

Project number: 6515
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Incorporating white clover into intensive grass based dairy and sheep production systems



Key external stakeholders:

Grassland farmers
Dairy farmers
Advisors
Wider grassland farming industry
Agricultural science students
Postgraduate students
Scientists

Practical implications for stakeholders:

- Grass-white clover swards receiving 150 kg N/ha can grow the same quantity of herbage annually as a grass-only sward receiving 150 kg N/ha
- Milk solids yield is increased by 33 kg/cow when white clover is incorporated into grazed grass swards
- There was no effect of companion grass ploidy on sward clover content
- A white clover sowing rate of 5-7.5 kg/ha is recommended.

Main results:

- Grass-white clover swards receiving 150 kg N/ha can grow the same quantity of herbage annually as a grass-only sward receiving 150 kg N/ha
- Milk solids yield is increased by 33 kg/cow when white clover is incorporated into grazed grass swards
- A white clover sowing rate of 5 kg/ha is recommended under cow grazing and 7.5 kg/ha under sheep grazing
- Overall sward DM degradability was not different between grass-only and grass-white clover swards

Opportunity / Benefit:

- Potential to reduce N fertiliser use by incorporating clover in grass swards
- Potential to increase milk solids production by incorporating clover into N fertilised grass swards

Collaborating Institutions:

Teagasc Athenry
AFBI Northern Ireland
Queens University Belfast
University College Dublin

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1. Project background:

The literature and recent research identified benefits of including white clover in grazing systems. These benefits include: herbage production benefits comparable to ~150 kg N fertiliser/ha and increased feed quality, dry matter (DM) intake and milk production compared to grass only swards, as well as the potential to reduce fertiliser N input costs, reduce energy requirements for the manufacture and transport of N fertiliser, and the reduction of nitrous oxide emissions. Research at Teagasc Solohead has demonstrated the successful inclusion of white clover (hereafter refer to as clover) in low stocking rate (<2.2 LU/ha) milk production systems and found similar milk production per cow on grass clover and fertilized grass only swards. At Moorepark, in an intensive grazing system receiving 250 kg N/ha a grass clover sward produced 1.1 t DM/ha more than a grass only sward, and milk production per cow was 12 kg MS/cow greater on the grass clover system compared to the grass only system. Additionally, a plot trial examining the interaction between white clover and N application rate showed that grass clover swards produced 2.9 t DM/ha more than grass only swards, regardless of N fertiliser application rate. Grass clover swards can increase DM intake and milk yield relative to grass only swards. While there is a lot of interest in white clover at farm level, there are many unknowns around white clover inclusion in intensive grazing systems. This project examined the effect of white clover inclusion at different N rates in grazed swards; the effect of companion grass (tetraploid or diploid) on sward clover content, effect of sowing rate on white clover establishment and rumen degradation rates.

2. Questions addressed by the project:

- In high stocking rate systems can white clover replace some chemical N?
- Does incorporating white clover in grazed swards affect milk production?
- What is the ideal white clover sowing rate?
- Is the rumen degradation rate faster on grass-only or grass-white clover swards?

3. The experimental studies:

This project had 3 experiments:

Experiment 1: Herbage production and animal performance on grass clover swards receiving 150 or 250 kg N/ha application rates compared to grass only high N fertiliser swards. This was a systems experiment. There were three systems – grass-only receiving 250 kg N/ha, grass-white clover receiving 250 kg N/ha and grass-white clover receiving 150 kg N/ha. Each treatment was stocked at 2.74 cows per ha. Measurements included herbage production, sward white clover content, herbage quality, milk production, milk composition.

Experiment 2: The effect of white clover seeding rate with perennial ryegrass on white clover establishment and growth under simulated grazing and animal grazing. This experiment was undertaken at Teagasc, AGRIC, Moorepark and Teagasc, AGRIC, Athenry under simulated grazing and animal. There were five clover sowing rates: 0.0, 2.5, 5.0, 7.5 and 10.0 kg/ha and three PRG sward types; diploid, tetraploid and a 50:50 diploid: tetraploid mixture sown at a rate of 27.5 kg/ha. Animal grazing plots at Moorepark were grazed by dairy cows, while at Athenry they were grazed by sheep. All plots received 150 kg N/ha/year. Measurements included clover plant emergence which was measured eleven weeks post sowing, herbage production, sward clover content and perennial ryegrass tiller density and stolon mass.

Experiment 3: The dry matter, crude protein, and neutral detergent fibre (NDF) in situ degradation characteristics of the grazed swards in Experiment 1 (grass-only receiving 250 kg N/ha, grass-white clover receiving 250 kg N/ha and grass-white clover receiving 150 kg N/ha). Paddocks were grazed 9 times between February and November 2013 by dairy cows to a target post-grazing sward height of 4 cm.

Samples were collected from each paddock immediately prior to grazing. Rumen degradation of dry matter, crude protein and NDF was measured using the in situ rumen degradation technique.

4. Main results:

Experiment 1:

- Herbage production was similar across all three treatments – 13.5 t DM/ha
- Sward clover content was 26.6% on grass-white clover receiving 150 kg N/ha and 22.5% grass-white clover receiving 250 kg N/ha
- Annual milk solids yield per cow was greater on grass-white clover receiving 150 kg N/ha (499 kg/cow) and grass-white clover receiving 250 kg N/ha (497 kg/cow) compared to grass-only (464 kg/cow)

Experiment 2:

- As clover sowing rate increased clover plant emergence increased
- Perennial ryegrass sward type had no effect on clover plant emergence
- Clover plant emergence was greater under grazing than under cutting at Moorepark
- Regardless of seeding rate, including clover in the seed mix resulted in an increase in herbage production compared to no clover.
- A clover sowing rate of at least 5 kg/ha is required at Moorepark and 7.5 kg/ha at Athenry

Experiment 3:

- Sward type did not impact overall dry matter degradability.
- The grass-white clover sward receiving 150 kg N/ha had the smallest immediately degradable DM fraction and the greatest undegradable DM fraction while the grass-only sward receiving 250 kg N/ha had the greatest immediately degradable DM fraction and the smallest undegradable DM fraction.
- Sward type had an effect crude protein degradability which was greater on the two clover treatments compared to the grass-only.
- The NDF degradability was greatest on the grass-white clover sward receiving 150 kg N/ha and lowest on the grass-only sward receiving 250 kg N/ha measured up to 12 hours incubation in the rumen.

5. Opportunity/Benefit:

Results show that incorporating white clover in fertilised perennial ryegrass swards can result in increased herbage production, can reduce the requirement for chemical N fertiliser and can improve milk solids yield.

6. Dissemination:

Results from the project were presented at the Moorepark, Grange, Clonakilty and Athenry Open Days. Visitors to Moorepark, both national and international, received presentations on the project and many interesting discussions took place. Poster and oral presentations were made at the Agricultural Research Forum 2015, EGF Conferences in 2015, 2016, 2018 and 2019, and the International Symposium on the Nutrition of Herbivores in 2018. Results were presented at the Teagasc National Dairy Conference in 2016 and 2019, and at the Irish Grassland Association in 2015 and 2020. Results were also published in articles in TRResearch and Today's Farm. One paper has been published from this project, one is accepted and three more are in preparation.

Main publications:

Egan, M., Galvin, N. and Hennessy, D. (2018) Incorporating white clover (*Trifolium repens* L.) into perennial ryegrass (*Lolium perenne* L.) swards receiving varying levels of nitrogen fertiliser: effects on milk and herbage production. *Journal of Dairy Science*, 101:3412–3427.

Hennessy, D., McAuliffe, S. and Egan M. (2018) Herbage and milk production from grass-only and grass-clover swards. In: Proceedings of the 27th General Meeting of the European Grassland Federation: Sustainable milk and meat production from grasslands. Cork, Ireland. 17 – 21st June 2018, *Grassland Science in Europe* 23: 222-224.

Egan, M., Lynch, M.B. and Hennessy, D. (2015). Effect of white clover seed inclusion rates with tetraploid, diploid and mixed perennial ryegrass under simulated and animal grazing. In: Agricultural Research Forum 2015, 9th and 10th March, pp. 137.

Popular publications:

Hennessy, D., Egan, M. and McCarthy, B. (2015) Role of white clover. *TRResearch*, 10 (2): 20-21.

Egan, M, Hennessy, D., Maher, J. And McCarthy, B. (2016) What has clover to offer Irish dairy farmers? Teagasc National Dairy Conference, 6 and 7 December 2016. p. 46-48.

McCarthy, B., Egan, M., McAuliffe, S., Coughlan, F., Dineen, M. and Hennessy, D. (2015) Influence of perennial ryegrass cultivar, ploidy and the incorporation of white clover to increase performance from grazed pasture. Proceedings of the Irish Grassland Association Dairy Conference, Cork, 8 January 2015. P. 4 – 22.

Hennessy, D., McAuliffe, S., Hurley, M. and Egan, M. (2017) Moorepark update: Herbage production and milk production from grass only and grass clover swards. Moorepark '17 - Irish Dairying – Resilient Technologies, Moorepark Open Day, 4th July, 2017, Fermoy, Ireland. Pg. 41-42.

7. Compiled by: Dr. Deirdre Hennessy
