 4. However, as always, there were a few challenges during the year, most notably during the main harvest window for first cut silage. The data presented in Figure 4 summarise how grass growth during 2014 compared with average growth during the past seven years (2007 to 2013).

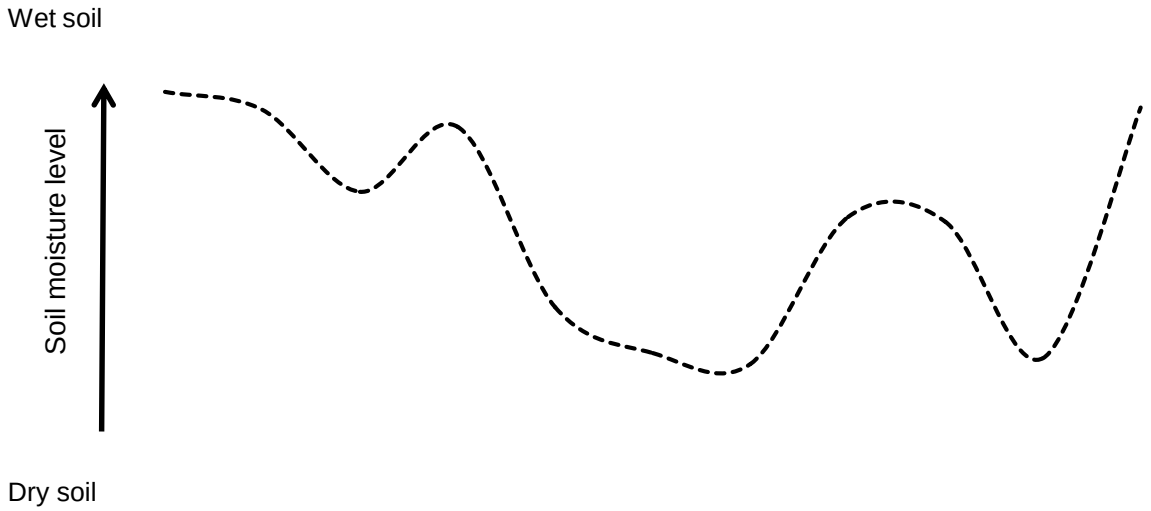
Figure 4 Average grass growth measured at Hillsborough and Greenmount during 2014, compared to the average grass growth measured during the previous seven year period.



Spring

The 2014 growing season began slowly, with growth below average throughout March and April. In addition, grazing conditions were challenging in many areas as shown by the relatively high soil moisture levels recorded at the GrassCheck sites in March and April (Figure 5). However, growth rates continued to increase, and by mid-May growth was higher than the long term average, with growth at individual sites exceeding 100 kg dry matter per hectare per day at this time. While this provided a welcome boost to first cut silage yields, the unsettled weather during mid and late May resulted in a delay in harvesting, which had a negative impact on the quality of silage made.

Figure 5 Average soil moisture levels measured at Hillsborough and Greenmount during 2014.



Mid-season

The weather turned more settled into June and through July, and this is reflected in the decreasing soil moisture levels in Figure 5, with weekly soil moistures recorded at all sites listed in Appendix 11. However, following the normal post-peak 'dip' in growth, grass growth rates surged again in mid June/early July, with growth again exceeding 100 kg dry matter per hectare per day at some of the GrassCheck sites. Grazing conditions were excellent at this time, and grass utilisation efficiency was high on many farms. However, grass growth dipped below average in mid-July as soil moisture levels fell rapidly, with a 'moisture deficit' restricting growth. However, heavy showers in early August quickly removed the restriction of soil moisture on most farms, with 106 mm (4 inches) of rain recorded at Hillsborough during the first week of August, compared with a total of 111 mm throughout June and July. Despite soil moisture now not being a limiting factor, growth remained below average throughout late July and August. The unsettled theme to the weather continued throughout August, with grazing conditions becoming more challenging during late August, with some farmers having to re-house animals for a short period in some cases.

Autumn

The arrival of settled and warm weather in early September was a welcome relief, and growth responded to the high temperatures, reaching highs of 50 to 60 kg dry matter per hectare per day, double the seasonal norm for late September. This settled and mild theme remained the main talking point of the weather throughout September and October, with growth remaining above average throughout this period.

September was exceptionally dry, with only 4.4 mm of rain recorded at Hillsborough. As a result grass supplies were generally good on most farms going into October and grazing conditions were excellent. However, heavy and thundery downpours throughout October, and particularly during late October and early November, quickly increased soil moisture content and made grazing conditions difficult and eventually impossible on many farms. Despite this abrupt end, 2014 in general provided ideal grazing conditions for extended periods, and an ideal opportunity for extended grazing well into October.

2014 annual production

Despite the slow start to growth in spring, excellent growing conditions on all but the driest soils throughout much of the main growing season and into autumn resulted in above average annual yields for 2014. For example, while the long term average annual yield of grass grown within the GrassCheck project is 11.0 tonnes dry matter per hectare, the annual dry matter yield across the Hillsborough and Greenmount sites during 2014 was 11.7 tonnes dry matter per hectare, with individual sites producing in excess of 13.0 tonnes dry matter per hectare. Note that these yields are based on an annual N fertiliser use of 270 kg/ha.

Grass quality

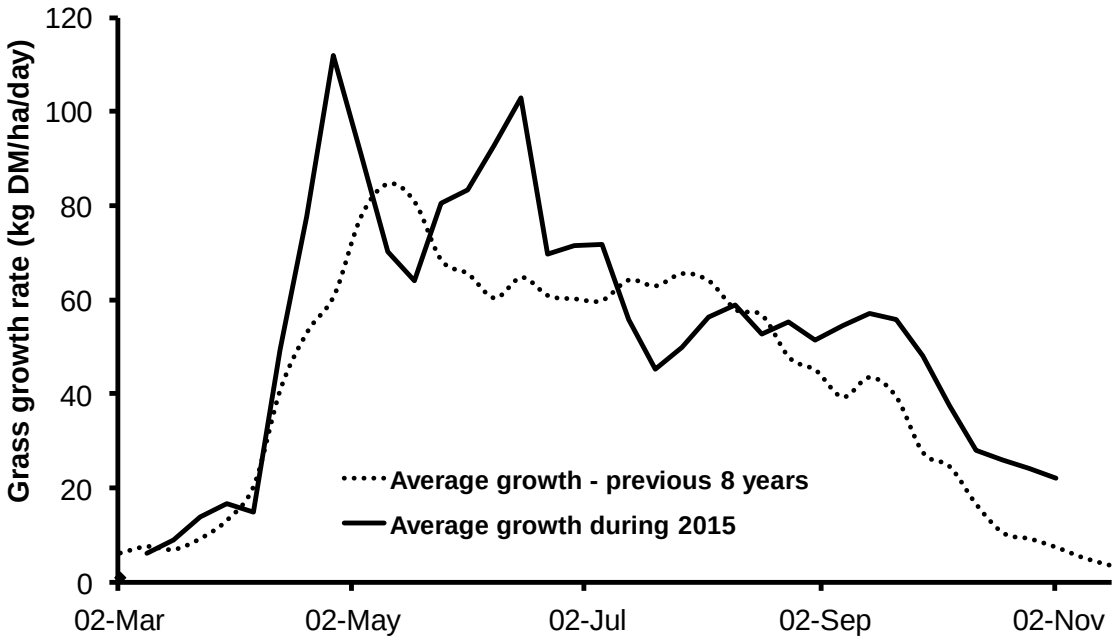
A fresh grass sample from each site each week was analysed by Near Infrared Reflectance Spectroscopy (NIRS), to estimate quality. During 2014 the average metabolisable energy content of the grass harvested at was 11.7 MJ/kg DM, with the average crude protein being 22.0% DM. The average weekly grass quality recorded at the sites over the duration of the growing season is shown in Appendix 5.

2015 grass growth and grass quality information

Grass growth

The period of warm sunny weather during September and October and the accompanying excellent late season growth will be remembered by many grassland farmers as the highlight of 2015. However, the persistent and heavy rain throughout a large part of the summer brought challenges for many, especially in the north and west. Figure 6 summarises grass growth during 2015, compared with average growth during the past eight years (2007 to 2014), with weekly growth recorded at all sites listed in Appendix 6.

Figure 6 Average grass growth measured at Hillsborough and Greenmount in 2015, compared to the average of the previous eight years.



Spring

The 2015 growing season started with growth close to the seasonal average throughout March and early April. However, grazing conditions were challenging on many farms throughout large parts of this period, with weekly soil moistures recorded at all sites listed in Appendix 12. Despite the difficult ground conditions, growth rates increased rapidly through mid and late April, with growth at individual sites exceeding 130 kg dry matter per hectare per day by late April. However, a return to cooler temperatures resulted in a rapid decrease in growth in early May, while the showery weather made grazing conditions difficult in some areas once again. Furthermore, the showery weather limited opportunities to harvest first cut silage, with silage making delayed by up to two weeks on some farms.

Mid-season

A more settled period of weather during June resulted in a surge in grass growth, with growth at all four sites being between 95 and 111 kg dry matter per hectare per day in mid-June. Grazing conditions were excellent at this time, and grass utilisation efficiency was high on many farms. However, grass growth dipped below average in mid-July as soil moisture levels fell rapidly, with this 'moisture deficit' beginning to restrict growth. These effects were short lived as cool temperatures and heavy showers combined to make grazing conditions challenging by late July. This weather persisted over the next five weeks, with over 4 inches (112 mm) of rainfall recorded at Hillsborough in August. This change in the weather also impacted on the harvesting of second cut silage, with a settled 'window' in the weather proving elusive. As a result, second cut silage turned into a prolonged stop-start operation in many areas. Given the unsettled weather, grazing conditions also became more challenging during late August, with some farmers having to re-house animals.

Autumn

The arrival of warm settled weather in early September brought a welcome change. Grass growth responded to the higher temperatures, with daily growth rates of 50 to 60 kg dry matter per hectare recorded, well above the seasonal norm for mid and late September. This warm settled spell continued throughout September and October, with growth remaining above average throughout this period. Indeed, the daily growth rates in excess of 20 kg dry matter per hectare through late October and into November, were particularly exceptional, being over twice the seasonal average for the time of year. While grazing and growing conditions were excellent on many farms at the start of November, heavy thundery downpours during the first two weeks of November brought the grazing season to an abrupt end on many farms.

Annual production during 2015

The annual yield of dry matter produced across the GrassCheck sites at Hillsborough and Greenmount during 2015 was 13.1 tonnes dry matter per hectare, with two of the four sites producing 13.6 tonnes dry matter per hectare. This is over 18% above the long-term GrassCheck average of 11.1 tonnes dry matter per hectare.

Grass quality

A fresh grass sample from each site each week was analysed by Near Infrared Reflectance Spectroscopy (NIRS), to estimate quality. During 2015 the average metabolisable energy content of the grass harvested

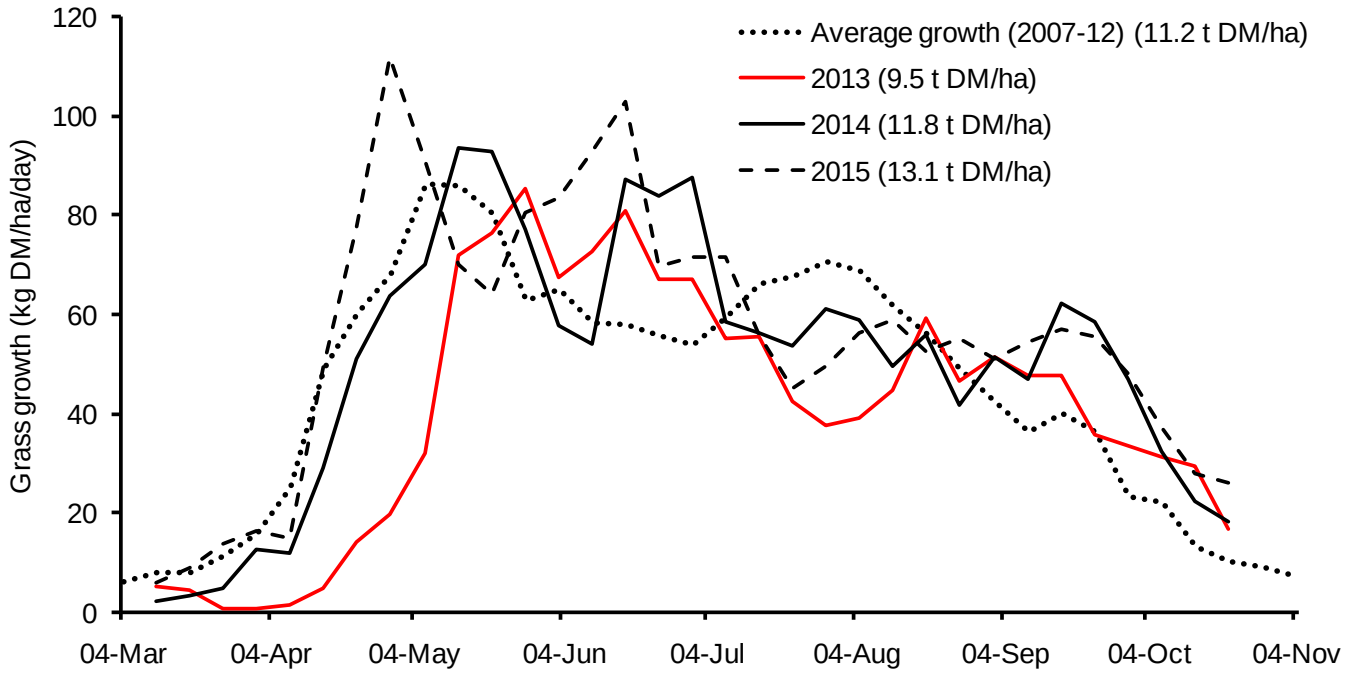
at was 11.9 MJ/kg DM, with the average crude protein being 20.2% DM. The average weekly grass quality recorded at the sites over the duration of the growing season is shown in Appendix 7.

Overall summary

Grass growth

This project included three full growing seasons, and grass growth during the season was very different between years. The average weekly grass growth measured at the four sites at Hillsborough and Greenmount is shown on Figure 7, with the long term average grass growth also included for comparison, with the sites also presented seperately in Appendices 13 and 14. The very difficult spring in 2013 is especially evident from Figure 7, although there is also an increasing trend for below average growth for long periods of March, April and early May, with weekly growth below the long term average for the majority of this period in each of these three years. Mid season growth followed a similar pattern in each of these years with growth generally higher than average during June yet below average during July and early August, although the extent of the difference in growth was widely different between years. The other notable similarilty in the growth recorded during these three years was the strong growing conditions at the end of the season, with 2014 and 2015 recording growth well inexcess of the long term average throughout mid and late September and early October.

Figure 7 The average weekly grass growth from the sites at Hillsborough and Greenmount measured in 2013, 2014 and 2015 compared to the long term average (2007-2012)

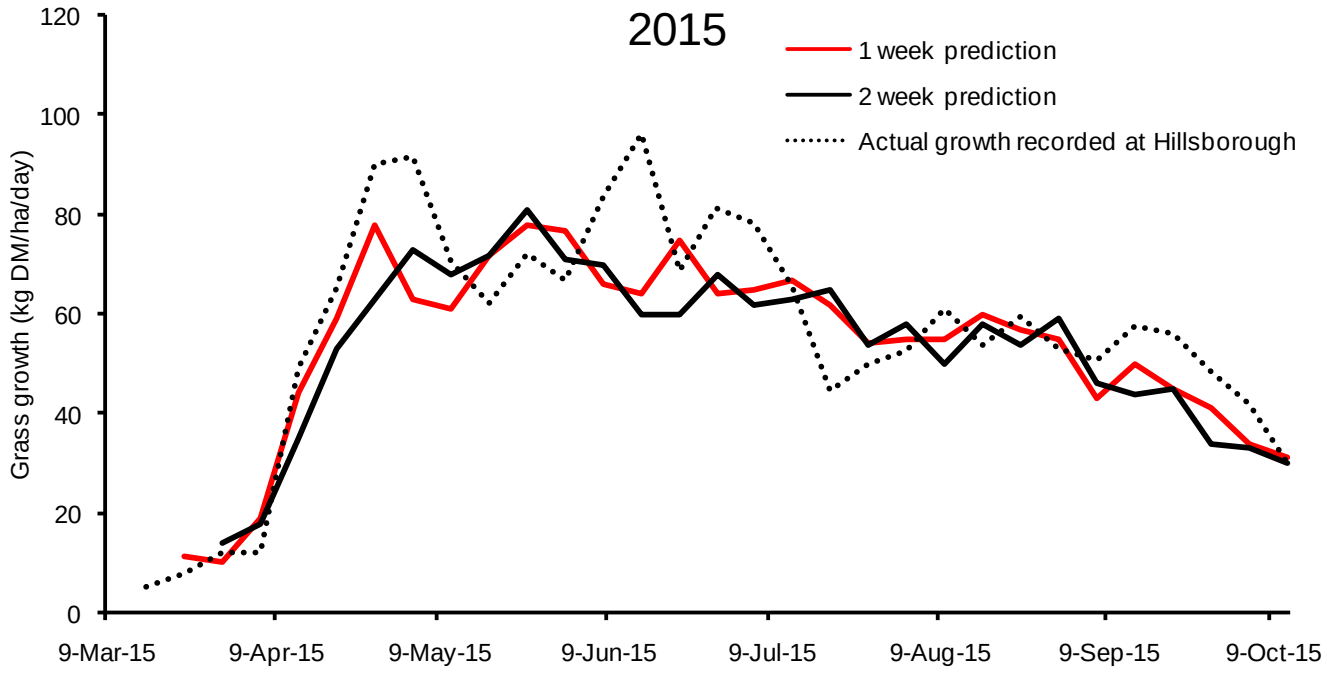


Regional growth predictions.

Throughout the three years of this project, the grass growth predictions were produced on a regional basis, with separate growth predictions generated for north, south, east and west regions of Northern Ireland. To facilitate these predictions, actual weather data was collected weekly from a series of weather stations positioned across Northern Ireland, weather forecasts were downloaded for the different regions and four versions of the model were run each week. Whilst the weather data is essential to be able to run the model, there are many factors which can impact on growth within the same region, and it is impossible to include all these factors in the production of a single regional prediction. Soil type, previous sward management and fertiliser N use are examples of factors which can vary between neighbouring farms, and indeed, can even vary within the same farm.

In terms of the performance of the model predictions during the three years of this project, the comparison of the predictions with the actual recorded at Hillsborough during 2013 and 2014 are presented in Appendix 15, with the 2015 data presented in Figure 8. During 2015, the one week and two week predictions has an r^2 of 0.75 and 0.65, with the main areas of difficulty being an underestimate of peak growth early May and in late season. The one and two week predictions during 2013 had an r^2 of 0.78 and 0.58, and in 2014 the respective values were 0.79 and 0.62.

Figure 8 Comparison of the grass growth simulated by the model and the actual grass growth recorded on the cut plots at Hillsborough during 2015



Additional information within bulletins – Grazing Management Focus

The inclusion of additional grassland and herd performance information in the weekly bulletin was an important development to the project in recent years. This element of the project was aimed at improving the overall interpretation of the growth data presented, with above/below average growth rates from the monitored sites reflected as surpluses or deficits of grass on the grazing platforms on actual dairy herds. Whilst this element was never designed to demonstrate best practise grazing management, some of the data presented in this feature received criticism from the dairy industry.

Distribution of the information collected by the project

The information collated by this project continues to be prepared as a 'weekly bulletin,' with the bulletins now uploaded weekly to the internet, and circulated around an extensive email distrubtion list in addition to being published in the weekly farming press. The weekly bulletins and the periodic press releases are all available on the Rural Portal and AFBI websites. An example of the bulletin as it appeared in the farming press during the three years of this project are presented in Appendix 8 and 9.

KEY PRESENTATIONS

- 30 weekly bulletins within the farming press in 2013 (18 March to 7 October).
- 31 weekly bulletins within the farming press in 2014 (17 March to 13 October).
- 31 weekly bulletins within the farming press in 2015 (16 March to 12 October).
- Press release: GrassCheck: Providing information to help improve the efficiency of grassland utilisation. Andrew Dale and Albert Johnston. April 2013
- Press release: Winter forage shortfall – act now to close the gap. Andrew Dale and Albert Johnston. August 2013
- Press release: Make the most of autumn grass! Andrew Dale and Albert Johnston. September 2013
- Article published in Northern Ireland Veterinary Today magazine. Predicting growth. Andrew Dale and Albert Johnston. Summer 2013
- Press release: The 2013 grass growing season – A year of extremes. Andrew Dale and Albert Johnston. November 2013
- Press release: GrassCheck returns as prospects for turnout improve. Andrew Dale and Norman Weatherup. March 2014
- Press release: GrassCheck 2014: Floods of autumn grass, then autumn floods! Andrew Dale and Norman Weatherup December 2014
- Press release: A renewed focus on grass management is essential. Andrew Dale and Norman Weatherup. April 2015
- Press release: A challenging year ends with an exceptional autumn! Andrew Dale and Norman Weatherup. December 2015
- A review of herbage mass estimation techniques appropriate for Northern Ireland, and suggested developments to improve adoption and accuracy of grassland management assessments – January 2015
- Article published in March 2016 edition of the CAFRE Dairy bulletin. Reducing milk production costs – grazing is key. Andrew Dale.

Presentations to farmer/industry groups

- Fodder Taskforce Group – summer and autumn 2013. Information from this project was utilised by this group which included many stakeholders (banks, UFU, NIAPA, NIGTA, NIMEA, Dairy UK). Two press releases were prepared in response to issues raised by this group based on information generated from this project.

- Loughgall Open Day – 12 June 2014. The weekly bulletin was outlined in detail to the 100 attendees, including how the data is collected and how best to use the information for making timely and correct grassland management decisions.
- Open Board meeting – 4 September 2014. Approximately 25 attendees at the AFBI Open Board meeting at Hillsborough took part in a tour of the dairy unit. As part of this tour the GrassCheck project was outlined to the visitors, with the group visiting the GrassCheck site at Hillsborough.

Throughout the three years of the project the results from the project were presented to a number of other groups including:-

30 April 13	Chilean farmers (x16)
25 July 13	Moovers and Shakers, Dairy Co (x 10)
19 Sept 13	Markethill UFU (x 25)
22 Oct 13	Dundalk Agriculture Students (x 30)
22 Nov 13	Dr Dave Barber and Amy Anstis, Australia,
10 Dec 13	Dungannon Royal A level students (x35)
12 Dec 13	Winter Fair
6 Feb 14	Ag Tech final Yr students (x 25)
27 Feb 14	Kildalton students (x 25)
27 Feb 14	Armagh/Down UFU meeting (x 20)
20 May 14	Lisnagarvey 41 Club (x 20)
23 July 14	Dairy Co group (x 14)
29 July 14	China Agricultural University Scientists (x 4)
6 Oct 14	Greenmount students (x 40)
19 Feb 15	Kildalton Agri students (x 40)
13 May 15	Gurteen College students (x 30)
29 Sept 15	Dairy farmers from Chile (x10)
16 Feb 16	Markethill dairy farmers discussion group (x30)
18 Feb 16	Kildalton College students (x50)
2 March 16	Farmers meeting organised by AHDB, Dairy, Lancashire, England (x4)
2 March 16	Farmers meeting organised by AHDB, Dairy, Cheshire, England (x22)
3 March 16	Farmers meeting organised by AHDB, Dairy, Holywell, Wales (x25)
7 March 16	Cookstown dairy discussion group (x24)
8 March 16	Dundalk Agricultural students (x50)
24 March 16	Video describing the GrassCheck project was posted to the AgriSearch Facebook page, and received over 2,000 views in its first week
14 April 16	An article highlighting the poor growth during spring 2016 was published in the FarmWeek (pages 1 and 4), with the article featuring data collected by the GrassCheck project

APPENDIX 1 Annual fertiliser nitrogen application pattern throughout this project.

	Rate of N (kg N/ha)
*Before first cut	28 (urea)
After first cut	28 (urea)
After second cut	35
After third cut	35
After fourth cut	35
After fifth cut	25
After sixth cut	25
After seventh cut	25
After eighth cut	17
After ninth cut	17
TOTAL	**270**

* Applied to all plots in one blanket application

APPENDIX 2 Mean grass growth over the previous three-week period, as measured on a weekly basis at five sites within Northern Ireland during 2013

	Hillsborough		Greenmount		Downpatrick
	Near Maginess	Garden field	Upper Croft	Right Croft	
	Average grass growth (kg DM/ha/day)				
11-Mar	*	*	*	5.04	7.35
18-Mar	*	4.18	*	4.39	13.43
25-Mar	0.00	0.00	0.00	0.00	8.47
01-Apr	0.00	0.00	0.00	0.00	3.82
08-Apr	0.50	0.50	4.13	0.58	0.93
15-Apr	2.41	5.13	9.19	1.90	2.24
22-Apr	4.29	3.28	21.14	26.54	7.67
29-Apr	23.48	9.25	21.09	24.88	16.90
06-May	29.46	30.89	29.29	37.89	42.34
13-May	91.63	73.68	44.44	76.66	66.47
20-May	92.89	73.49	55.91	82.68	92.93
27-May	82.71	106.56	67.28	84.41	107.69
03-Jun	62.44	93.80	57.75	55.30	88.11
10-Jun	64.22	87.01	71.27	68.40	89.86
17-Jun	87.37	95.99	74.17	66.02	103.90
24-Jun	64.73	69.49	63.19	69.65	67.97
01-Jul	72.25	79.60	57.41	58.79	59.51
08-Jul	37.65	65.32	54.78	61.61	51.60
15-Jul	44.86	62.65	54.45	59.74	45.26
22-Jul	38.57	39.84	40.84	50.15	41.82
29-Jul	39.89	43.11	27.26	39.62	23.36
05-Aug	25.97	30.84	47.83	50.58	20.62
12-Aug	36.43	26.31	59.05	56.56	32.34
19-Aug	46.58	49.43	68.84	72.06	40.29
26-Aug	42.17	42.14	52.97	47.74	26.42
02-Sep[1]	*	47.94	49.58	56.76	28.36
09-Sep	*	48.35	51.36	43.27	21.62
16-Sep	*	40.73	56.11	46.24	13.33
23-Sep	*	44.50	35.82	26.74	18.79
30-Sep	*	34.40	39.01	27.17	16.68
07-Oct	*	31.51	32.82	28.63	21.45
14-Oct	*	29.47	32.94	25.75	22.25
21-Oct	*	22.35	14.61	12.46	18.84

[1] Plots removed from project at end of August

APPENDIX 3 Average weekly grass quality from the sites at Hillsborough and Greenmount throughout 2013

	Dry matter (%)	Metabolisable energy (MJ/kg DM)	Crude protein (% DM)	Acid detergent fibre (% DM)	Water soluble carbohydrates (% DM)
11-Mar-13	28.6	13.1	24.7	19.0	16.9
15-Mar-13	22.3	12.5	26.7	22.0	13.7
25-Mar-13	*	*	*	*	*
01-Apr-13	*	*	*	*	*
08-Apr-13	31.3	12.8	20.5	20.8	19.4
15-Apr-13	17.2	12.3	26.0	23.7	12.2
22-Apr-13	18.4	12.2	21.3	23.9	16.2
29-Apr-13	18.9	12.1	22.1	24.6	16.1
03-May-13	19.6	12.2	21.1	24.1	16.4
13-May-13	16.2	11.5	21.1	28.1	13.6
20-May-13	15.6	11.4	20.3	28.4	13.6
24-May-13	17.6	11.7	19.8	26.8	14.9
03-Jun-13	17.3	11.9	18.3	25.9	15.5
07-Jun-13	19.0	11.7	18.6	26.8	15.8
17-Jun-13	14.9	10.9	16.5	31.1	14.2
24-Jun-13	17.1	11.5	17.6	24.4	18.8
01-Jul-13	18.3	11.6	17.2	27.3	16.0
08-Jul-13	18.7	11.5	15.2	28.1	16.4
11-Jul-13	19.2	11.5	15.6	28.2	15.4
22-Jul-13	21.6	11.6	17.0	27.3	16.3
29-Jul-13	17.8	11.5	21.5	28.0	11.1
05-Aug-13	18.6	11.4	18.5	28.7	13.2
12-Aug-13	19.3	12.0	20.1	25.0	13.8
19-Aug-13	17.4	11.5	20.3	27.9	11.5
23-Aug-13	15.4	11.1	21.1	30.5	10.2
02-Sep-13	16.9	11.1	21.9	30.3	9.3
09-Sep-13	14.3	11.4	22.5	28.5	9.7
13-Sep-13	15.2	11.5	22.4	27.5	11.3
23-Sep-13	14.4	11.4	24.4	28.6	8.7
30-Sep-13	16.6	11.7	24.9	26.7	10.8
07-Oct-13	13.8	11.5	26.0	28.0	7.0
14-Oct-13	12.6	11.1	25.7	30.2	5.0
22-Oct-13	10.3	8.5	19.2	21.6	6.1

APPENDIX 4 Mean grass growth over the previous three-week period, as measured on a weekly basis at five sites within Northern Ireland during 2014

	Hillsborough		Greenmount		Downpatrick
	New Close	Garden field	Upper Croft	Right Croft	
	Average grass growth (kg DM/ha/day)				
10-Mar-14	*	*	*	*	7.25
17-Mar-14	*	4.00	4.00	2.00	23.38
24-Mar-14	*	6.80	5.45	1.99	18.82
31-Mar-14	3.37	14.10	14.26	8.48	16.22
07-Apr-14	9.71	18.93	10.21	8.05	29.11
14-Apr-14	24.89	38.19	25.71	26.56	35.69
21-Apr-14	46.82	66.24	44.66	45.37	48.79
28-Apr-14	66.45	68.99	54.93	63.79	63.51
05-May-14	82.29	82.97	54.12	60.69	57.33
12-May-14	104.43	107.01	82.91	79.80	72.39
19-May-14	99.50	105.35	78.07	87.95	76.21
26-May-14	78.45	89.45	71.44	69.26	71.40
02-Jun-14	59.95	68.21	52.11	50.74	60.19
09-Jun-14	51.82	48.01	57.46	58.65	58.92
16-Jun-14	104.76	103.44	73.66	67.35	69.43
23-Jun-14	81.68	91.07	86.61	76.17	57.17
30-Jun-14	85.53	113.27	80.66	71.20	46.12
07-Jul-14	66.63	58.12	49.72	59.72	33.66
14-Jul-14	61.46	59.39	50.93	52.63	29.90
21-Jul-14	58.53	53.21	49.23	52.54	43.35
28-Jul-14	75.19	69.70	51.03	48.67	45.78
04-Aug-14	70.18	59.89	53.56	51.58	40.13
11-Aug-14	64.26	49.3	42.12	41.63	27.42
18-Aug-14	66.47	55.8	50.66	50.38	37.49
25-Aug-14	49.48	41.5	36.49	38.63	29.96
01-Sep-14	54.81	51.2	51.50	47.42	32.35
08-Sep-14	61.32	47.15	44.27	34.50	31.58
15-Sep-14	63.85	69.95	63.99	50.12	29.16
22-Sep-14	70.52	68.27	51.23	43.48	24.34
29-Sep-14	56.13	60.48	37.77	33.74	12.36
06-Oct-14	30.62	37.07	30.37	31.03	16.41
13-Oct-14	14.93	28.10	21.89	24.27	16.48
20-Oct-14	18.29	21.43	16.91	14.85	15.09

APPENDIX 5 Average weekly grass quality from the sites at Hillsborough and Greenmount throughout 2014

	Dry matter (%)	Metabolisable energy (MJ/kg DM)	Crude protein (% DM)	Acid detergent fibre (% DM)	Water soluble carbohydrates (% DM)
10-Mar-14	17.0	12.4	26.3	22.8	12.4
17-Mar-14	18.7	12.4	23.7	22.6	14.4
24-Mar-14	20.7	12.8	22.9	20.6	16.8
31-Mar-14	15.8	11.9	26.1	25.8	9.0
07-Apr-14	15.3	11.6	26.3	27.2	9.2
14-Apr-14	17.1	11.8	23.9	26.5	12.5
21-Apr-14	17.9	12.4	24.5	23.2	13.5
28-Apr-14	15.7	11.8	21.4	26.0	13.7
05-May-14	14.8	11.7	24.6	26.4	11.3
12-May-14	15.8	11.6	20.6	27.4	14.0
19-May-14	13.7	11.1	20.4	30.3	11.4
26-May-14	14.3	11.5	22.2	28.1	11.8
02-Jun-14	14.1	11.4	21.1	28.3	12.5
09-Jun-14	15.4	11.9	21.5	25.7	14.3
16-Jun-14	16.1	11.4	19.0	28.5	13.1
23-Jun-14	19.6	11.8	18.3	26.4	15.4
30-Jun-14	19.2	11.6	17.3	27.5	16.0
07-Jul-14	18.3	11.8	20.2	26.3	14.4
14-Jul-14	18.4	11.9	19.7	25.6	15.0
21-Jul-14	16.5	11.6	20.5	27.5	11.8
28-Jul-14	16.1	11.4	20.9	28.9	10.6
04-Aug-14	16.8	11.5	21.1	27.8	12.1
11-Aug-14	16.7	11.7	22.9	26.9	11.8
18-Aug-14	16.4	11.5	20.0	28.0	13.6
25-Aug-14	16.1	11.5	20.3	27.7	12.9
01-Sep-14	13.9	11.4	23.0	28.6	9.8
08-Sep-14	14.2	11.6	22.6	27.0	11.7
15-Sep-14	15.6	11.4	20.7	28.4	12.2
22-Sep-14	15.0	11.0	20.8	30.7	10.5
29-Sep-14	15.2	11.5	23.5	27.9	9.3
06-Oct-14	15.5	11.6	23.2	27.4	11.5
13-Oct-14	13.6	11.6	23.9	27.5	9.8
20-Oct-14	15.6	11.7	27.1	26.9	7.6

APPENDIX 6 Mean grass growth over the previous three-week period, as measured on a weekly basis at five sites within Northern Ireland during 2015

	Hillsborough		Greenmount		Downpatrick
	New Close	Garden field	Stoney field A	Stoney field B	
	Average grass growth (kg DM/ha/day)				
09-Mar-15	*	*	*	*	*
16-Mar-15	5.00	5.00	9.66	15.79	4.00
23-Mar-15	8.89	6.68	18.70	20.58	6.00
30-Mar-15	16.75	7.11	23.34	19.13	7.00
06-Apr-15	17.52	6.16	17.93	17.42	9.00
13-Apr-15	56.13	42.15	49.52	49.46	29.67
20-Apr-15	81.79	48.72	88.81	91.04	39.48
27-Apr-15	107.84	72.50	133.84	133.46	70.26
04-May-15	94.10	88.86	92.49	88.20	66.91
11-May-15	66.78	74.18	68.66	70.80	67.86
18-May-15	58.35	65.74	63.75	68.51	66.28
25-May-15	64.41	80.10	88.43	88.87	70.50
01-Jun-15	65.33	68.40	96.03	103.67	67.77
08-Jun-15	78.40	89.00	99.46	106.00	60.83
15-Jun-15	97.50	94.95	109.84	111.07	67.55
22-Jun-15	70.99	65.90	73.42	68.35	45.94
29-Jun-15	88.30	74.64	63.19	60.41	39.44
06-Jul-15	74.99	81.78	65.32	65.11	42.40
13-Jul-15	70.46	60.57	44.86	47.15	33.49
20-Jul-15	48.75	40.03	46.15	46.07	18.21
27-Jul-15	59.59	40.48	48.34	50.86	35.99
03-Aug-15	48.88	56.20	60.54	59.40	42.96
10-Aug-15	65.91	55.72	60.31	54.22	52.56
17-Aug-15	49.44	57.60	54.97	48.22	39.30
24-Aug-15	62.20	56.40	50.56	52.13	42.14
31-Aug-15	58.60	47.18	49.06	50.34	43.92
07-Sep-15	47.83	53.65	53.24	62.76	43.33
14-Sep-15	57.50	57.47	54.51	58.46	41.35
21-Sep-15	51.01	60.76	56.58	54.29	33.27
28-Sep-15	45.89	50.84	49.34	46.24	32.00
05-Oct-15	37.59	46.06	33.13	32.83	26.00
12-Oct-15	28.26	31.95	26.86	24.65	22.00

APPENDIX 7 Average weekly grass quality from the sites at Hillsborough and Greenmount throughout 2015

	Dry matter (%)	Metabolisable energy (MJ/kg DM)	Crude protein (% DM)	Acid detergent fibre (% DM)	Water soluble carbohydrates (% DM)
09-Mar-15	*	*	*	*	*
16-Mar-15	14.6	12.1	29.2	24.5	9.3
23-Mar-15	22.2	13.1	24.2	19.1	16.6
30-Mar-15	17.4	12.5	24.9	22.4	15.1
06-Apr-15	17.1	12.3	27.5	23.5	11.1
13-Apr-15	16.2	12.0	22.1	24.9	16.8
20-Apr-15	16.8	11.9	21.3	25.9	14.9
27-Apr-15	18.5	12.2	18.1	23.8	19.8
04-May-15	16.2	12.2	19.5	24.0	16.9
11-May-15	15.0	11.6	23.1	27.4	12.1
18-May-15	14.7	11.9	21.5	25.7	14.2
25-May-15	14.5	11.6	18.9	27.7	13.4
01-Jun-15	15.8	11.5	17.5	27.8	15.7
08-Jun-15	16.6	11.9	17.6	25.5	17.4
15-Jun-15	19.6	12.1	14.5	24.5	20.7
22-Jun-15	16.0	11.7	17.5	27.1	15.9
29-Jun-15	18.7	12.0	17.7	25.5	17.1
06-Jul-15	18.2	11.7	15.6	26.9	17.3
13-Jul-15	22.4	12.4	17.1	23.0	19.4
20-Jul-15	16.3	11.9	17.9	25.6	16.2
27-Jul-15	15.8	12.0	17.4	25.2	16.2
03-Aug-15	18.6	12.0	14.8	25.3	18.7
10-Aug-15	15.5	11.7	17.9	26.6	14.4
17-Aug-15	17.1	12.0	18.5	25.5	15.5
24-Aug-15	14.4	11.8	19.7	26.1	13.0
31-Aug-15	14.2	11.6	22.0	27.4	10.6
07-Sep-15	14.2	11.7	19.7	27.0	13.9
14-Sep-15	13.0	11.8	21.8	26.4	12.0
21-Sep-15	13.9	11.9	20.5	25.6	13.5
28-Sep-15	13.9	11.5	22.5	27.9	11.0
05-Oct-15	13.9	11.8	21.8	26.2	11.9
12-Oct-15	13.4	11.8	23.2	26.1	11.4

APPENDIX 8 An example of the weekly bulletins released to the farming press during 2013 and 2014.

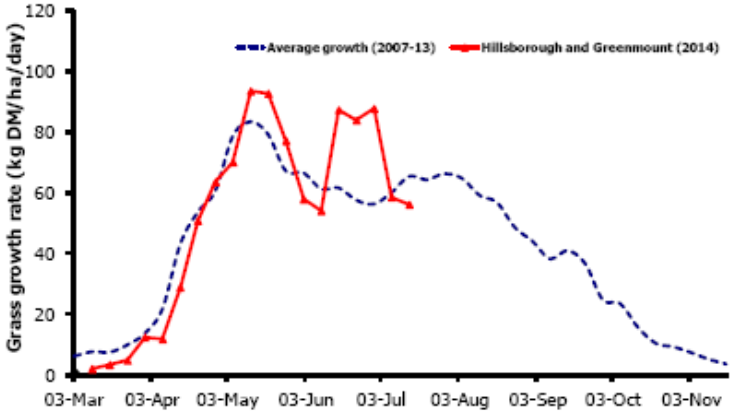
GrassCheck

Grass Growth and Quality

Week beginning 14 July 2014

Grazing Management Focus

Kenneth, Sheila and Geoffrey Malcomson manage a 120-cow Holstein herd along with 45 pedigree Charollais sheep at Donaghmore, near Newry, Co. Down. The herd is mainly winter calving with cows calving from September onwards. The grazing platform is approximately 26 ha with additional area being able to be brought in if needed. Annual rolling herd performance is 7700 litres on 1.82 tonnes of concentrate – 3500 litres from forage.



3-week Grass Growth (kg DM/ha/day)*	
Greenmount	52
Hillsborough	60
Average	56

* 270 kg N/ha/year applied

Grass Quality	
Dry matter (%)	18
ME (MJ/kg DM)	11.9
Crude protein (%)	20
Sugars (% DM)	15

Grass supply

Average farm cover	2,495 kg DM/ha
Pre-grazing cover	3,116 kg DM/ha
7-day grass growth	53 kg DM/ha/day (based on farm cover)
Herd grass demand	61 kg DM/ha/day

Cow performance

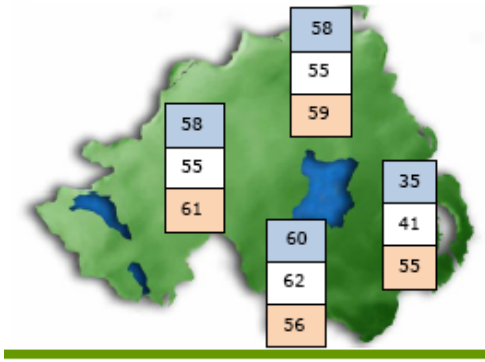
Milk yield and quality	23 litres/cow/day, 3.66% BF, 3.22% PR
Milk from forage	18 litres/cow/day
Concentrate feed level	2.5 kg/cow/day

Management issues

48 ha of 1st cut silage was ensiled on 13th May with a further 40 ha of 2nd cut being made on 23rd June. 3rd cut silage ground has received 70 kg N/ha and 30 kg K/ha while grazing ground receives 32kg N/ha after each grazing. A further 16 ha of maize and 19 ha of grain are also grown to be fed as part of a TMR this winter.

Cows are managed in one group and have been grazing full time from 20th April 2014. Currently grass demand is exceeding supply so round bale silage will be offered at milking time to meet this shortfall until 2nd cut aftergrass can be brought into the grazing platform. In addition, 13 cows have already been dried off as the average days in milk is 240 and calving is due to commence at the end of August.

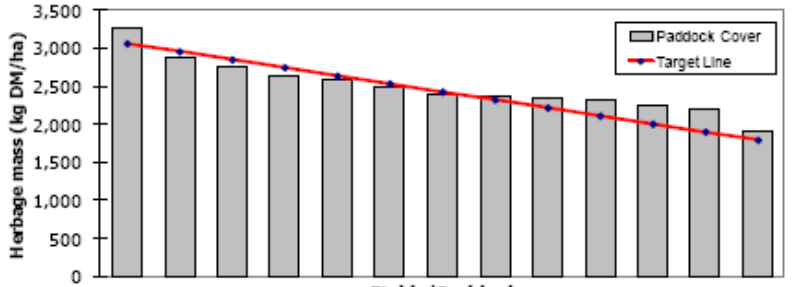
Grass growth predictions represent the average daily growth over a 21 day period.



Grass Growth Predictions (kg DM/ha/day)

Current
1 week ahead
2 weeks ahead

Comment: Showery and warm weather should keep growth up around seasonal average. Dry soils are still in moisture deficit, and this continues to restrict growth in some areas.



Target line in wedge reflects a pre-grazing target of 3100 kg DM/ha and a post-grazing target 1800 kg DM/ha. This is the quantity of grass required for a stocking rate of 4.3 cows/ha (112 cows grazing 25.9 ha) and a rotation length of 21 days, with cows eating 14 kg grass DM/day.

cafre College of Agriculture, Food & Rural Enterprise

afbi Agri-Food and Biosciences Institute

AgriSearch Farmer Funded Research

Department of Agriculture and Rural Development

Also available on DARD Rural Portal http://www.ruralni.gov.uk/grasscheck

GrassCheck is part funded through producers' levy.

GrassCheck 14 07 14 malcomson.pdf - Adobe Reader

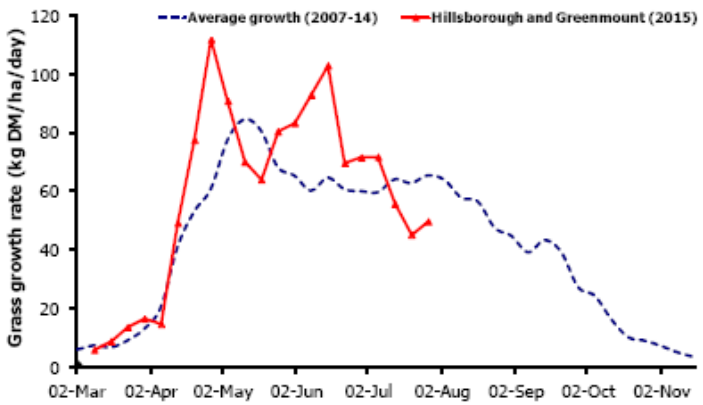
APPENDIX 9 An example of the weekly bulletins released to the farming press during 2015.

GrassCheck

Grass Growth and Quality

Week beginning 27 July 2015

Grazing Management Focus



3-week Grass Growth (kg DM/ha/day)*	
Greenmount	50
Hillsborough	50
Downpatrick	36

*270 kg N/ha/year applied

Grass Quality	
Dry matter (%)	16.2
ME (MJ/kg DM)	12.0
Crude protein (%)	17.4
Sugars (% DM)	16.2

Chris Catherwood is farm manager in an equity partnership with the Rankin Family at Crossnamuckley, near Newtownards. The 220 cow herd block calves in spring and places maximum emphasis on milk from grazed grass. 2014/15 CAFRE Benchmarking results for the farm show a yield of 7300 litres, feeding 1400kg of concentrates equating to 4200 litres of milk from forage. This excellent performance requires great attention to detail and a high standard of grassland management.

Grass supply

Average farm cover	2,295 kg DM/ha
Pre-grazing cover	3,010 kg DM/ha
Current grass growth	69 kg DM/ha/day
Herd grass demand	52 kg DM/ha/day

Grass wedge

Stocking rate	3.2 cows/ha
Rotation length	21 days
Estimated grass intake	16 kg DM/cow/day
Post-grazing target	1,500 kg DM/ha

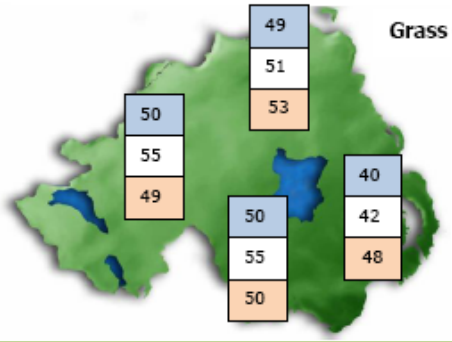
Cow performance

Milk yield and quality	25.5 litres/cow/day, 3.99% BF, 3.41% PR
Concentrate feed level	3.0 kg/cow/day
Milk from forage	18.8 litres/cow/day

Management issues

2nd cut silage was taken on 1st July, 3 weeks earlier than last year. This area is now within the grazing platform as would normally be the case but is available one rotation earlier thus explaining the surplus within the grass wedge. Paddocks will be baled if the surplus continues and covers exceed 3500kg DM/ha. However, Chris is reluctant to do this after August to ensure there is sufficient grass to extend the grazing season. Target entry cover is 2800 – 3000 kg DM/ha, exiting at 1500kg DM/ha. Grass quality remains very high with swards being pre mowed rather than topping aftermaths. 120kg/ha (50kg/acre) of Goulding's Selenigrass (25% N, 2% Mg, 0.002% Se) is currently being sown after grazing.

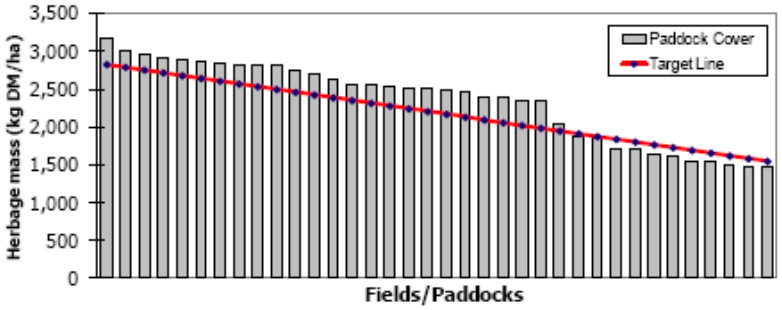
Grass growth predictions represent the average daily growth over a 21 day period



Grass Growth Predictions (kg DM/ha/day)

Current
1 week ahead
2 weeks ahead

General comment: The continuing cool and very unsettled weather is affecting growth and grazing conditions in many areas, with growth at all sites remaining below the seasonal average.



Also available on DARD website
www.dardni.gov.uk/index/farming/livestock/grass/grasscheck.htm
GrassCheck is part funded through producers' levy.

APPENDIX 10 Weekly soil moisture content (ratio moisture to dry) at each of the sites throughout 2013

	Hillsborough		Greenmount		Downpatrick
	Near Maginess	Garden field	Upper Croft	Right Croft	
	Average grass growth (kg DM/ha/day)				
11/03/2013	*	*	*	*	*
18/03/2013	*	*	*	*	*
25/03/2013	*	*	*	*	*
01/04/2013	*	*	*	*	*
08/04/2013	*	*	0.74	0.79	0.52
15/04/2013	0.90	0.71	0.84	0.86	0.58
22/04/2013	0.93	0.66	0.93	0.80	0.50
29/04/2013	0.85	0.60	0.87	0.78	0.53
06/05/2013	0.78	0.58	0.77	0.75	0.51
13/05/2013	0.96	0.65	0.83	0.92	0.55
20/05/2013	0.91	0.69	0.77	0.79	0.71
27/05/2013	0.88	0.62	0.81	0.75	0.50
03/06/2013	0.76	0.58	0.65	0.68	0.50
10/06/2013	0.65	0.44	0.71	0.55	0.34
17/06/2013	0.78	0.49	0.61	0.66	0.44
24/06/2013	0.74	0.53	0.81	0.75	0.39
01/07/2013	0.71	0.51	0.65	0.68	0.39
08/07/2013	0.62	0.44	0.58	0.63	0.38
15/07/2013	0.54	0.37	0.48	0.53	0.31
22/07/2013	0.36	0.29	0.35	0.38	0.20
29/07/2013	0.32	0.30	0.41	0.43	0.19
05/08/2013	0.49	0.42	0.57	0.59	0.28
12/08/2013	0.41	0.42	0.45	0.44	0.21
19/08/2013	0.47	0.49	0.51	0.48	0.23
26/08/2013	0.42	0.43	0.57	0.53	0.21
02/09/2013	0.40	0.39	0.54	0.48	0.20
09/09/2013	*	0.48	0.61	0.49	0.28
16/09/2013	*	0.51	0.60	0.61	0.30
23/09/2013	*	0.50	0.54	0.53	0.24
30/09/2013	*	0.45	0.55	0.59	0.32
07/10/2013	*	0.51	0.60	0.56	0.35
14/10/2013	*	0.53	0.59	0.58	0.29
21/10/2013	*	0.67	0.64	0.68	0.38

NB. At a soil moisture:dry soil ratio below 0.40, growth rates are likely to be reduced

APPENDIX 11 Weekly soil moisture content (ratio moisture to dry) at each of the sites throughout 2014.

	Hillsborough		Greenmount		Downpatrick
	New Close	Garden field	Upper Croft	Right Croft	
	Average grass growth (kg DM/ha/day)				
10/03/2014	*	*	*	*	*
17/03/2014	0.72	0.69	0.65	0.76	*
24/03/2014	0.57	0.74	0.77	0.72	*
31/03/2014	0.59	0.74	0.68	0.71	*
07/04/2014	0.77	0.64	0.72	0.75	0.52
14/04/2014	0.64	0.66	0.72	0.77	0.52
21/04/2014	0.50	0.61	0.69	0.72	0.49
28/04/2014	0.43	0.56	0.64	0.64	0.43
05/05/2014	0.52	0.55	0.73	0.69	0.36
12/05/2014	0.63	0.58	0.76	0.78	0.40
19/05/2014	0.57	0.62	0.76	0.72	0.48
26/05/2014	0.58	0.57	0.74	0.74	0.41
02/06/2014	0.59	0.64	0.76	0.76	0.45
09/06/2014	0.54	0.64	0.78	0.76	0.50
16/06/2014	0.43	0.49	0.65	0.62	0.34
23/06/2014	0.30	0.33	0.47	0.54	0.25
30/06/2014	0.45	0.40	0.58	0.56	0.25
07/07/2014	0.52	0.47	0.51	0.53	0.30
14/07/2014	0.51	0.46	0.60	0.58	0.28
21/07/2014	0.42	0.42	0.57	0.50	0.26
28/07/2014	0.40	0.40	0.56	0.58	0.24
04/08/2014	0.43	0.48	0.66	0.66	0.36
11/08/2014	0.54	0.63	0.68	0.69	0.48
18/08/2014	0.55	0.50	0.71	0.67	0.34
25/08/2014	0.51	0.49	0.67	0.66	0.36
01/09/2014	0.55	0.61	0.74	0.77	0.32
08/09/2014	0.54	0.54	0.71	0.68	0.34
15/09/2014	0.44	0.42	0.64	0.62	0.24
22/09/2014	0.37	0.39	0.57	0.56	0.25
29/09/2014	0.36	0.37	0.53	0.55	0.25
06/10/2014	0.53	0.53	0.68	0.69	0.46
13/10/2014	0.56	0.58	0.68	0.71	0.42
20/10/2014	0.66	0.63	0.72	0.75	0.43

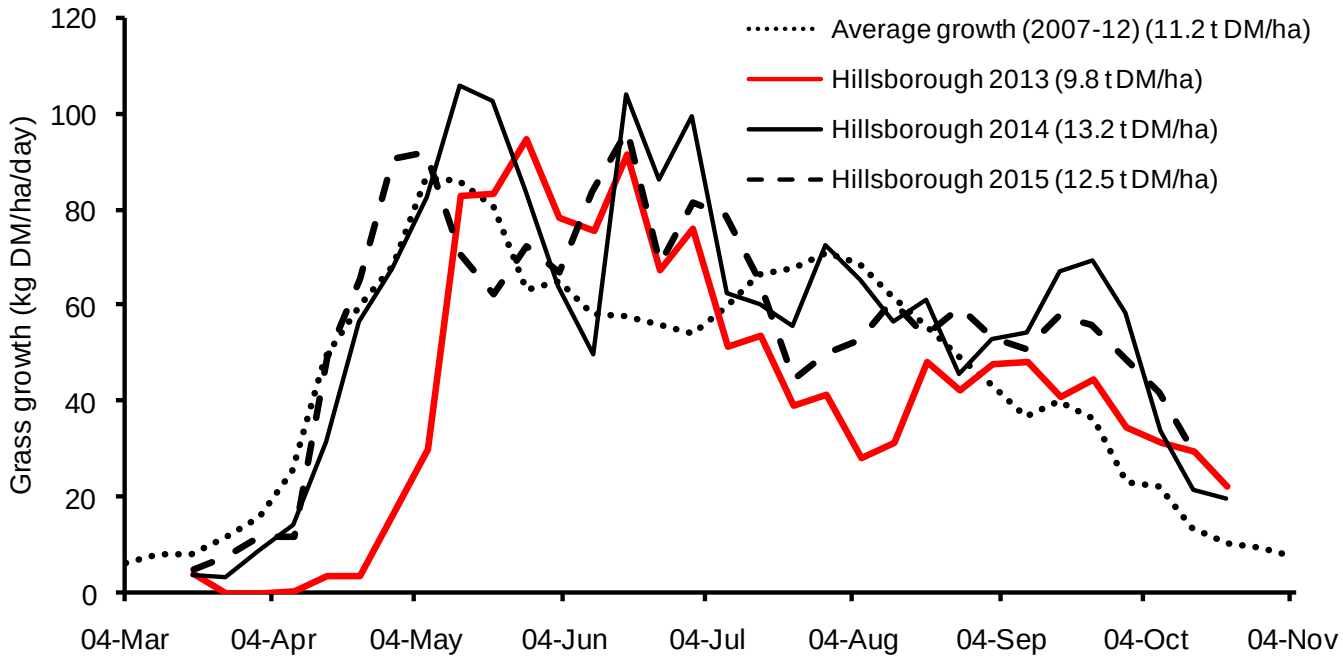
NB. At a soil moisture:dry soil ratio below 0.40, growth rates are likely to be reduced

APPENDIX 12 Weekly soil moisture content (ratio moisture to dry) at each of the sites throughout 2015.

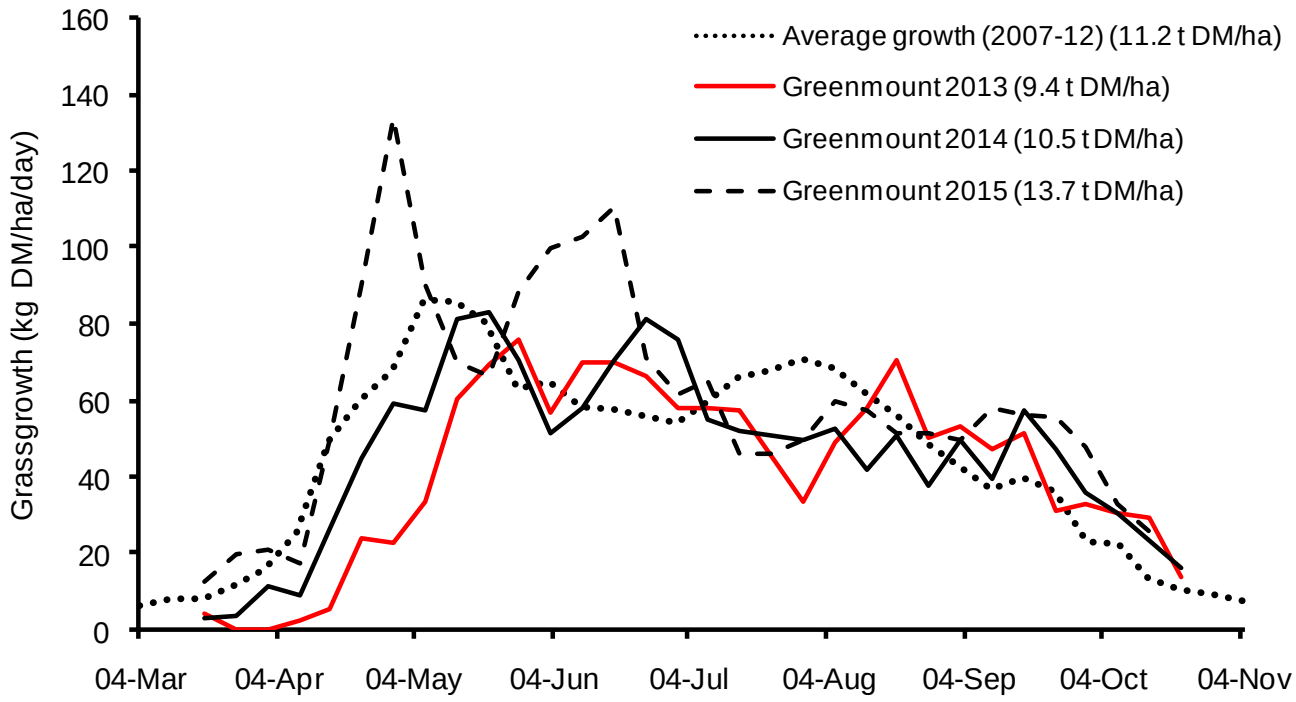
	Hillsborough		Greenmount		Downpatrick
	New Close	Garden field	Stoney field A	Stoney field B	
	Average grass growth (kg DM/ha/day)				
09/03/2015	*	*	*	*	*
16/03/2015	*	*	0.66	0.69	0.44
23/03/2015	0.59	0.67	0.58	0.57	0.49
30/03/2015	0.70	0.57	0.65	0.64	0.47
06/04/2015	0.69	0.77	0.68	0.65	0.48
13/04/2015	0.73	0.70	0.66	0.74	0.55
20/04/2015	0.58	0.62	0.56	0.54	0.46
27/04/2015	0.55	0.61	0.61	0.65	0.52
04/05/2015	0.58	0.67	0.63	0.65	0.50
11/05/2015	0.66	0.72	0.60	0.64	0.52
18/05/2015	0.67	0.70	0.61	0.61	0.44
25/05/2015	0.63	0.67	0.57	0.61	0.49
01/06/2015	0.57	0.67	0.59	0.58	0.53
08/06/2015	0.57	0.66	0.55	0.55	0.43
15/06/2015	0.38	0.44	0.35	0.34	0.35
22/06/2015	0.41	0.46	0.40	0.38	0.28
29/06/2015	0.44	0.41	0.40	0.40	0.34
06/07/2015	0.36	0.38	0.37	0.37	0.31
13/07/2015	0.39	0.37	0.42	0.43	0.40
20/07/2015	0.39	0.42	0.53	0.53	0.41
27/07/2015	0.52	0.51	0.58	0.55	0.55
03/08/2015	0.45	0.49	0.61	0.61	0.54
10/08/2015	0.51	0.57	0.59	0.65	0.44
17/08/2015	0.49	0.55	0.55	0.53	0.46
24/08/2015	0.61	0.57	0.59	0.61	0.34
31/08/2015	0.55	0.58	0.62	0.62	0.49
07/09/2015	0.49	0.58	0.59	0.60	0.46
14/09/2015	0.52	0.59	0.62	0.58	0.49
21/09/2015	0.57	0.63	0.63	0.64	0.52
28/09/2015	0.58	0.61	0.67	0.64	0.57
05/10/2015	0.58	0.57	0.59	0.60	0.56
12/10/2015	0.47	0.54	0.69	0.64	0.53

NB. At a soil moisture:dry soil ratio below 0.40, growth rates are likely to be reduced

APPENDIX 13 The weekly grass growth and the total annual herbage production (t DM/ha) recorded at the Hillsborough site during the three years of the project.



APPENDIX 14 The weekly grass growth and the total annual herbage production (t DM/ha) recorded at the Greenmount site during the three years of the project



APPENDIX 15 Comparison of the grass growth simulated by the model and the actual grass growth recorded on the cut plots at Hillsborough during 2013 and 2014.