Field trials on the performance of LessN for enhancing nitrogen utilisation in pasture

Part 2, Second and Third Harvests

A report prepared for

Donaghys

By

IWM Consultancy

SUMMARY

The first part of this report was submitted on 20th April 2011 and contained results from the first set of harvests within the first grazing period in six field trials. In two trials (Greenpark and Pendarves, Canterbury) plots were maintained after harvest for further assessment of residual effect of treatments before second grazing. In Pendarves, a repeat application of all treatments was made on the same plots and pasture growth was monitored for two grazing periods after that.

Significant increases in pasture growth and dry matter (DM) production was measured in the Pendarves trial but not in the trial at Greenpark. At Pendarves, pasture DM as measured by mowing was significantly greater in plots sprayed with LessN plus urea 40 than either the control or plots sprayed with urea 40 alone. Probe reading data showed increases in DM with the LessN plus urea 40 treatment but this increase was statistically significant over the control only. Reductions in pasture response to all treatments were observed in the successive harvests. This is often the case and nitrogen response is usually greater in the first grazing rotation after application.

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Introduction

The first part of this report, describing the results from six field trials on dairy farms was presented on 20th April 2011. The trials showed that on average, spraying a mixture of LessN at 3 L/ha and urea dissolved in water at 40 kg/ha increased pasture DM production by 38% as estimated by mowing or 47% as estimated by probing compared to the control. In comparison, increases in DM over the control by sprayed urea at 40 kg/ha without LessN was 21% as estimated by mowing and 26% as estimated by probing. The increase in pasture productivity obtained with the LessN treatment was similar to that of urea application at 80 kg/ha. The question of any residual effect from LessN was addressed by maintaining two of those trials for extra grazing periods. In one trial a second application of all treatments was made over the experimental plots to find out the pasture response to repeated applications. The current report will present results from these two trials and should be taken in conjunction with the first report.

Methodology

For a complete description of methodology, please refer to the first report and the protocol from Donaghys. The two farms selected for the extended study (details in Table 1) were the following:

Ross Stewart farm in Greenpark in which an extra harvest was undertaken.

Peter Webster farm in Pendarves in which a repeated application of treatments was undertaken in the same plots and data were collected during two successive harvests following.

Experimental design, data collection and analysis were the same as described in the first report. All data were arranged and tabulated in MS Excel worksheets and analysed using Genstat statistical programme.

Table 1. Details of trials carried out on different farms.

Owner/ manager	Location	Last grazing	Application date	Soil temp (℃)	Harvest date 1	Harvest date 2
Ross Stewart*	Greenpark	17/03/2011	17/02/2011	14	13/04/2011	--
Peter Webster	Pendarves	27/03/2011	3/03/2011 and 28/03/2011	12	28/04/2011	25/05/2011

* Pasture contained a high portion of forbs including plantain, chicory and dandelion.

Results

Greenpark trial

Analysis of variance on data from the second grazing period in this trial did not show any statistically significant effect from treatments on the pasture DM increase estimated either by probing or by mowing (Table 2). Similarly, pasture growth rate during the second grazing period was not statistically affected by any of the treatments. Nevertheless, non-significant increases in DM in plots sprayed with LessN plus dissolved urea 40 (LessN system) amounted to 25.8% when estimated by pasture probe and by 22.9% when measured by mowing. These results should be read in conjunction with the results from the first grazing period (first report, also quoted in Table 8, Appendix) that showed highly significant effects from the treatments

Table 2. Pasture dry matter (kg/ha) in different treatments measured within one grazing cycle in the trial at Greenpark during the second grazing cycle in March-April 2011 as estimated by different methods.

Treatment	DM (probe)	DM (mowing)	Growth rate (probe)
Control	585.8	482.5	26.6
Solid 40	638.1	425.3	29.0
Solid 80	654.9	511.5	29.8
Liquid 40	632.5	588.4	28.8
Liquid 40 + LessN	736.9	592.9	33.5
F Test	ns	ns	ns

Pendarves trial

First grazing after repeat application

Highly significant effects were observed on pasture production and growth rate in this trial following a second application of treatments (Table 3). One month after application, pasture DM increase estimated by probing was 1178 kg/ha in the control plots and 1407 kg/ha in sprayed urea at 40 kg/ha. Pasture DM in LessN system was 1475 kg/ha, a significant increase of 25% over the control and a non-significant increase of 5% over the sprayed urea 40 treatment. Pasture DM in the LessN system was statistically similar to that in solid urea 80 kg/ha treatment. Pasture growth rate data followed the same pattern.

Pasture DM estimated by mowing showed even greater response to the LessN system. Plots sprayed with LessN plus dissolved urea 40 produced significantly greater DM than any other treatment except solid urea at 80 kg/ha with which they were similar (Table 3). Pasture DM in the LessN system was 30% greater than the control and almost 22% greater than the sprayed urea at 40 kg/ha. The LessN system also showed significantly higher growth rate than control or urea 40 kg/ha treatments and was similar to solid urea at full rate.

It is noteworthy that increases in pasture DM in this grazing period follows highly significant increases measured during the first grazing period (first report, also quoted in Table 8, Appendix). Those results showed a statistically significant increase in pasture growth with lessN system over sprayed urea 40 amounting to 15.6%.

Table 3. Pasture dry matter (kg/ha) in different treatments measured within one grazing cycle in the trial at Pendarves during the first grazing cycle following a repeat application of treatments in March-April 2011 as estimated by different methods.

Treatment	DM (probe)	DM (mowing)	Growth rate (probe)
Control	1178.4 d	902.6 c	38.0 d
Solid 40	1435.8 bc	1040.1 b	46.3 bc
Solid 80	1567.0 a	1190.9 a	50.6 a
Liquid 40	1406.9 bc	964.7 bc	45.4 bc
Liquid 40 + LessN	1475.4 ab	1173.7 a	47.6 ab
F Test	**	**	**
$LSD_{0.05}$	130.0	120.3	4.2

Second grazing after repeat application

Significant treatment effects were observed on pasture growth in the second assessment, 58 days after the application of treatments. This was true whether pasture DM was estimated by probe or by mowing. The increase in pasture DM in LessN plus dissolved urea 40 over the control was more than 16% irrespective of the measurement method used (Table 4).

Table 4. Pasture dry matter (kg/ha) in different treatments measured within one grazing cycle in the trial at Pendarves during the second grazing cycle following a repeat application of treatments in April-May 2011 as estimated by different methods.

Treatment	DM probe	DM mowing	Growth rate
Control	908.0 b	541.9 b	39.5
Solid 40	907.0 b	534.6 b	39.4
Solid 80	1041.9 a	591.0 a	45.3
Liquid 40	956.4 ab	541.6 b	41.6
Liquid 40 + LessN	1054.9 a	632.5 a	45.9
F Test	*	*	*
$LSD_{0.05}$	124.3	70.6	5.4

Discussion

The extended monitoring and repeat application of treatments provided information on the longer term effect of LessN. In the trial at Pendarves site where a repeat application was carried out, pasture DM production in the LessN system was similar to that of the solid urea at 80 kg/ha at both grazing cycles following the repeat application (Tables 3 & 4). In order to elucidate the effect of LessN as an additive, one should compare pasture production in the LessN system with that in the sprayed urea 40 treatment. Although pasture DM was increased in the LessN system over sprayed urea 40, this increase was statistically significant only when DM was estimated by mowing method and not when it was measured by pasture probe. Piggot (1989) compared four methods for estimating pasture production, namely: visual estimate, pasture height, plate and probe readings and found no differences in their reliability or error. The difference in the two methods used in this study might have come from several possible sources. Firstly, probe readings are based on the density and total height of the pasture whereas mowing cuts only a portion of the total (hence lower DM values in mowing method). Secondly, probe readings were taken from the whole length of plots while mowing was taken from a 10 m length at one end only. Moreover, probe readings were taken at the beginning of the trial as a baseline and the increase in growth was recorded for individual plots. It is suggested that both sets of data be used together to provide a more reliable estimate of treatment effects.

The objective of this extended study was to investigate if there was a residual effect from urea or LessN treatments on pasture growth. Tables 5-7 bring in data from the part 1 of the report to provide a comparison for treatment effects over three measurement dates based on either probe readings or mowing methods. Based on percent increase in DM over the control, it seems the treatment effects showed a decline over time. For example, percent increase in DM over the control based on pasture probe readings decreased from 41% after the first application to 25% after the repeat application and further to 16% in the second grazing following that (Table 5). While it is expected for the effect of a fertiliser application to decrease in time, it is not clear why the effect of the repeat application was smaller than the first application despite the fact that the time interval between application and harvest has increased by ten days. Lower soil temperature (22 vs. 12℃), air temperature and light intensity in the second grazing period were contributing factors. It is also possible that the level of other soil nutrients had decreased and limited the full utilisation of LessN and urea. To quantify the residual effect from LessN system, similar trials should be conducted in the summer months along with monitoring and supplementing soil nutrients.

Results from the trial at Greenpark did not show significant increases in pasture production in the second grazing period (Tale 3) while statistically significant differences were observed in the first grazing period (Table 8, Appendix). This is often the case and most pasture response to nitrogen is seen in the first grazing rotation. The trial at Pendarves showed significant increases in pasture DM in both grazing periods although to a lower degree in the second period. It is possible that differences in species composition, pasture management, or soil fertility levels have contributed to a better response in the Pendarves trial.

Pasture DM increases at Pendarves measured at three grazing periods are presented in Tables 5-7 to show the general trend in response. Values for the first grazing period are taken from the first report. Dates for measurements are 24 March, 28 April and 25 May for the 1st, 2nd and 3rd periods, respectively. In general, a diminishing response to nitrogen treatments is observed in the second and third grazing periods.

Table 5. Pasture dry matter (kg/ha) as affected by different treatments in the trial at Pendarves measured at three grazing periods by pasture probe following two applications of treatments[1]. Values in brackets are percent increase in pasture DM over the control.

Treatment*	1st **	2nd	3rd	Total
Control	1159.8 c	1178.4 d	908.0 b	3260.1 c
Solid 40	1430.0 b	1435.8 bc	907.0 b	3860.3 b
Solid 80	1526.0 ab	1567.0 a	1041.9 a	4229.9 a
Liquid 40	1414.0 b (22%)	1406.9 bc (19%)	956.4 ab (5%)	3865.0 b (18.6%)
Liquid 40 + LessN	1634.3 a (41%)	1475.4 ab (25%)	1054.9 a (16%)	4182.4 ab (28.3%)
F Test	**	**	*	**
$LSD_{0.05}$	149.1	130.0	124.3	344.1

[1]Treatments were applied on 3 March and re-applied on 28 March.

Table 6. Pasture dry matter (kg/ha) as affected by different treatments in the trial at Pendarves measured at three grazing periods by mowing following two applications of treatments[1]. Values in brackets are percent increase in pasture DM over the control.

Treatment*	1st **	2nd	3rd	Total
Control	969.8 b	902.6 c	541.9 b	2414.3 c
Solid 40	1111.9 ab	1040.1 b	534.6 b	2686.6 bc
Solid 80	1087.8 b	1190.9 a	591.0 a	2869.6 ab
Liquid 40	1154.4 ab (19%)	964.7 bc (7%)	541.6 b (0%)	2660.8 bc (10.2%)
Liquid 40 + LessN	1293.5 a (33%)	1173.7 a (30%)	632.5 a (17%)	3099.6 a (28.4%)
F Test	**	**	*	**
$LSD_{0.05}$	192.3	120.3	70.6	309.7

[1]Treatments were applied on 3 March and re-applied on 28 March.

Table 7. Percent increase in pasture DM over the control in the trial at Pendarves measured at three grazing periods by different methods following two applications of treatments[1].

	Pasture probe			Mowing		
Treatment	**1st**	**2nd**	**3rd**	**1st**	**2nd**	**3rd**
Solid 40	23.3	21.8	-0.1	14.7	15.2	-1.4
Solid 80	31.6	33.0	14.7	12.2	31.9	9.1
Liquid 40	21.9	19.4	5.3	19.0	6.9	0.0
Liquid 40 + LessN	40.9	25.2	16.2	33.4	30.0	16.7

[1]Treatments were applied on 3 March and re-applied on 28 March.

References

Dastgheib F. 2011. Field trials on the performance of LessN for enhancing nitrogen utilisation in pasture. Part 1, First Harvest. A report prepared for Donaghys By IWM Consultancy. Submitted 20/04/2011.

Piggot G.J. 1989. A comparison of four methods for estimating herbage yield of temperate dairy pastures. *New Zealand Journal of Agricultural Research*. Vol. 32: 121-123.

Appendix

Table 8. Pasture dry matter (kg/ha) in different treatments measured in the first grazing cycle after application in the field trials in Greenpark and Pendarves during the summer of 2010-11. Values estimated by either pasture probe reading or mowing.

	Greenpark		Pendarves	
Treatment	**probe**	**mowing**	**probe**	**mowing**
Control	1242.9 c	902.4 c	1159.8 c	969.8 b
Solid 40	1290.8 bc	955.4 bc	1430.0 b	1111.9 ab
Solid 80	1718.6 a	1189.9 ab	1526.0 ab	1087.8 b
Liquid 40	1446.5 bc	1068.9 abc	1414.0 b	1154.4 ab
Liquid 40 + LessN	1649.1 ab	1259.7 a	1634.3 a	1293.5 a
F test	***	**	***	*
$LSD_{0.05}$	252.2	206.3	149.1	192.3

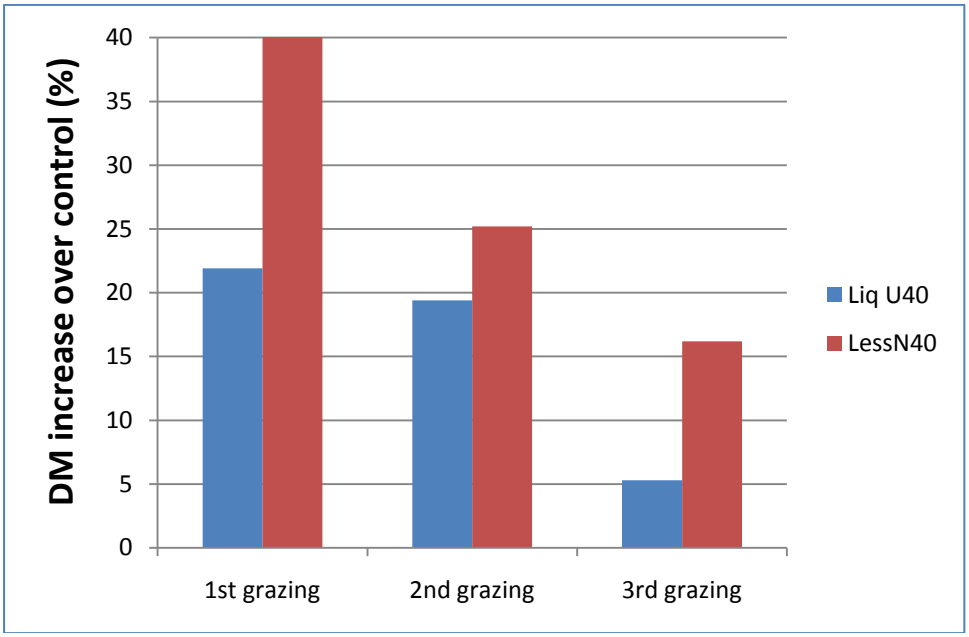

Figure 1. Percent increase in pasture DM over the control in the trial at Pendarves as estimated by pasture probe readings.

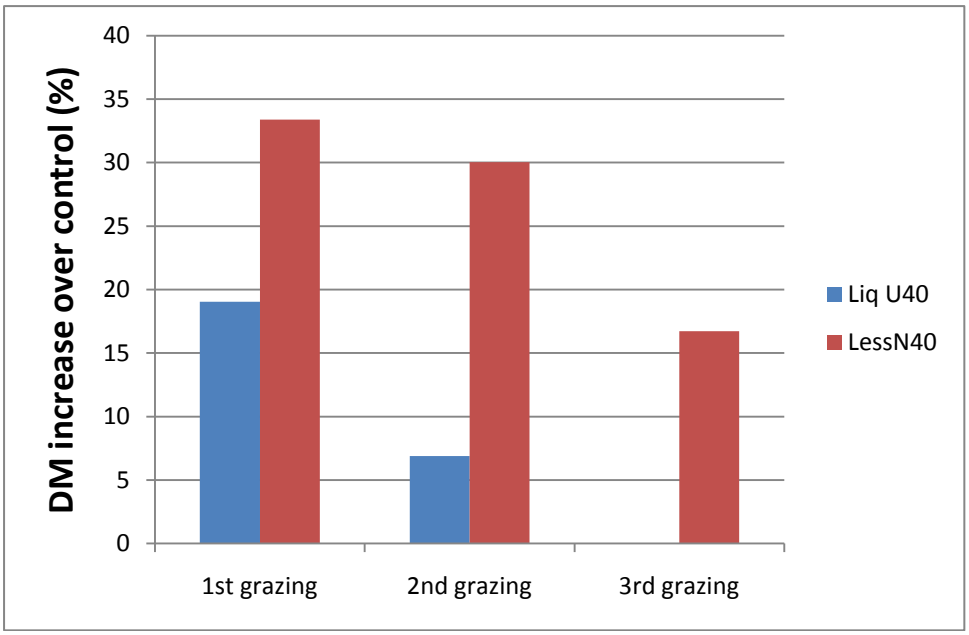

Figure 2. Percent increase in pasture DM over the control in the trial at Pendarves as estimated by mowing.