Final Report 2016

Project Title

Summary sheet (up to two pages)

Project number	74208		
Start date	June 2011	**End date**	November 2015

Project aim and objectives

The Recommended List for Grass and Clover (RGCL) is an annual independent, technical publication that provides essential information on grass and clover varieties. This enables the selection of grass and clover varieties that are suited to British production systems, maximising the productivity and efficiency of these systems. However a weakness in this evaluation system is the management of Recommended List trials can be different from that which occurs at farm level. While this occurs due to pragmatic reasons, it is essential to ensure evaluations from the RGCL trialling system can be reliably extrapolated to recommendations at farm level.
To address this issue AHDB commissioned NIAB to carry out experimental trials to assess the effect of nitrogen application levels (with particular focus on low input systems) on ryegrass (PRG) and Timothy (TIM) pure stands and mixed grass clover swards.
The aim of these trials was to assess the reliability of using recommendations from the current procedures for varieties when managed under low inorganic conditions.

Key messages emerging from the project

- Nitrogen increases dry matter yield with all species tested.
- The effect of N on quality is less and more variable than yield.
- No consistent significant differences in ranking were identified with PRG and TIM varieties with increasing N levels.
- Clover yield were significantly lower when grown in companion with Cocksfoot compared to PRG and TIM.
- Persistence was higher with higher N levels which could delay the need for re-sowing.
- The relative performance of varieties selected from the RGCL will be similar under most, lower N, conditions on farms.

Summary of results

Perennial ryegrass
There are clear increases in yield due to the additional N.

Dry matter yields (t/ha) from different N levels

	100 N	200 N	400 N	SE	LSD
Year 1 conservation	8.6	11.1	16.7	0.68	1.34
Year 2 simulated grazing	3.8	5.8	10.1	0.52	1.02
Year 3 conservation	5.0	6.8	12.7	0.7	1.39

Under the conservation management treatments Seagoe was the highest yielding variety under all three treatments with Premium and Rodrigo being the lowest two. There were significant differences between the varieties in the two lowest N treatments in the first year harvests and in all N treatments in the third year harvests but rankings were little changed.

Under the simulated grazing management AberGreen was the highest yielding variety under all treatments. Premium ranked higher under the 100 N treatment than the two higher levels of N. Differences in rank with other varieties were small and not significant.

D values showed no significant difference between 100N and 200N in any combination. However, there was a significant difference between the 400N compared to the 100 and 200N. With higher N levels D values decreased under conservation management in year 1 and increased under the simulated management in year 2.

Generally persistence improved with increasing N levels and there was less weed invasion in swards at the higher N levels. This was particularly noticeable at the Yorkshire site at Headley Hall. This could have a significant effect on the need to reseed. There were some changes in ranking between varieties although the differences in levels of ground cover were small.

Timothy

As with the PRG there were clear increases in yield due to the additional N. Yield differences between the varieties were small and there were no significant rank changes with the N treatments in comparison with the RGCL figures. As with the PRG the D values declined with increasing N levels under the second cut conservation management in year 1 but not with the first cut or the year 2.

Clover

There were significant differences between grass species in the yields of clover with less clover recorded when grown with Cocksfoot and more when Timothy was the companion species. There were no significant yield differences in the combined grass clover yields in both harvest years. Differences between the varieties used within grass species were small and not significant.

Two varieties of clover were used in the trials, both being medium leaf size types. Yields of Crusader were significantly lower than AberConcord in the second harvest year. Yields of grass and clover were similar with both clover varieties in both harvest years.

Lead partner	NIAB
Scientific partners	
Industry partners	
Government sponsor	

Has your project featured in any of the following in the last year?	
Events	***Press articles***
Grassland 2014 Demonstrations at open days	
Conference presentations, papers or posters	***Scientific papers***
Article in NIAB Landmark magazine Paper at BGS conference Poster at EGF conference	
Other	

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Full Report

Q1: Financial reporting –

	Yes	No	N/a
Was the project expenditure in line with the agreed budget?	X		
Was the agreed split of the project budget between activities appropriate?	X		
If you answered no to any of the questions above please provide further details:			

Q2: Milestones – were the agreed milestones completed on time?

Project milestones	**Proposed completion date**	**Actual completion date**
Sowing trials	September 2011	September 2011
Sowing trials	September 2012	September 2012
Harvesting grass trials	October 2012	October 2012
Maintenance of clover trials	October 2012	October 2012
Harvesting grass & clover trials	October 2012	October 2013
Harvesting grass & clover trials	October 2013	October 2013
Harvesting grass & clover trials	October 2014	October 2014
Harvesting grass & clover trials	October 2015	October 2015
If any of the milestones above are incomplete/delayed, please provide further details:		

Q3: Results – what did the work find?

Background

The Recommended List (RGCL) for Grass and Clover is an annual independent, technical publication that provides essential information on grass and clover varieties. This enables the selection of grass and clover varieties that are suited to British production systems, maximising the productivity and efficiency of these systems. However a weakness in this evaluation system is the management of Recommended List trials can be different from that which occurs at farm level. While this occurs due to pragmatic reasons, it is essential to ensure evaluations from the RGCL trialling system can be reliably extrapolated to recommendations at farm level.

To address this issue AHDB commissioned NIAB to carry out experimental trials to assess the effect of nitrogen application levels (with particular focus on low input systems) on ryegrass and Timothy pure stands and mixed grass clover swards. The aim of these trials was to assess the reliability of using recommendations from the current procedures for varieties when managed with low inorganic N levels.

Nitrogen rates on grassland have always been lower than tillage crops. Between 1983 and 1999 they were on average 27 kg/ha lower. However since 2000, grassland rates have consistently fallen and over the last five years the average difference has been 85 kg/ha. It is therefore important that variety trial results are applicable to lower N levels than those used in the RGCL trials. See Defra survey of fertiliser practice 2014: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/419275/fertiliseruse-statsnotice-01apr15.pdf

All trials were managed with the appropriate levels of P&K and at sites with acceptable pH levels.

Trial procedures

Perennial ryegrass trial

Trials for comparing the nitrogen rate for different perennial ryegrass monocultures (**PRG** trial) and Timothy monocultures (**TIM** trial) were sown at 3 locations in 2011 and two locations in 2012 and managed according to the National List (NL) trials procedures.

- Headley Hall (SE 443 414)
- Devon (SX 771 636)
- Harper Adams (SJ 716 201) (2011 sowing only)

PRG Varieties

AberGreen(D)	Aubisque(T)
Premium(D)	Montova(T)
Rodrigo(D)	Seagoe(T)

D – diploid, T – tetraploid

TIM Varieties

Comtal
Comer
Motim

The management of the trials was as per the NL procedures which can be accessed at: https://www.gov.uk/guidance/vcu-protocols-and-procedures-for-testing-agricultural-crops

With the exception of 2 separate Nitrogen (N) treatments:

Low; 100 kg N/ha^{-1}.

Medium; 200 kg N/ha^{-1}.

These were compared with the NL procedures (400 kg N/ha^{-1}).

The management of the trials followed a conservation (silage) management in the first and third year after sowing and a simulated grazing management in the second year after sowing. PRG and TIM varieties were grown in separate trials as the differences in heading dates required different harvest times under conservation management.

The sowing rates for the trials were as follows:

PRG Diploid 25 kg/ha
PRG Tetraploid 37 kg/ha
TIM 16 kg/ha

White clover companion cropping trials

Additional trials were sown at the same sites for comparing mixed white clover/ perennial ryegrass swards (**WC** trial) in 2011 and 2012, in the previously described three locations. The trials were managed under a pre-yield NL procedure the first year after establishments and thereafter following the NL procedures for harvest.

Six perennial ryegrass (*L. perenne*), three timothy (*Phleum pratense*) and three Cocksfoot (*Dactylis glomerata*) were selected. Each selected variety was sown with companion white clover (*Trifolium repens* L.) varieties Aberconcord and Crusader.

Table 1 – White Clover trial variety selection.

Perennial ryegrass	Timothy	Cocksfoot
AberGreen(D)	Comer	Abertop
Aubisque(T)	Comtal	Sparta
Montova(T)	Motim	Lidacta
Premium(D)		
Rodrigo(D)		
Seagoe(T)		

The management of the WC trials was as per the NL procedures which can be accessed at the location noted above. Clover was sown at 3.5 kg/ha. N application to the clover trials followed the NL procedures with 40kg/ha in February or March and a further 40kg/ha after each of the first four cuts.

Results

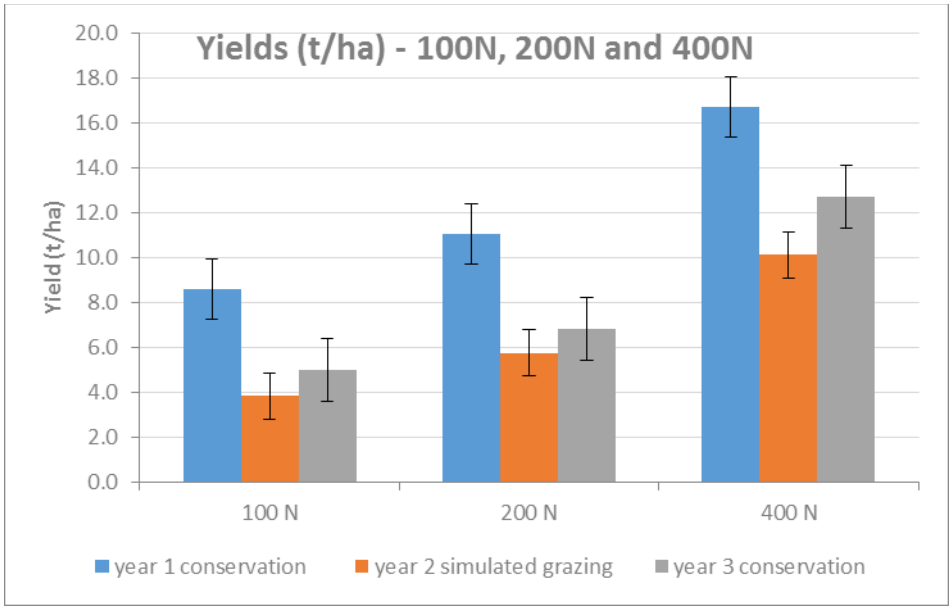
Perennial Ryegrass

Yields for each of the 3 N levels are shown in table 2 and figure 1 below. There are clear increases in yield due to the additional N.

Table 2 – Dry matter yields (t/ha) from different N levels

	100 N	200 N	400 N	SE	LSD
Year 1 conservation	8.6	11.1	16.7	0.68	1.34
Year 2 simulated grazing	3.8	5.8	10.1	0.52	1.02
Year 3 conservation	5.0	6.8	12.7	0.7	1.39

Figure 1 – Yields (t/ha) from each N level



Yields from the PRG varieties are shown in tables 3 – 5 below.

Table 3 - First Year Conservation Harvests – dry matter yields

	N LEVELS					
	100	**200**	**400**	**100**	**200**	**400**
Mean t/ha	8.6	11.1	16.7			
Variety	**Yields as % of mean within N level**			**Ranking**		
AberGreen	99	98	100	**3**	**4**	**2**
Aubisque(T)	101	101	99	**2**	**2**	**3**
Montova(T)	96	99	99	**5**	**3**	**4**
Premium	95	95	97	**6**	**6**	**6**
Rodrigo	97	98	98	**4**	**5**	**5**
Seagoe(T)	112	109	108	**1**	**1**	**1**
LSD	8.1	6.4	5.5			

Due to the low number of varieties it is not possible to provide any statistics in relation to ranking.

Table 4 -Third Year Conservation Harvests – dry matter yields

	N LEVELS					
VARIETY	**100**	**200**	**400**	**100**	**200**	**400**
Mean t/ha	5.0	6.8	12.7			
Variety	**Yields as % of mean within N level**			**Ranking**		
AberGreen	102	105	105	**3**	**2**	**2**
Aubisque(T)	98	101	97	**4**	**3**	**4**
Montova(T)	103	100	99	**2**	**4**	**3**
Premium	93	92	96	**5**	**6**	**6**
Rodrigo	92	94	96	**6**	**5**	**5**
Seagoe(T)	110	107	108	**1**	**1**	**1**
LSD	8.5	6.5	7.6			

Under the conservation management treatments Seagoe was the highest yielding variety under all three treatments with Premium and Rodrigo being the lowest two. There were significant differences between the varieties in the two lowest N treatments in the first year harvests and in all N treatments in the third year harvests but rankings were little changed.

Overall yields from the tetraploids are higher than the diploids from the both years' conservation management but not significantly so.

Table 5 - Second Year Simulated Grazing Harvests – dry matter yields

	N LEVELS					
VARIETY	**100**	**200**	**400**	**100**	**200**	**400**
Mean t/ha	3.8	5.8	10.1			
Variety	**Yields as % of mean within N level**			**Ranking**		
AberGreen	106	110	105	**1**	**1**	**1**
Aubisque(T)	98	96	97	**4**	**5**	**6**
Montova(T)	98	99	100	**5**	**4**	**3**
Premium	102	95	98	**2**	**6**	**5**
Rodrigo	96	100	99	**6**	**3**	**4**
Seagoe(T)	101	100	102	**3**	**2**	**2**
LSD	6.1	5.2	6.3			

Under the simulated grazing management AberGreen was the highest yielding variety under all treatments. Premium ranked higher under the 100 N treatment than the two higher levels of N. Differences in rank with other varieties were small and not significant. The diploids tend to be higher yielding than the tetraploids under this management.

Digestibility

Digestibility (D) was assessed from samples taken from the first and second conservation cuts in year one and from the 6th cut from the simulated grazing management in year two. No D values were recorded in the third harvest year. Table 5 shows the mean D values for each cut while Table 6 shows the individual variety means for year 1, cut 2.

Table 5 – Mean D values

	N LEVELS			LSD
Management	**100 N**	**200 N**	**400 N**	
Year 1 cut 1 (conservation)	74.3	73.4	70.6	1.39
Year 1 cut 2 (conservation)	74.7	74.6	71.1	2.08
Year 2 (simulated grazing)	71.2	71.9	74.4	1.56

D values showed no significant difference between 100N and 200N in any combination. However, there was a significant difference between the 400N compared to the 100 and 200N with decreasing N levels under conservation management in year 1 and increasing N levels under the simulated management in year 2.

Table 6 - D values for year 1 cut 2 (conservation)	**N LEVELS**			**RANKING**		
Variety	**100 N**	**200 N**	**400 N**	**100 N**	**200 N**	**400 N**
Abergreen	74.4	75.0	71.6	4	4	2
Aubisque(T)	75.9	75.7	70.6	1	1	5
Montova(T)	74.0	73.3	70.1	5	5	6
Premium	73.7	73.3	70.7	6	6	4
Rodrigo	75.5	75.0	72.4	2	3	1
Seagoe(T)	74.9	75.4	71.0	3	2	3
LSD	1.62	1.46	1.54			

The ranking of Aubisque was higher under the two lower N levels compared to the 400N level. Also Aubisque has significant interaction with Rodrigo being significantly lower than Rodrigo at 400N but higher at 100N and 200N.

Persistence
Persistence (expressed as percentage ground cover) was assessed at the end of each harvest year. Results from the second and third harvest years are presented in Table 7 below.

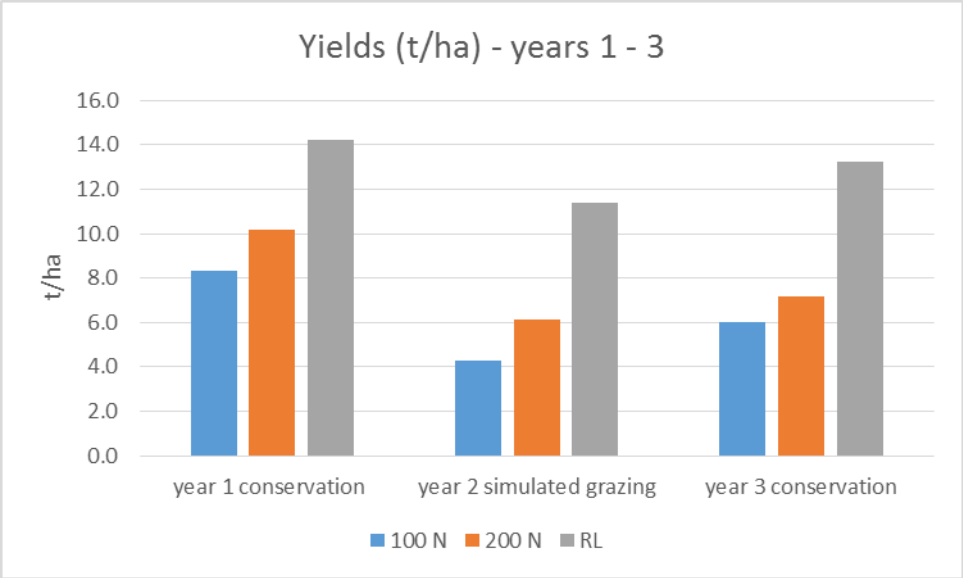
Table 7 – Ground cover scores

	N LEVELS					
Year 2 (simulated grazing)	**100**	**200**	**400**	**100**	**200**	**400**
	% ground cover			**Ranking**		
Abergreen	66	69	72	1	3	3
Aubisque(T)	61	65	73	5	4	2
Montova(T)	62	65	70	4	5	5
Premium	63	70	71	3	1	4
Rodrigo	64	69	75	2	2	1
Seagoe(T)	61	64	65	6	6	6
Mean	**63**	**67**	**71**			
Year 3 (conservation management)	**100**	**200**	**400**	**100**	**200**	**400**
	% ground cover			**Ranking**		
Abergreen	66	70	73	1	1	1
Aubisque(T)	60	63	62	5	6	5
Montova(T)	60	65	67	6	5	3
Premium	64	67	64	3	3	4
Rodrigo	65	70	67	2	2	2
Seagoe(T)	61	66	59	4	4	6
Mean	**63**	**67**	**65**			

Generally persistence improved with increasing N levels and there was less weed invasion in swards at the higher N levels. This was particularly noticeable at the Yorkshire site at Headley Hall. There were some changes in ranking between varieties although the differences in levels of ground cover were small.

Timothy
The trials with Timothy were limited to two N treatments (100 N and 200 N) only as there were no complementary RGCL trials at the sites growing the trials. For comparison, data from the RGCL tables are included to represent the higher N level. As with the PRG there were clear increases in yield due to the additional N.

Figure 2 – Yields (t/ha) from each N level



Yield differences between the varieties were small and there were no significant rank changes with the N treatments in comparison with the RGCL figures. As with the PRG the D values declined with increasing N levels under the second cut conservation management in year 1 but not with the first cut or the year 2. These are shown in Table 8 below.

Table 8 - Mean D values

	N LEVELS		
Management	**100 N**	**200 N**	**RGCL**
Year 1 cut 1 (conservation)	68.6	65.7	68.0
Year 1 cut 2 (conservation)	66.6	65.4	63.8
Year 2 (simulated grazing)	70.7	69.7	71.7

Differences of D values between the varieties in each of the treatments were small.

Nitrogen Use Efficiency (NUE)

Combining data from all managements produces an indication of NUE across the grass ploidies and species. This is shown in table 9 below.

Table 9 – kg/ha dry matter per kg N applied

	N Level		
Species	**100**	**200**	**400**
Diploid ryegrass	56.8	38.7	32.6
Tetraploid ryegrass	59.4	40.1	33.3
Timothy	62.1	39.1	32.4

With lower N levels the NUE was higher although yields were much lower. Timothy appear to perform relatively better under the 100N level than the PRG varieties.

White Clover

White clover and grass plus white clover yields with the four companion species are shown in table 10 below.

Table 10 – clover and grass/clover yields (t/ha)

	Year 2		Year 3	
Species	**clover**	**grass & clover**	**clover**	**grass & clover**
Cocksfoot	4.6	13.6	3.9	14.1
Diploid PRG	6.2	14.1	6.1	14.4
Tetraploid PRG	6.1	13.9	6.7	14.2
Timothy	6.7	13.2	7.4	13.9
Mean	5.9	13.7	6.0	14.1
lsd	0.86	1.23	0.79	0.88

There were significant differences between grass species in the yields of clover with less clover recorded when grown with Cocksfoot and more when Timothy was the companion species. There were no significant yield differences in the combined grass clover yields in both harvest years. Differences between the varieties used within grass species were small and not significant.

Levels of clover with each companion species from each harvest year are shown in Table 11 below.

Table 11 - % clover for third harvest year from each sowing

	% Clover		
Year	2011 sowing	2012 sowing	Mean
Cocksfoot	28.9	27.7	28.4
Diploid PRG	42.0	45.2	43.3
Tetraploid PRG	45.6	48.8	46.9
Timothy	53.1	53.8	53.4
Mean	42.4	43.8	43.0
LSD			5.53

Clover levels were significantly lower when grown with Cocksfoot and higher when grown with Timothy. There were higher levels of clover when grown with tetraploid PRG than with diploid PRG.

Two varieties of clover were used in the trials, both being medium leaf size types. Relative clover and grass/clover yields are shown in Table 12 below.

Table 12 – Yields (t/ha) of clover and grass/clover

	Year 2		Year 3	
Species	**clover**	**grass & clover**	**clover**	**grass & clover**
AberConcord	6.3	13.9	6.2	14.2
Crusader	5.5	13.5	5.8	14.1
LSD	0.61	0.87	0.56	0.62

Yields of Crusader were significantly lower than AberConcord in the second harvest year. Yields of grass and clover were similar with both clover varieties in both harvest years. At the first cut the yield of grass and clover were significantly lower with Cocksfoot than the other grass species. The yield of the clover/diploid ryegrass was lower than the clover/tetraploid ryegrass and clover/timothy at the first cut in year three harvest.

Two varieties of clover were used in the trials, both being medium leaf size types. Yields of Crusader were significantly lower than AberConcord in the second harvest year. Yields of grass and clover were similar with both clover varieties in both harvest years

Q4: Discussion – what do the results mean for levy payers?

The results mean that varieties can be selected with confidence from the RGCL for re-seeding pastures on farms that apply moderate to high levels of N fertiliser.

Q5: New knowledge – what key bit of new knowledge that has come out of this project?

- RGCL rankings are applicable to lower N levels.
- Clover does not perform well when sown with Cocksfoot as the companion grass.
- Timothy appears to perform relatively better than PRG under low N levels.

Q6: Gaps in knowledge – what gaps in knowledge did this project identify?

There are some queries in relation to digestibility across the N level.

Q7: Cost:benefit – what is value of this project?

This project provides confidence that the results from the RGCL remains of value to growers across a range of N input levels and therefor justifies the continuing input of AHDB funds to the RGCL project.

Q8: Additional deliverables – what activity is planned with the results from this project?

Activity	What is planned?	When likely to happen?
Events	Demonstration at Headley Hall in 2016	June
Press articles	Article in NIAB Landmark magazine	2016
Conference presentations, papers or posters	BGS Events	2016/2017
Scientific papers		
Other		
Other		