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Fertiliser Planning (Dairy)

26th January 2022

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Housekeeping

- You are automatically muted
- Use the Q&A function (not the chat box) to ask questions
- If you have issues – leaving and re-joining usually fixes them.
- The webinar will be recorded
- Please complete the feedback survey at the end

Agenda

8.00	Welcome & Introduction	Seamus McCaffrey, AgriSearch
8.05	Fertiliser Planning for 2022: costs-benefit of fertiliser application	Debbie McConnell, AFBI
8.25	Nutrient Management – Back to Basics	Aveen McMullan, CAFRE
8.35	Fertiliser use on farm - 2022	Robert Patterson, CAFRE
8.50	Reducing reliance on fertiliser N	David Patterson, AFBI
9.00	Questions & Answers	

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Webinar

Fertiliser planning for 2022: cost-benefit of fertiliser application

Dr Debbie McConnell
Dairy Grassland Research

January 2022

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Introduction

- Nitrogen is a key nutrient in grassland production systems
- N.I. imports 342,000 tonnes of fertiliser per annum, of which 86,700 tonnes is nitrogen (N; DAERA, 2021)
- Contracted supply of fertilisers across Europe due to:
  - Significant rise in energy costs impacting fertiliser manufacture, particularly in Europe
  - COVID disruptions to both production and transport infrastructure of fertilisers
  - Global reduction in fertiliser exports

UK natural gas prices during 2021

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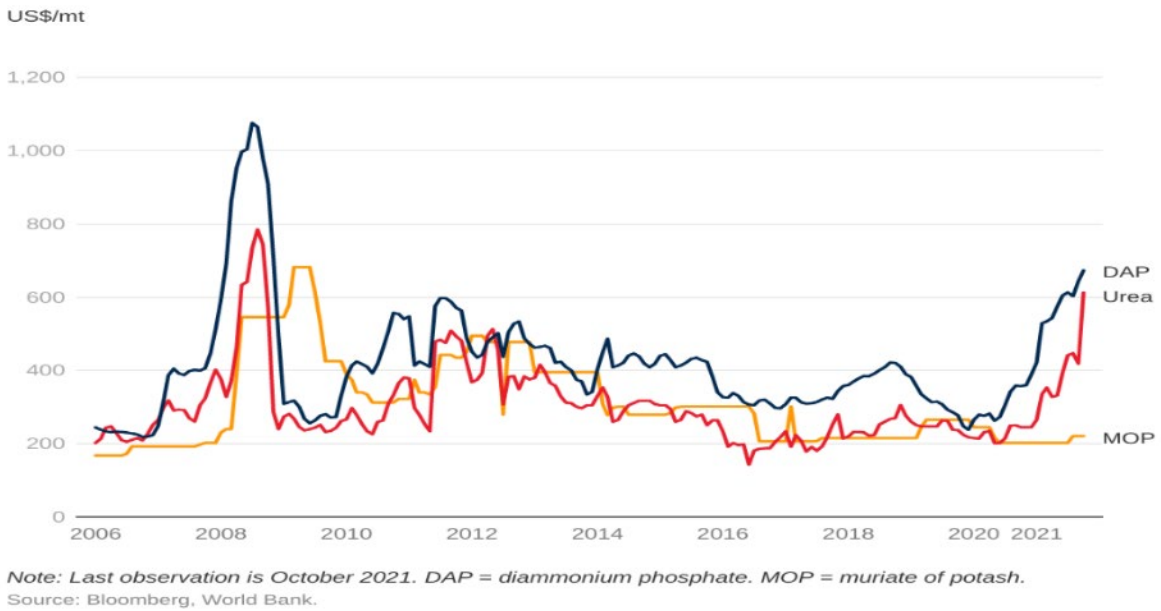
Introduction

- Significant rise in farm-gate fertiliser prices autumn 2021 – spring 2022
- High degree of uncertainty of prices for 2022 season
- Questions:
  - How does this impact the cost of forage production?
  - Is it still cost-effective to spread fertiliser?
  - How do I maximise value of this fertiliser?



Global fertiliser prices 2008 to 2021

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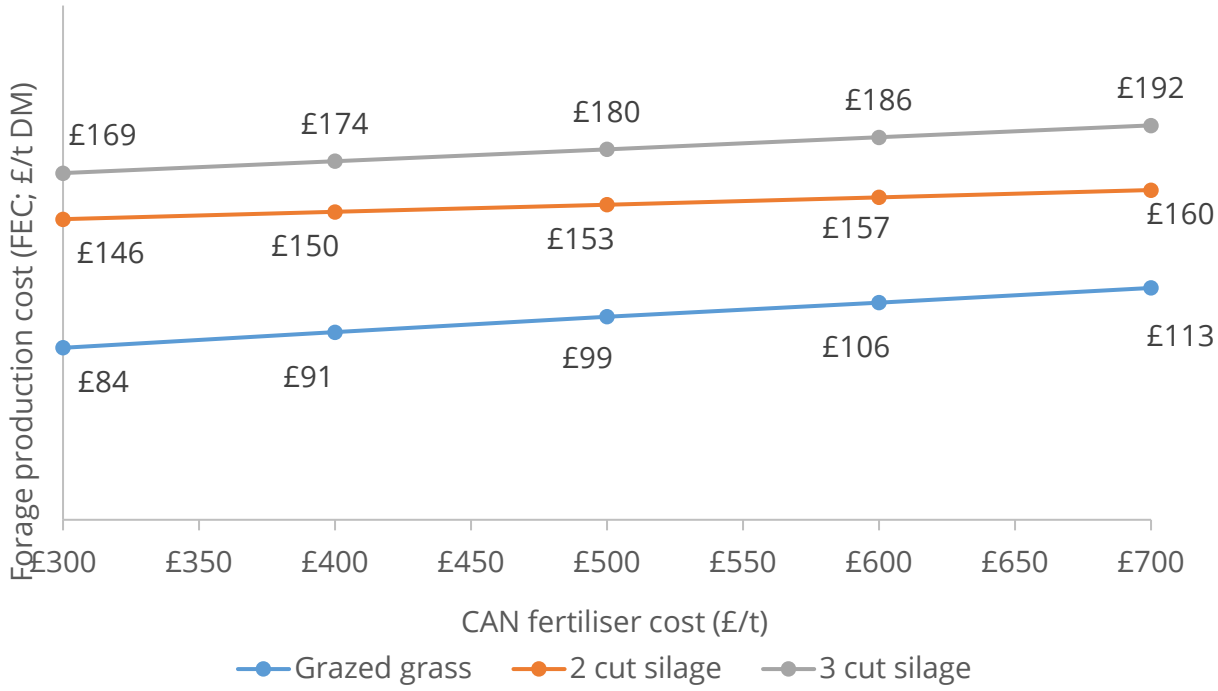
Impact of rising fertiliser prices on cost of forage production

- Fertiliser costs typically account for around 25%, 12% and 18% of the full economic cost of producing 1 kg of forage either as grazed grass, two cut silage or three cut silage, respectively
- CAN fertiliser price increases from £300 to £600/t equate to c. £11 – 22 increase in forage production costs per tonne DM
- For a typical 40ha grazing platform this increase equates to an additional expenditure of £8,940/yr
- For a 40ha silage platform the increase equals £5,161 and £7,868/yr under 2-cut and 3-cut silage management, respectively.



Impact of CAN fertiliser price (£/t) on full economic costs of forage production for grazed or ensiled grass

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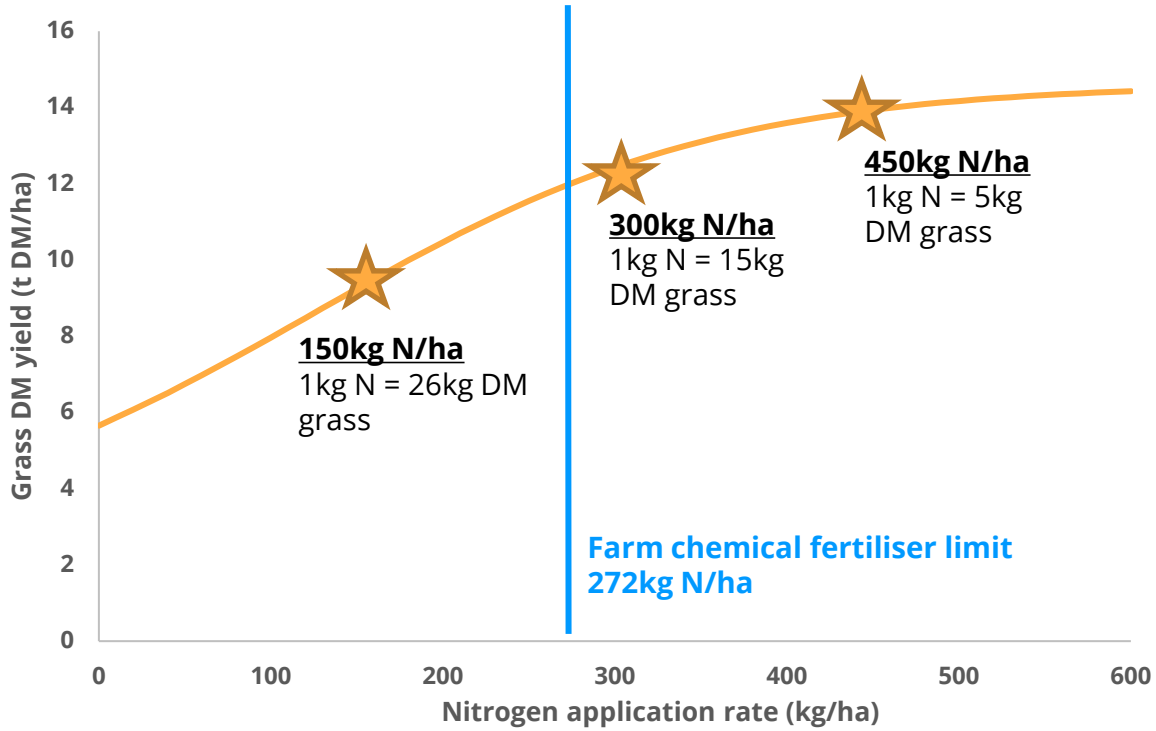
N response curves

- Grass growth response to fertiliser is influenced by a range of factors and can vary significantly between and within farms and seasons.
- As fertiliser application rate increases, N response rate decreases
  - Significant reductions in N response over 300kg N/ha
  - At high N application rates other factors become limiting e.g. temperature, soil moisture
- Grass yield data from the GrassCheck programme indicates:
  - Average N response rate of **20 kg DM grass per 1 kg of N fertiliser application**
  - Higher response the more economical it is to spread fertiliser



Impact of N application rate on grass growth response (kg DM)

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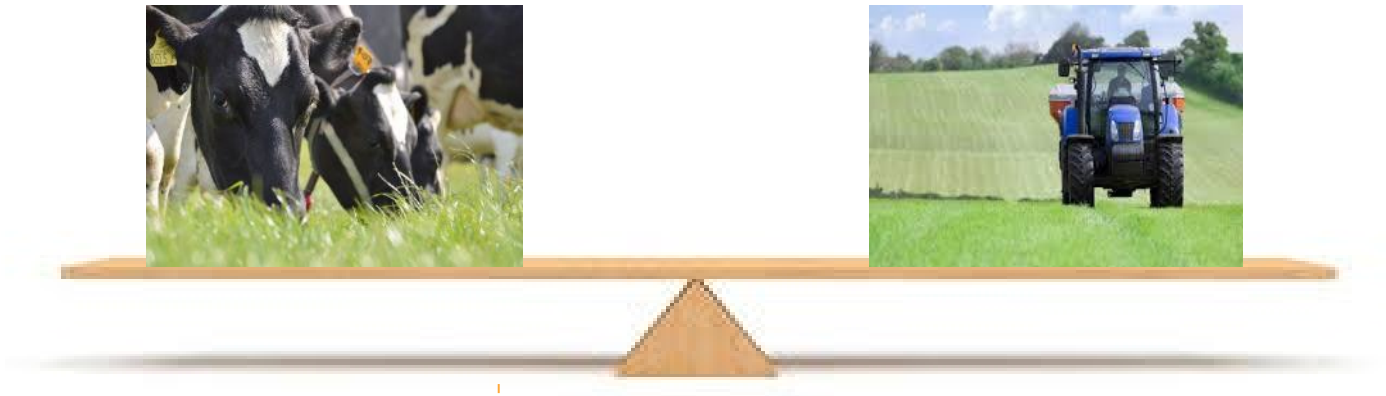
Evaluating the cost - benefit of fertiliser application

- Compare the relative feed value of grass produced vs the cost of the fertiliser



- Values **greater than 1.0** = grass feed value is **greater** than the fertiliser cost
- Values **less than 1.0** = grass feed value produced is **less** than the fertiliser cost

- Assumptions: Concentrate price = £300/tonne, Grass quality = 11.3 MJ/kg DM (Grasscheck farm average 2018 – 2021), grass utilisation rate = 80%

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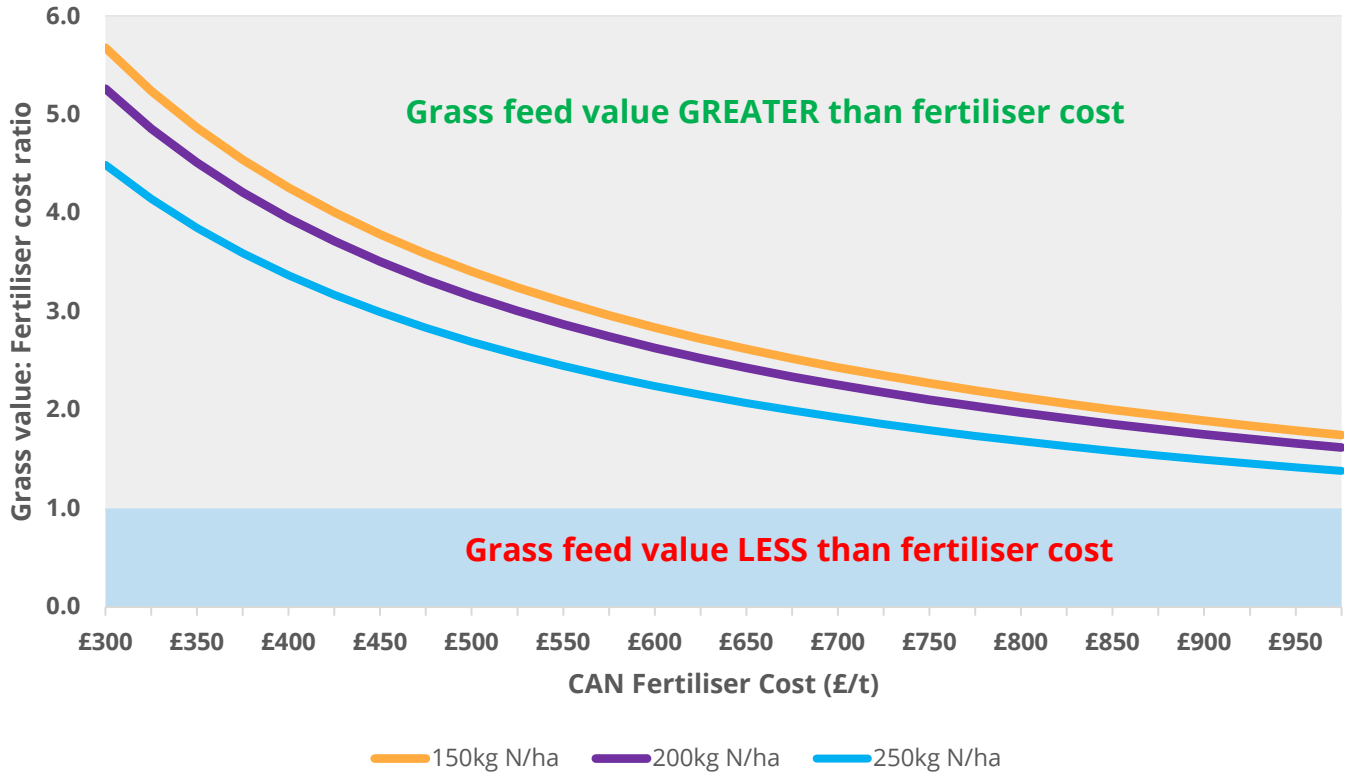
Cost-benefit of fertiliser application

- As the price of fertiliser rises the grass value-fertiliser cost ratio decreases
    - CAN @ £300/t = grass value 4.49 – 5.68 times greater than fertiliser cost
    - CAN @ £600/t = grass value 2.25 – 2.84 times greater than fertiliser cost
- As application rate increases, grass value: fertiliser cost ratio decreases
- However all curves, still remaining above a ratio of 1.0



Impact of CAN fertiliser cost on grass value-fertiliser cost ratio at three different N application rates

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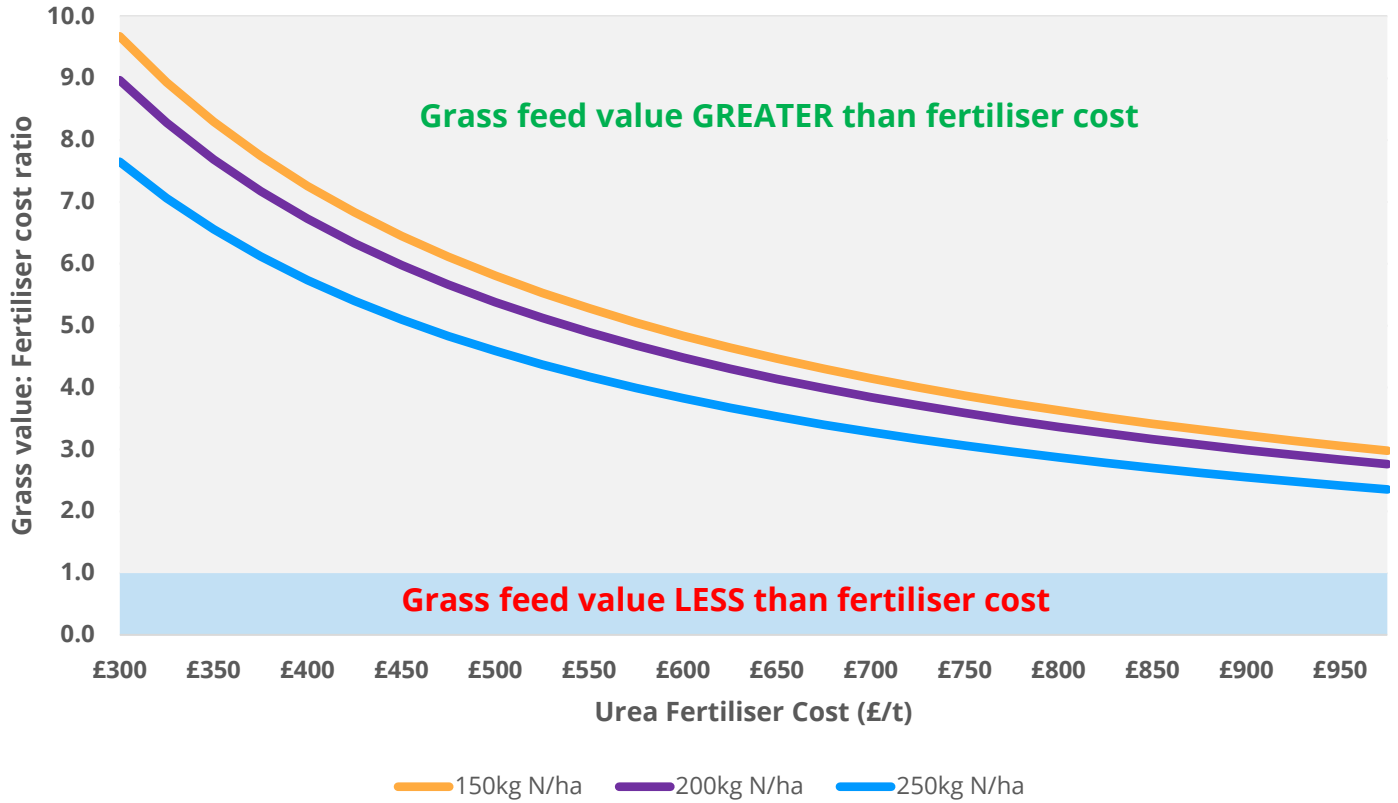
Cost-benefit of fertiliser application

- As the price of fertiliser rises the grass value-fertiliser cost ratio decreases
    - Urea @ £400/t = grass value 5.73 – 7.25 times greater than fertiliser cost
    - Urea @ £800/t = grass value 2.86 – 3.63 times greater than fertiliser cost
- As application rate increases, grass value: fertiliser cost ratio decreases
- However all curves, still remaining above a ratio of 1.0



Impact of urea fertiliser cost on grass value-fertiliser cost ratio at three different N application rates

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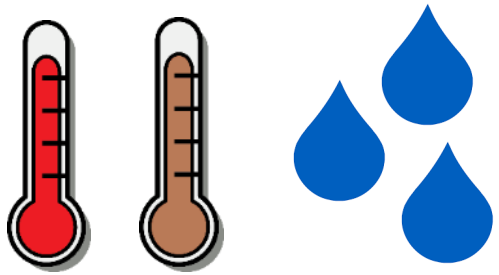
Factors affecting grass response to N fertiliser application

SOIL HEALTH

SWARD COMPOSITION

APPLICATION CONDITIONS



TIME OF YEAR

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Impact of soil health on cost-benefit of fertiliser application

- Grass response to N fertiliser application impeded by:

  Poor soil structure Soil pH status Limited biological activity

- Reduces cost effectiveness of fertiliser application

Impact of soil pH on utilisation of fertiliser N, P and K (Egan, 2017)

Soil pH	N utilisation	P utilisation	K utilisation	% of fertiliser wasted
5.0 – 5.5	77%	48%	77%	32%
5.5 – 6.0	85%	52%	100%	21%
6.0 - 6.5	100%	100%	100%	0%

Impact of low soil pH on the cost-benefit of fertiliser application

N fertiliser rate (kg/ha)	Cost of CAN (£/t)				
	500	600	700	800	900
150	2.4	2.0	1.7	1.5	1.3
200	2.2	1.8	1.6	1.4	1.2
250	1.9	1.6	1.4	1.2	1.0

Values **greater than 1.0** = grass feed value is **greater** than the fertiliser cost

Values **less than 1.0** = grass feed value produced is **less** than the fertiliser cost

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Impact of time of year on cost-benefit of fertiliser application

Timing of, and conditions at fertiliser application can significant impact on grass response to N fertiliser application. GrassCheck data shows:

- Peak grass N response occurs May – June
- Response in early spring is typically low due to light and temperature inhibiting growth
- BUT increasing volatility within and between seasons

Impact of month on average N response rate and grass feed value-fertiliser price ratio

Month	N response rate (kg grass DM/kg N applied)	Cost of Urea (£/t)			
		£400	£600	£800	£1,000
Mar	4	1.0	0.7	0.5	0.4
Apr	16	4.5	3.0	2.3	1.8
May	26	7.5	5.0	3.7	3.0
Jun	29	8.3	5.5	4.1	3.3
Jul	26	7.4	4.9	3.7	3.0
Aug	24	6.8	4.6	3.4	2.7

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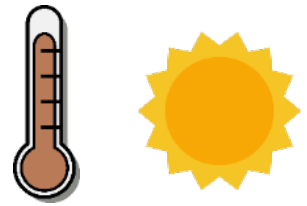
Jun	29	8.3	5.5	4.1	3.3
Jul	26	7.4	4.9	3.7	3.0
Aug	24	6.8	4.6	3.4	2.7

2.5 – 34.5 kg DM/ha/day



17.5 – 93.4 kg DM/ha/day

Latest weather data on the GrassCheck website

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Summary

- Recent fertiliser prices increases have had a significant impact on the cost of producing both grazed grass and grass silage

- Despite this, good quality grass remains the cheapest feedstuff available to N.I. farmers and the ratio of grass value to fertiliser costs is still positive in many cases (given the high cost of alternative feeds)

- However, with the increase in fertiliser price significant it is important to ensure maximum grass response from any fertiliser applied through good management practices:
  - Soil health
  - Timing of fertiliser application
  - Grass utilisation

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Nutrient Management

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1. Assessing Soil Nutrient/Health Status
2. Value of Nutrients on Farm
3. Planning Fertiliser Applications
4. Applying for Maximum Effect
5. NAP Regulatory Considerations

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Soil Nutrient Status

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Soil Analysis/Crop Requirement

- Correct pH
- Identify P & K indexes

DAERA Direct Soil Sampling Service

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Effect of Soil pH on Fertiliser Utilisation

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	% Utilisation			% Waste	Potential Financial Loss £/ha	
Soil pH	Nitrogen	Phosphorus	Potassium	Fertiliser	Fertiliser @ £256/t	Fertiliser @ £600/t
5.0-5.5	77%	48%	77%	32%	£45.06	£106.6
5.5-6.0	85%	52%	100%	21%	£29.57	£69.99
6.0-6.5	100%	100%	100%	0%	£0	£0

Source: Teagasc, DAERA, 2017
150kg N/ha of 27-4-4
64% of soil samples below pH 6

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Soil Health Status

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Soil Structure

- air & water movement
- biological activity
- crop establishment & root growth
- tolerance of stress

Sward Assessment

- low yielding grasses
- problem areas

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Value of Manures

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Manure Type	DM%	kg @ m^3			Units @ 1000gal		
		N	P	K	N	P	K
Cattle slurry	**6**	1	0.6	2.3	9	5	20
Pig slurry	**4**	1.8	0.75	2	16	16	18
		kg/tonne			**Units/tonne**		
Cattle FYM	**25**	0.6	1.9	8.5	1.2	4	17
Broiler litter	**66**	9.9	9.6	14	20	19	28

Assuming spring application using LESSE
Availability N 40%, P 50% (P Index 2) & K 90% of slurry

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Planning Fertiliser Application

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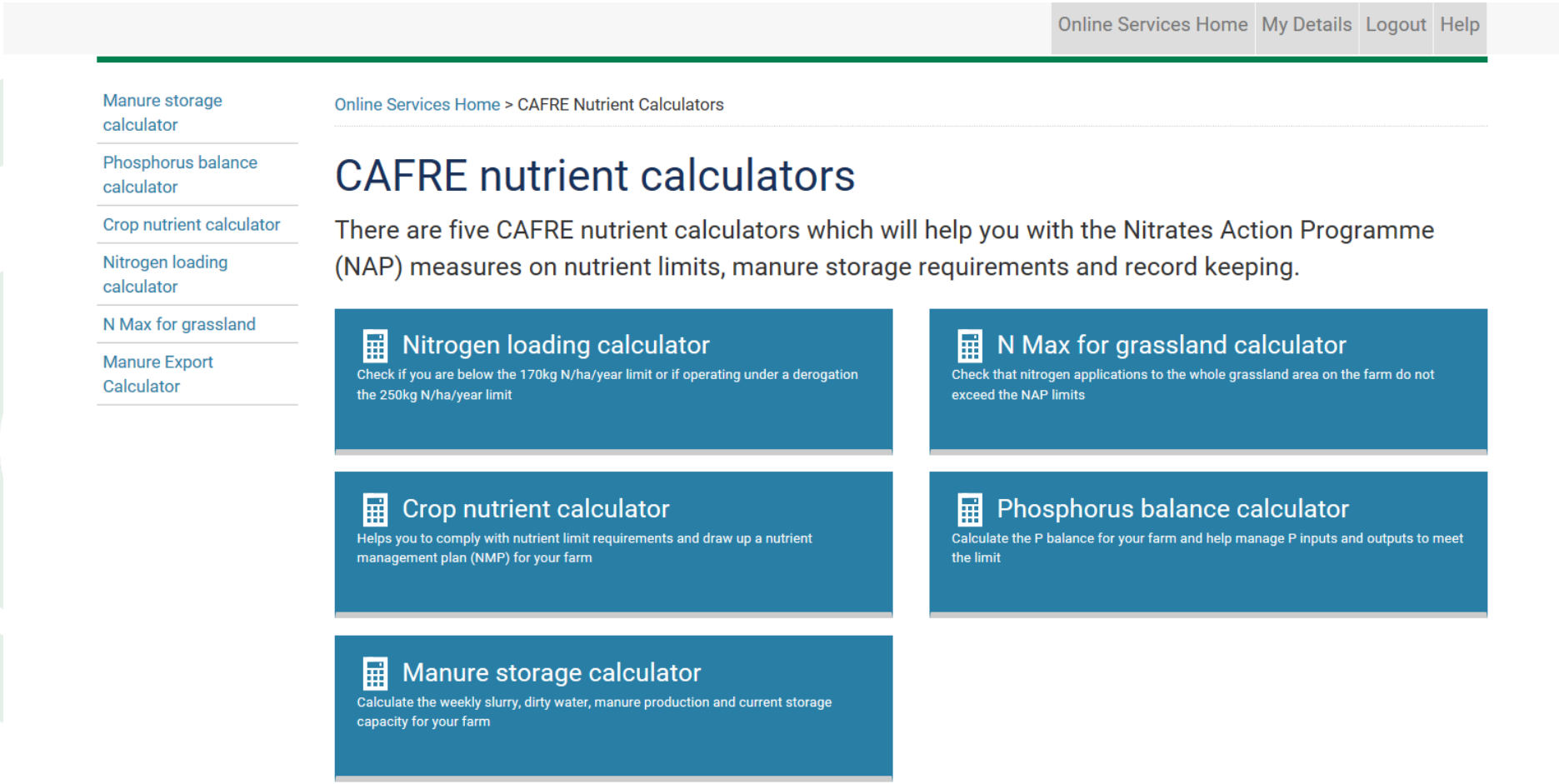

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How much fertiliser is required?

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Crop Nutrient Calculator

Return to Fields List | Help Manual | Conversion Calculator

Field(s):	1/103/017 - Silage fields (P2K2-)	Year:	2021	Crop:	Silage 68-70D Silage

Add/edit field plan

Enter your field, soil & cropping details for this field plan by clicking on the boxes below.

Field & soil details
Field: Silage fields (P2K2-)

Cropping
Silage 68-70D Silage

Manure & fertiliser
Manure & Fertiliser Added

Download field plan
Download PDF report

What is crop recommendation?

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Silage Cut 1

	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Total crop recommendation	120.00 kg/ha *96.00 units/acre*	40.00 kg/ha *32.00 units/acre*	80.00 kg/ha *64.00 units/acre*

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Applying organic manure

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Livestock Manure

Manure type	Volume applied (m^3/ha & t/ha)	Method of application	When applied	
Dairy Cow Slurry 6% Dry Matter *	22	Slurry - Trailing shoe or Band spread	Spring	Update Cancel
				Add Manure

* Typically dry matter is 6% for cattle slurry and 4% for pig slurry.

Other Organic Manure (e.g., sewage sludge, abattoir waste, digestate)

Enter the type, volume applied and nutrient content on a fresh weight basis as outlined on the analysis report in g/kg. Use the calculator to convert from P to P_2O_5 and K to K_2O.

Manure type	Volume applied (m^3/ha & t/ha)	Nitrogen (g/kg N)	Phosphate (g/kg P_2O_5)	Potash (g/kg K_2O)	
					Add Manure

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Applying chemical fertiliser

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Fertiliser type	Quantity of product applied (kg/ha)	
27 0 0 (+5% SO3)	250	Edit Delete
		Add fertiliser

Other fertilisers

Fertiliser name	Quantity of product applied (kg/ha)	Nitrogen (% N)	Phosphate (% P_2O_5)	Potash (% K_2O)	
					Add fertiliser

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Crop Nutrient Summary for this field

Silage Cut 1

	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Total crop recommendation	120.00 kg/ha *96.00 units/acre*	40.00 kg/ha *32.00 units/acre*	80.00 kg/ha *64.00 units/acre*
Organic manure - nutrients supplied	22.88 kg/ha *18.30 units/acre*	26.40 kg/ha *21.12 units/acre*	49.50 kg/ha *39.60 units/acre*
Chemical fertiliser - nutrients supplied	84.38 kg/ha *67.50 units/acre*	0.00 kg/ha *0.00 units/acre*	0.00 kg/ha *0.00 units/acre*
Nutrients to be supplied	-12.75 kg/ha *-10.20 units/acre* (undersupplied)	-13.60 kg/ha *-10.88 units/acre* (undersupplied)	-30.50 kg/ha *-24.40 units/acre* (undersupplied)

Fertiliser Budgeting

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Crop Nutrient Calculator Summary Report

2. Organic Manure Totals

Organic Manure	Total Quantity
Dairy Cow Slurry 6% Dry Matter	2392 m^3 *(526350 gallons)*

3. Chemical Fertiliser Totals

Chemical Fertiliser	Total Quantity
0 0 60	2250 kg
27 0 0 (+5% SO3)	35000 kg
46 0 0	3125 kg

Applying to maximum effect

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- **Timing**
  - apply early in the season
- **Application method**
  - use of LESSE
- **Equipment**
  - regular maintenance & calibration
- **Accurate application**
  - make use of available technology

Regulatory Requirements

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Observe buffer zones from waterways

- chemical fertiliser 2m
- slurry 10m (3m LESSE) - increased to 15 (5m LESSE) in Feb

Prepare a fertilisation plan

- chemical phosphate fertiliser
- high phosphorus (P) manures
- anaerobic digestate

Crop Nutrient Report

Name:	MS AVEEN MCMULLAN		Report Year: 2021
Address:	RATHKELTAIR HOUSE MARKET STREET DOWNPATRICK CO.DOWN BT30 6LZ		
Farm Survey Number:	1/103/017	Soil Type:	Medium soils
Field Number:	Dairy grazing (P2+K2+)	Soil Analysis Date:	Jan 2021
Field Size:	25 hectares (61.78 acres)	P Index:	2+
		K Index:	2+
		pH:	6.3
		Soil Nitrogen Status (SNS):	Moderate
Last Crop:	Grass moderate input (100 - 250 kg N/ha)		
Next Crop:	Grazing Dairy Cow Rotational		

	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Total Crop Requirement:	340.00 kg/ha (272.00 units/acre)	20.00 kg/ha (16.00 units/acre)	0.00 kg/ha (0.00 units/acre)
Organic Manure Nutrients:	11.44 kg/ha (9.15 units/acre)	13.20 kg/ha (10.56 units/acre)	24.75 kg/ha (19.80 units/acre)
Fertiliser Nutrients:	192.50 kg/ha (154.00 units/acre)	0.00 kg/ha (0.00 units/acre)	0.00 kg/ha (0.00 units/acre)
Nutrients to be Supplied:	- 136 kg/ha (- 109 units/acre) (undersupplied)	- 7 kg/ha (- 6 units/acre) (undersupplied)	+ 25 kg/ha (+ 20 units/acre) (oversupplied)

Organic Manure to be Applied

Manure Type	Volume Applied	Method of Application	When Applied
Dairy Cow Slurry 6% Dry Matter	11 m³/ha	Slurry - Trailing shoe or Band spread	Spring

Fertiliser to be Applied

Fertiliser Type	Quantity of Product Applied
46 0 0	125 kg/ha
27 0 0 (+5% SO3)	500 kg/ha

Summary

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- Improve Soil Fertility
- Target manures and top up with chemical fertiliser
- Use a fertilisation plan

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Fertiliser use on farm - 2022

Robert Patterson
Dairying technologist - CAFRE

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Application Considerations

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Fertilizer Efficiency = Grass and Crop Performance/Purchased Fertiliser Input

- Soil Temperature
- Field Specific Plan – Nutrients Action Plan
- Rotational Sowing – Little and Often
- Record Fertiliser Use and Grass Growth
- Sower Accuracy
- Sulphur

On Farm Scenarios

- **Optimal levels of soil fertility – pH 6.2, P index 2+, K index 2+**
- **Target slurry application - 22.5 - 28 m^3/ ha (2,000 - 2,500 gallons acre) - LESSE**
- **DAERA Online Crop Nutrient Calculator - develop nutrient management plans**
- **Scenarios - optimal fertiliser and grass growth responses in spring**

Scenario 1 – First cut silage (cutting date early – mid May)

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Crop requirement = **120 kg N/ ha**, **40 kg P_2O_5/ ha** and **60 kg K_2O/ ha**

Applying 28 m^3/ ha (2,500 gallons/ acre) slurry (LESSE) =

29 kg N/ ha, **34 kg P_2O_5/ ha** and **63 kg K_2O/ ha**

Additional Nitrogen requirement = **91 kg N/ha**

(Eg. **91 kg N/ha =** Applying 330 kg/ha (2.7 bags/ acre) 27 % CAN

Consider split applications to increase efficiency of uptake

Scenario 2 – Grazing turnout – February/Early March

- Walk the grazing platform late January to determine paddock covers and the average farm cover

Slurry

- Mid February – slurry (1/3) paddocks with the lowest covers (below 2,100 kg DM/ha or 6cm) (22.5 m^3/ ha or 2,000 gallons/ac) – supplies 23 kg N/ ha (19 units/ acre)
- Apply slurry to the remainder of the grazing platform suitable once grazed off

Fertiliser

- Apply early nitrogen in February to paddocks which will respond
- 30 kg N/ha (23 units/acre) - eg Protected urea
- Don't apply to paddocks which received slurry in the first round
- Apply to paddocks with covers greater than 1,900 kg DM/ha or 5cm
- Rotationally apply nitrogen following grazing

Scenario 3 – Grazing turnout –Early/Mid April

- Walk the grazing platform late January to determine paddock and average farm covers

Slurry

- Apply Slurry to the grazing platform on grass covers below 2,500 Kg DM/ha or 7.5cm when conditions are suitable via LESSE (22.5 m^3/ ha or 2,000 gallons/ac) – supplies 23 kg N/ ha (19 units/ acre)

Fertiliser

- No requirement for nitrogen to be applied February/early March
- Prioritise covers which have not received slurry to graze first
- Rotationally apply nitrogen following the first grazing

Summary

- Only apply fertiliser in February / early March if you can utilise the grass and conditions are right
- Apply recommended levels of nutrients to maximise your first cut yield – best response per kg of Nitrogen (DAERA Online Calculators)
- Focus on controlling factors within your control to maximise your fertiliser efficiency – measure & budget grass to increase utilisation

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Reducing reliance on fertiliser N

David Patterson

Jan 2022

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Reducing reliance on fertiliser N

- increase species diversity to deliver more sustainable grassland
- use of legumes to fix biological N
- white & red clover

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Increase Diversity: Step by Step

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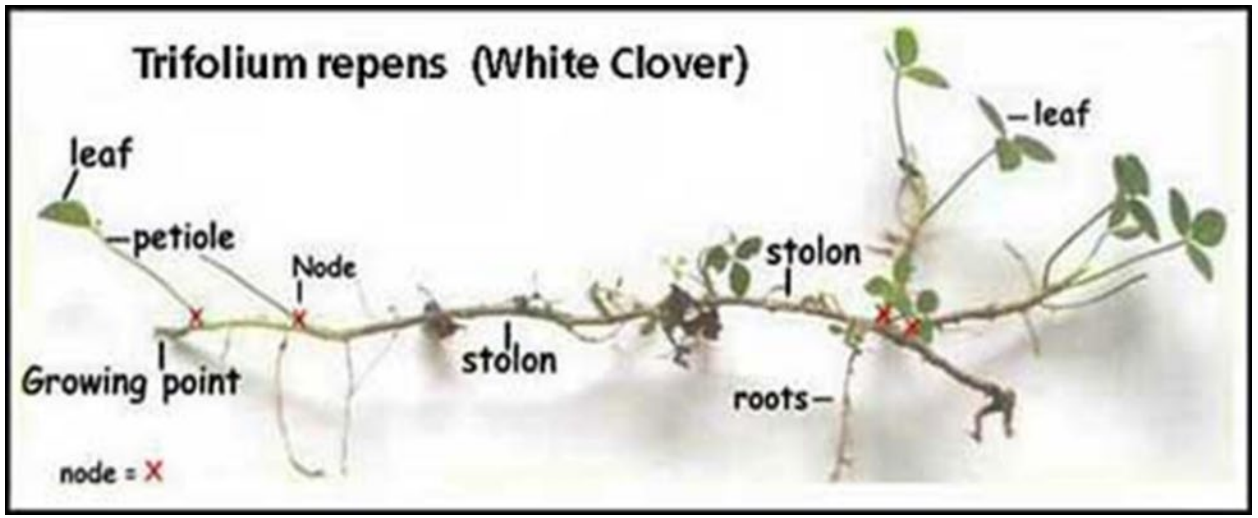
Features of Grass/ White Clover

- white clover can substitute chemical N with fixed atmospheric N
  avg =150 kgN/ha



- ideal for grazing swards (stoloniferous) AND its growth complements perennial ryegrass (PRG)
- higher DM intakes due to the higher digestibility of WC (less cellulose and lignin)

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Features of Red Clover

- grass/ red clover mix
- 14-16 tDM/ha 18-22%CP
- persists for 2 - 4 years
- upright habit, elevated growing point

Grass/White Clover Productivity

	GRASS ONLY	GRASS/ WHITE CLOVER
Fertiliser kgN/ha	250	150
Herbage Yield tDM/ha	13.5	13.4
Milk solids kg/cow	489	510
N use efficiency %	37	55

n.b.

- same SRate
- same meal
- 20% WC

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Ref:Teagasc Moorepark

but there are challenges…

- less predictable spring yields of clover
- less out-of-season growth
- perception of poor clover persistency
- bloat incidence
- establishing clover into new and existing swards

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Summary

- grass/clover sward can substitute fertiliser N and improve herbage digestibility
- establishment and persistency challenges
- different management strategy

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Key Messages

- Recent fertiliser price increases will significantly increase the cost of producing both grazed grass and grass silage.

- However, good quality grass remains the cheapest feedstuff available on NI farms and in most cases, it is still economic to apply chemical N up to 200 kg N/ha, providing grass is well utilised.

- Maximise grass response from fertiliser applied through good management practices:

  - Soil health (pH, P and K) - Timing of fertiliser application - Good grass utilisation

- Slurry and manures are valuable sources of nutrients – nutrient management planning is critical

- Longer term – white/red clover have significant potential to reduce reliance on N fertiliser

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Forthcoming Webinars

31st January	Beef & Sheep Fertiliser Planning
1st February	Arable Conference: Understanding Carbon in Arable Rotations
2nd February	Sheep Conference: Pasture Productivity
7th February	Targeted Selective Treatment of Anthelmintics: An introduction
8th February	Arable Conference: Nitrogen & Biopesticides
9th February	Sheep Conference: Resilience through Health & Environment
22nd & 24th February	Ulster Grassland Society Annual Conference: Efficiency Driving a Lower Carbon Footprint
1st March	Multi-Species Swards: A View from the Farm