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College of Agriculture, Food & Rural Enterprise

Fertiliser Planning (Beef)

31st January 2022

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	Rachel McGarrell, 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

Jan 2022

afbini.gov.uk

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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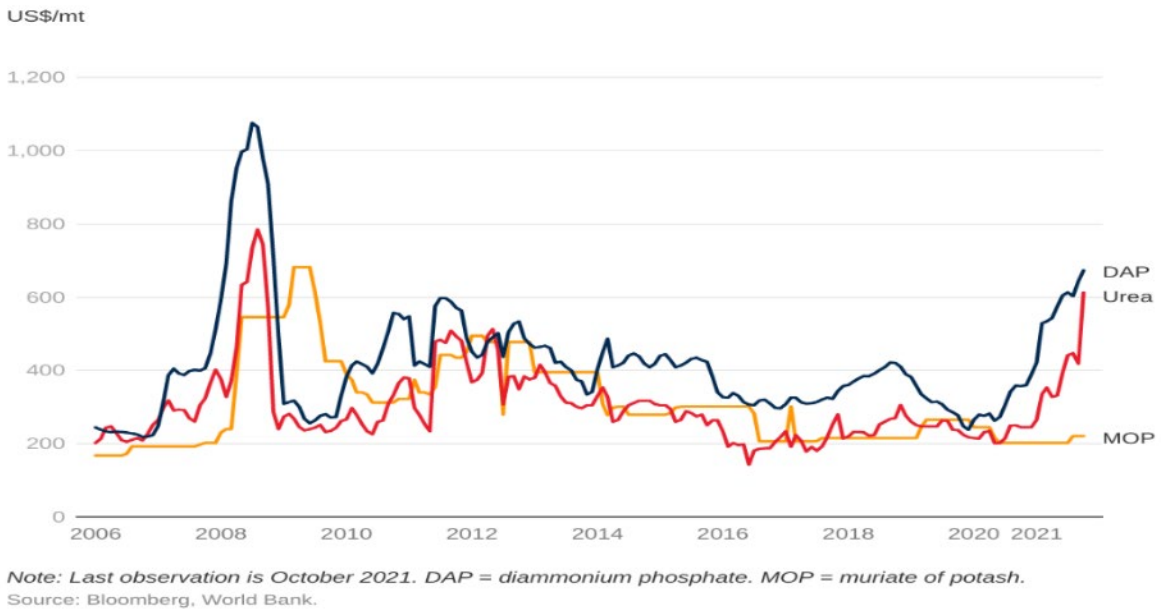
Introduction

- 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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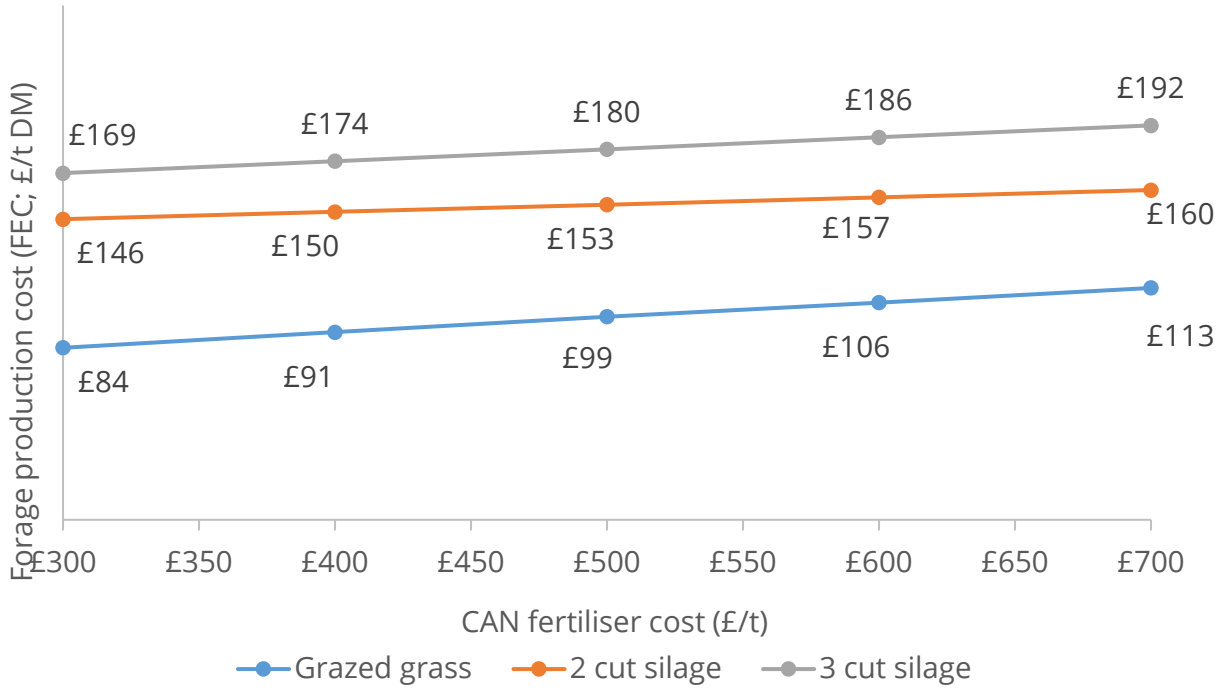
Impact of rising fertiliser prices on cost of forage production

- 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 20ha grazing platform this increase equates to an additional expenditure of £4,470/yr
- For a 20ha silage platform the increase equals £2,580 and £3,934/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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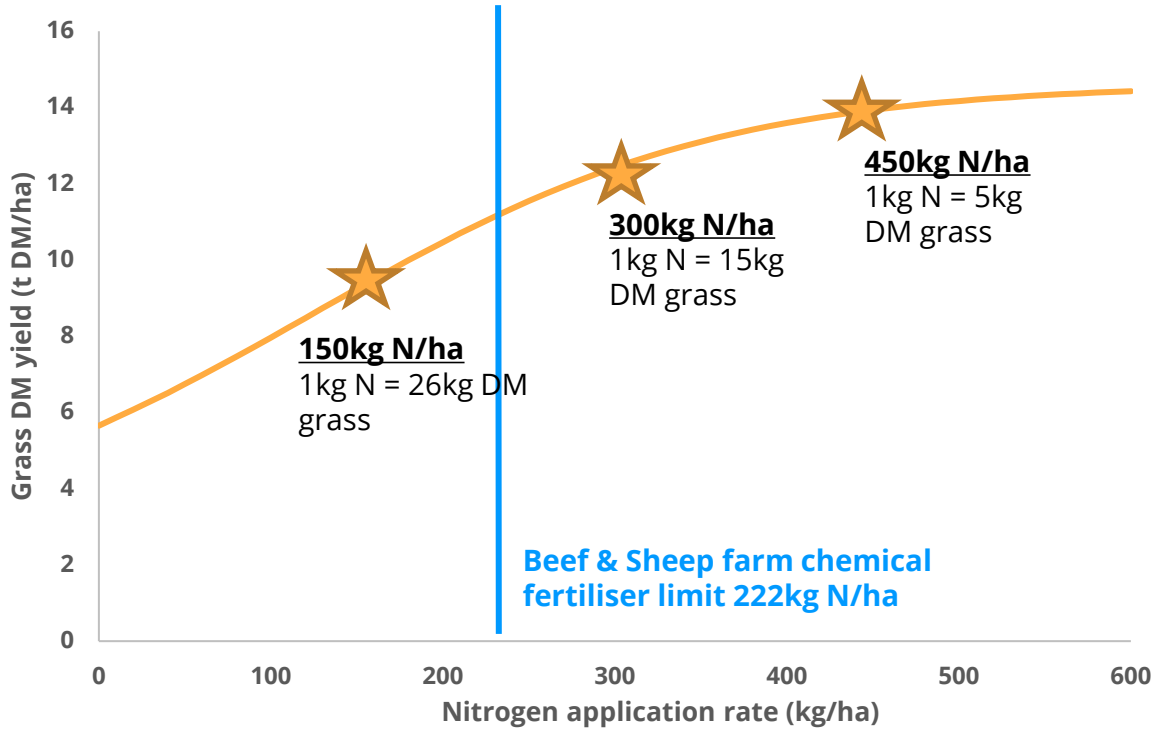
N response curves

- 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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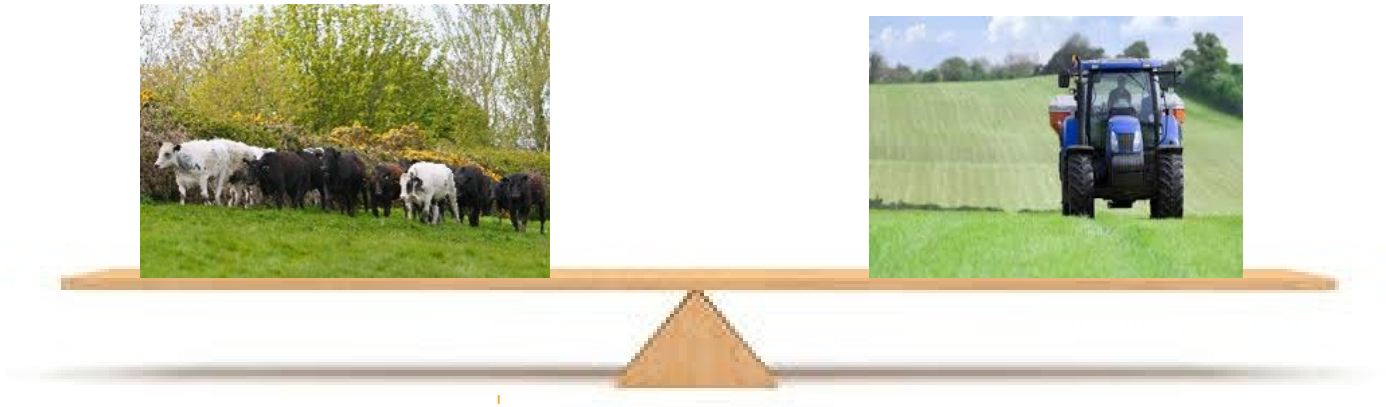
Evaluating the cost - benefit of fertiliser application

- 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 = £270/tonne, Grass quality = 11.3 MJ/kg DM (GrassCheck farm average 2018 – 2021), grass utilisation rate = 80%

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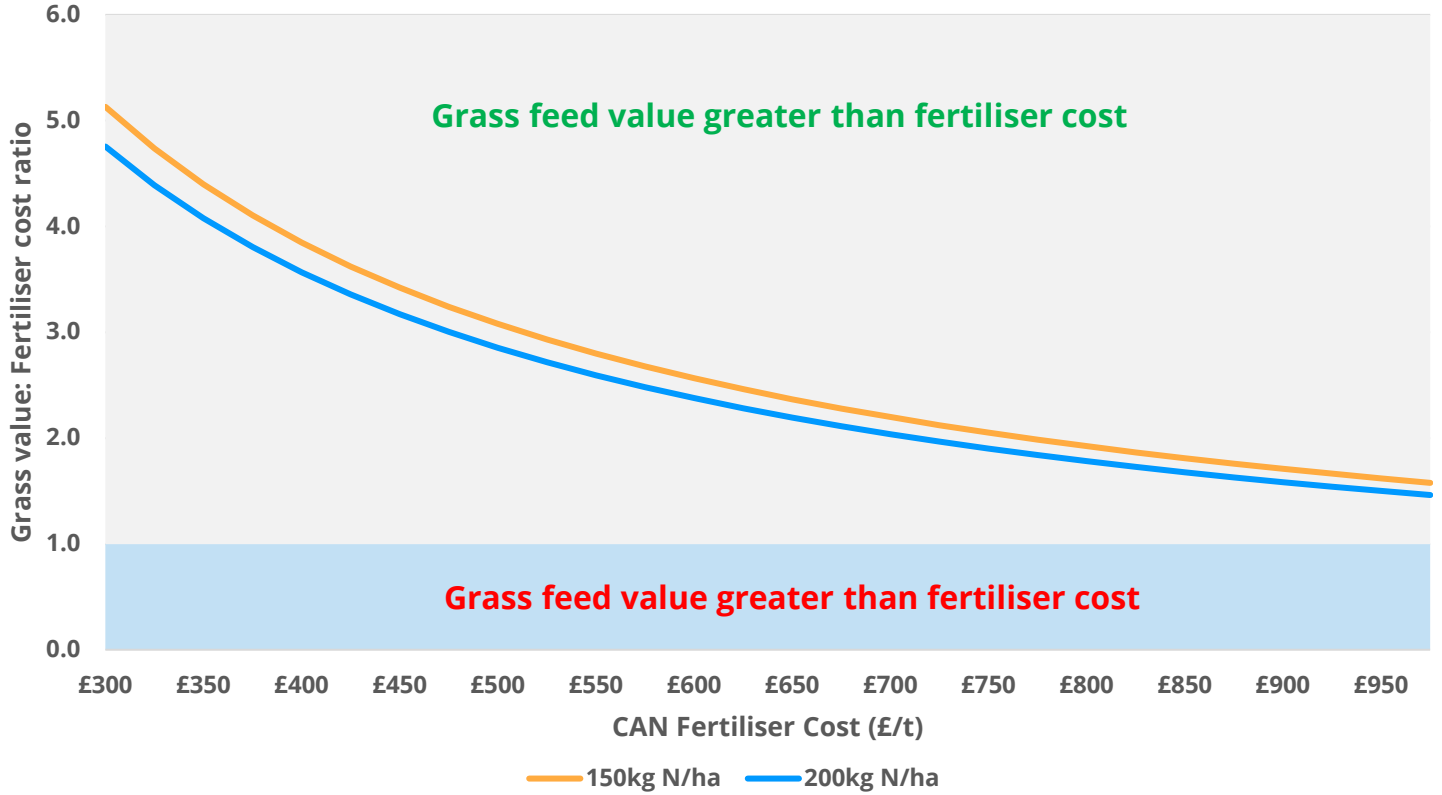
Cost-benefit of fertiliser application

- As the price of fertiliser rises the grass value-fertiliser cost ratio decreases
    - CAN @ £300/t = grass value 4.9 times greater than fertiliser cost
    - CAN @ £600/t = grass value 2.5 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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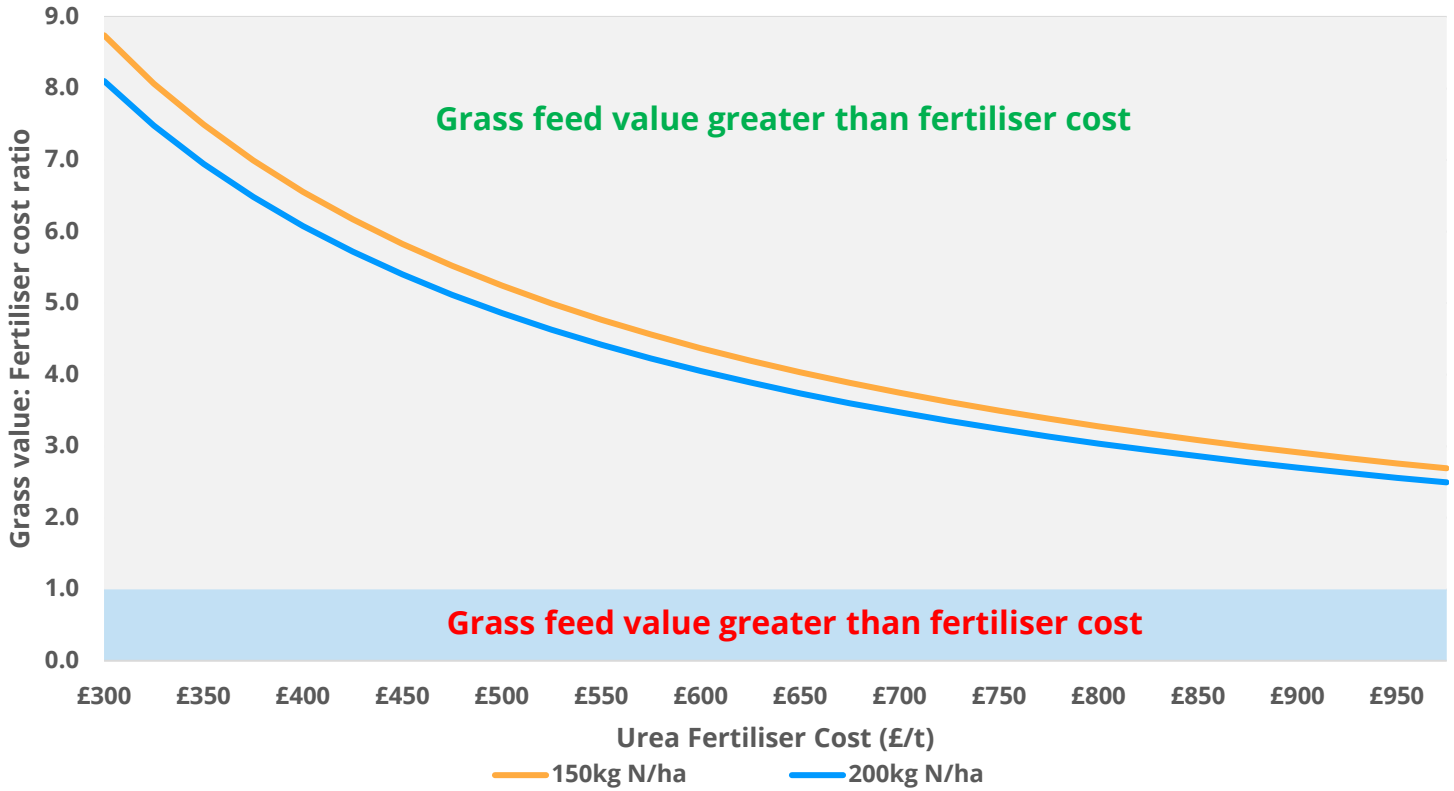
Cost-benefit of fertiliser application

- As the price of fertiliser rises the grass value-fertiliser cost ratio decreases
    - Urea @ £400/t = grass value 6.4 times greater than fertiliser cost
    - Urea @ £800/t = grass value 3.1 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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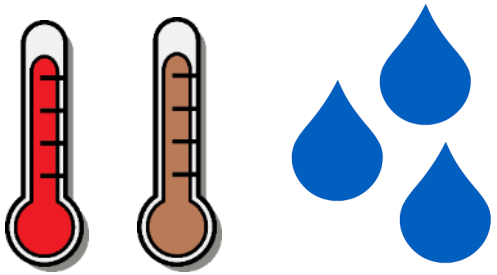
Factors affecting grass response to N fertiliser application

SOIL HEALTH

APPLICATION CONDITIONS



SWARD COMPOSITION

GRASS UTILISATION

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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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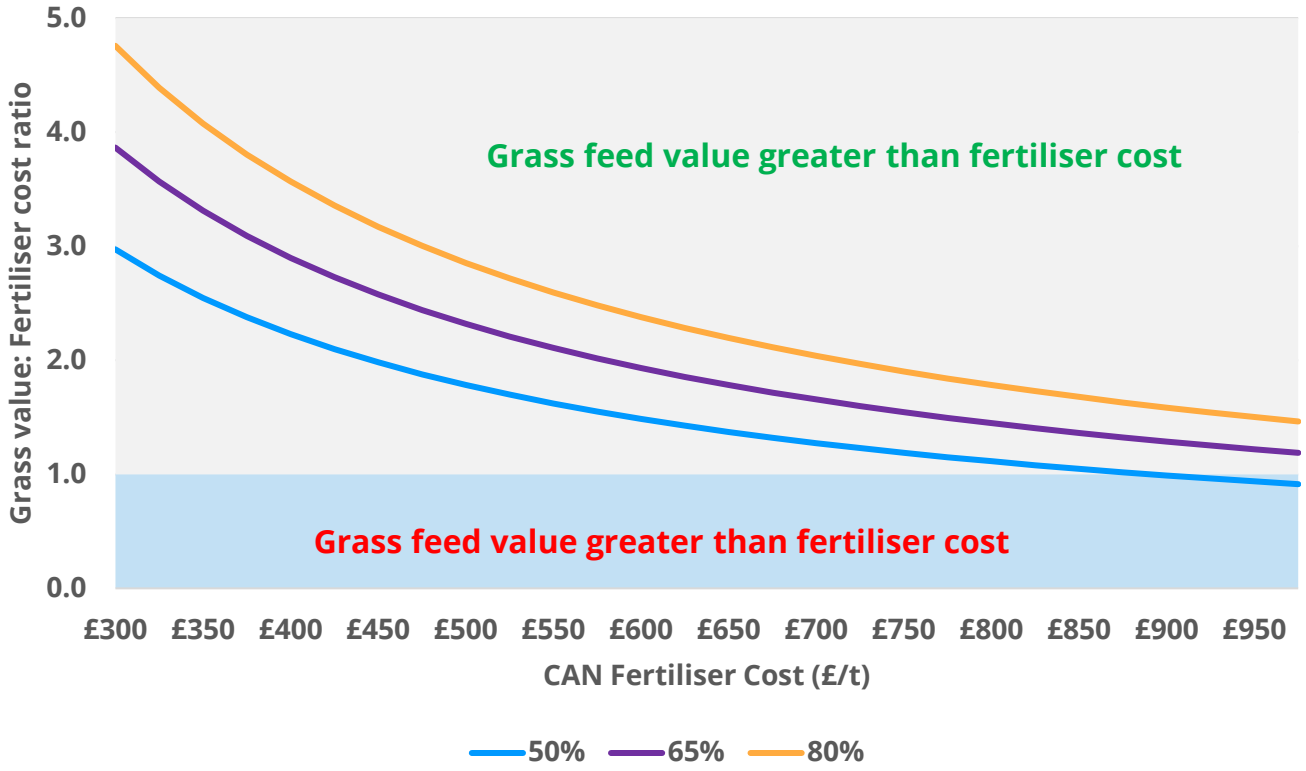
Impact of grass utilisation on cost-benefit of fertiliser application

- Returns from N fertiliser application can be improved by increasing grass utilisation rates
- Grazing system (AHDB, 2018):
  - Set stocking = 40%
  - Rotational grazing = 65%
  - Paddock grazing = 80%



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

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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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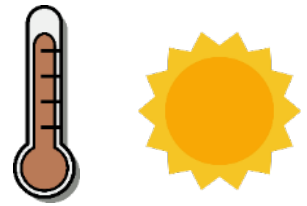
May	26	7.5	5.0	3.7	3.0
Jun	29	8.3	5.5	4.1	3.3
Jul	26	7.4	4.9	3.7	3.0
Aug	24	6.8	4.6	3.4	2.7

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

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

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

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

Planning Fertiliser Application

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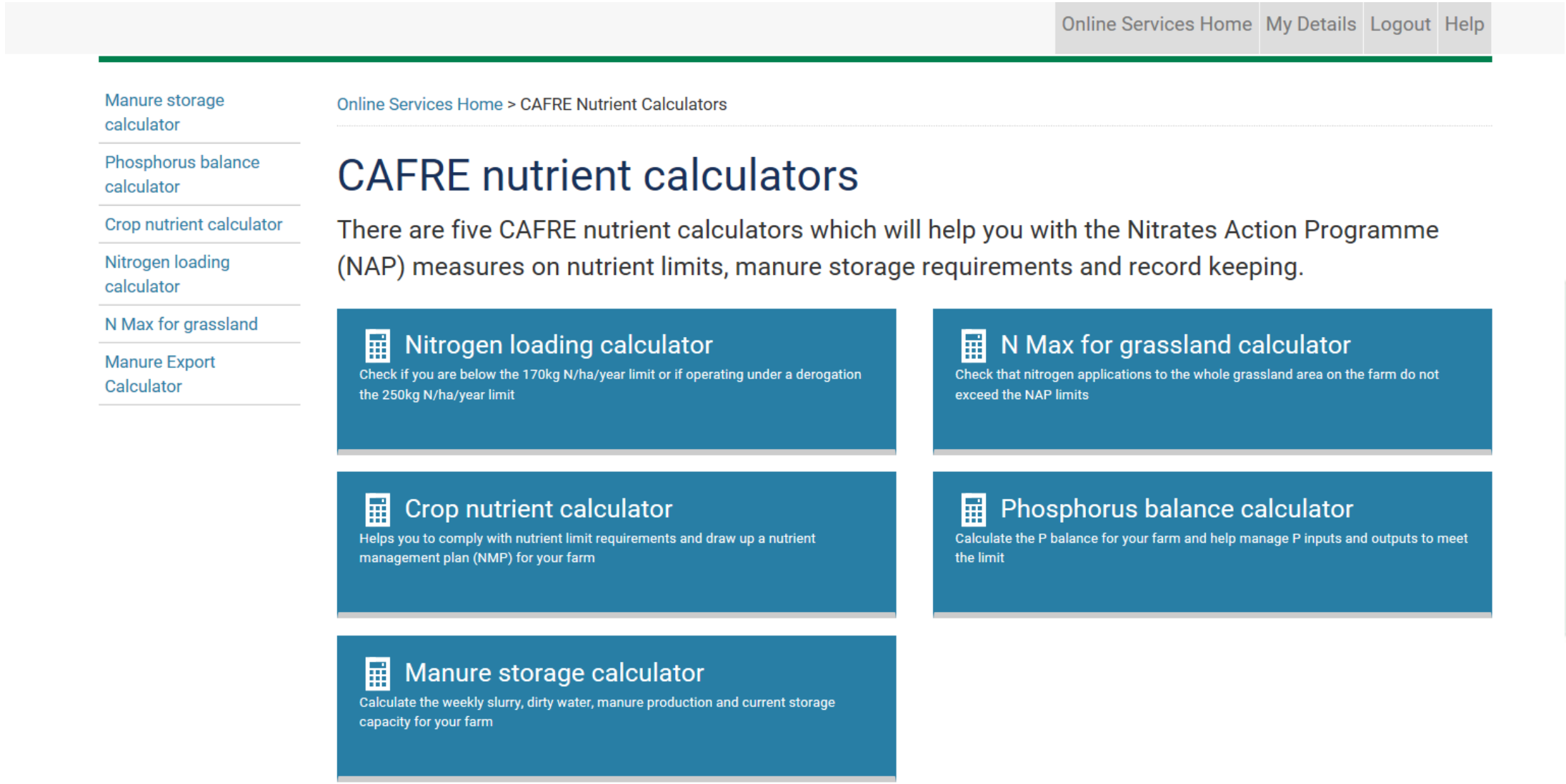

How much fertiliser is required?

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Crop Nutrient Calculator

Return to Fields List | Help Manual | Conversion Calculator

Field(s):	1/123/456 - B&S Grazing 1 (P2-K1)	Year:	2022	Crop:	Grazing Beef and Sheep

Add/edit field plan

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

Field & soil details
Field: B&S Grazing 1 (P2-K1)

Cropping
Grazing Beef and Sheep

Manure & fertiliser
Manure & Fertiliser Added

Download field plan
Download PDF report

What is crop recommendation?

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	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Total crop recommendation	250.00 kg/ha *200.00 units/acre*	35.00 kg/ha *28.00 units/acre*	30.00 kg/ha *24.00 units/acre*

Applying organic manure

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Livestock Manure

Manure type	Volume applied (m^3/ha & t/ha)	Method of application	When applied	
Beef Cattle Slurry 6% Dry Matter	13.2	Slurry - Trailing shoe or Band spread	Spring	Edit Delete
				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

Applying chemical fertiliser

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Known fertilisers **

** Northern Ireland Fertiliser list 2008 compiled by DAERA Quality Assurance Branch.

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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Field(s):	1/123/456 - B&S Grazing 1 (P2-K1)	Year:	2022	Crop:	Grazing Beef and Sheep

Chemical Fertiliser to be Applied

	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Total crop recommendation	250.00 kg/ha *200.00 units/acre*	35.00 kg/ha *28.00 units/acre*	30.00 kg/ha *24.00 units/acre*
Organic manure - nutrients supplied	13.73 kg/ha *10.98 units/acre*	15.84 kg/ha *12.67 units/acre*	29.70 kg/ha *23.76 units/acre*
Chemical fertiliser - nutrients supplied	67.50 kg/ha *54.00 units/acre*	0.00 kg/ha *0.00 units/acre*	0.00 kg/ha *0.00 units/acre*
Nutrients to be supplied	-168.77 kg/ha *-135.02 units/acre* (undersupplied)	-19.16 kg/ha *-15.33 units/acre* (undersupplied)	-0.30 kg/ha *-0.24 units/acre* (undersupplied)

Fertiliser Budgeting

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Crop Nutrient Calculator Summary Report

2. Organic Manure Totals

Organic Manure	Total Quantity
Beef Cattle Slurry 6% Dry Matter	715 m^3 *(157300 gallons)*

3. Chemical Fertiliser Totals

Chemical Fertiliser	Total Quantity
27 0 0 (+5% SO3)	7250 kg
27 4 4 (+6% SO3)	2250 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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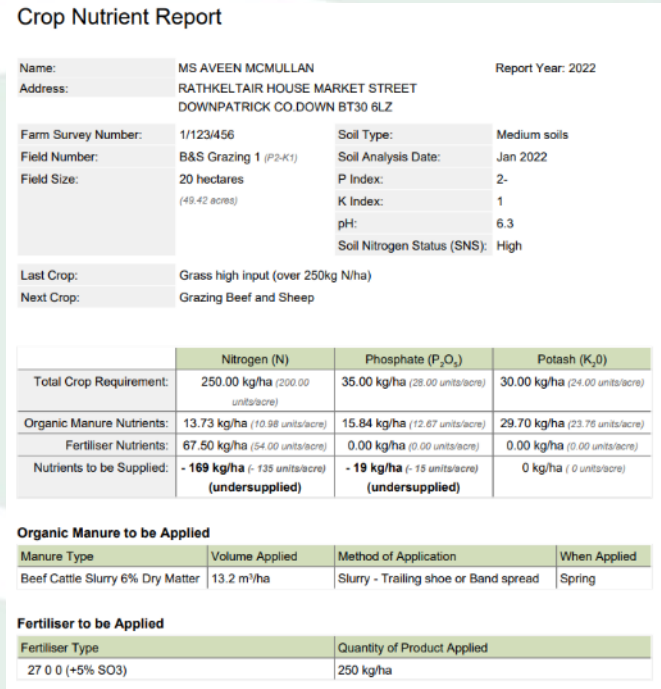
Observe buffer zones from waterways

- 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: 2022
Address:	RATHKELTAIR HOUSE MARKET STREET DOWNPATRICK CO.DOWN BT30 6LZ		
Farm Survey Number:	1/123/456	Soil Type:	Medium soils
Field Number:	B&S Grazing 1 (P2-K1)	Soil Analysis Date:	Jan 2022
Field Size:	20 hectares (49.42 acres)	P Index:	2-
		K Index:	1
		pH:	6.3
		Soil Nitrogen Status (SNS):	High
Last Crop:	Grass high input (over 250kg N/ha)		
Next Crop:	Grazing Beef and Sheep		

	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Total Crop Requirement:	250.00 kg/ha (200.00 units/acre)	35.00 kg/ha (28.00 units/acre)	30.00 kg/ha (24.00 units/acre)
Organic Manure Nutrients:	13.73 kg/ha (10.98 units/acre)	15.84 kg/ha (12.67 units/acre)	29.70 kg/ha (23.76 units/acre)
Fertiliser Nutrients:	67.50 kg/ha (54.00 units/acre)	0.00 kg/ha (0.00 units/acre)	0.00 kg/ha (0.00 units/acre)
Nutrients to be Supplied:	**- 169 kg/ha** (- 135 units/acre) **(undersupplied)**	**- 19 kg/ha** (- 15 units/acre) **(undersupplied)**	0 kg/ha (0 units/acre)

Organic Manure to be Applied

Manure Type	Volume Applied	Method of Application	When Applied
Beef Cattle Slurry 6% Dry Matter	13.2 m^3/ha	Slurry - Trailing shoe or Band spread	Spring

Fertiliser to be Applied

Fertiliser Type	Quantity of Product Applied
27 0 0 (+5% SO3)	250 kg/ha

Summary

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

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CAFRE-Practical advice and scenarios.

Rachel Megarrell, CAFRE Beef and Sheep adviser.

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Do we really need to sow fertiliser?

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- Yes – to achieve target silage and grazing yields.
- Every kg of fertiliser purchased must count! - If fertiliser is used efficiently then a good grass growth response will be achieved per kg of fertiliser sowed.
- Nitrogen, Phosphorus and Potassium are the major nutrients required for plant growth. When P & K are at optimum levels the response from N applied is the greatest.

- **'Aim to use purchased fertiliser in a smart way'**

Reasons for inefficient fertiliser uptake

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- Inappropriate timing and application of fertiliser.
- Inappropriate timing and application of slurry/manure.
- Soil pH too low.
- Soil type.
- Poor sward quality.
- Poor grassland management.

Forward planning

- Winter feeding strategy.
- Have you set a sales plan for stock that are currently on farm?
- From this set targets for silage quality relative to:
  - Calving pattern
  - Beef finishing system
  - Land type
  - Sward type

Fodder budget

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	Number of stock	Daily silage req/head (kg)	Total daily req (kg)	Housing date	Turnout date	Days	Monthly requirement (tonnes)	Winter requirement (tonnes)
Ewes	180	5	900	10/01/2022	01/04/2022	81	27	73
Suckler cows	40	35	1400	15/10/2022	15/04/2023	182	42	255
Steers (300kg)	20	22	440	15/10/2022	15/04/2023	182	13	80
Heifers (300kg)	20	22	440	15/10/2022	15/04/2023	182	13	80
			0.9				95	**488t (500t)**

How are you going to make this silage?

- 2 cut scenario;
- Av 1st cut yield of 8t/ac
- Av 2nd cut yield of 6t/ac
- **TOTAL of 14t/acre required to meet animal requirements** (fresh weight)
    - Need 500 tonnes of fresh weight silage in the pit with silage land yielding 14t/ac fresh weight = (35.7) approx 40 acres of silage cut twice.
    - Assume – There is a good quality grass sward, pH level is correct and P & K levels are optimum (therefore slurry applied meets crop need) ***identified via a valid soil analysis report***

Fertiliser requirements

- **1st cut:**
- Apply 120kgN/ha = 96 units/acre
- 2500 gallons of slurry in good conditions via LESSE will contribute approximately 22.5 units N/acre.
- This leaves 73.5 units N to be applied using artificial fertiliser. Using a 27% N product you need to apply 2.7 bags/ac.
- **2nd cut:**
- Apply 100kgN/ha = 80 units/acre
- 2500 gallons of slurry in good conditions via LESSE as quickly as possible after 1st cut has been harvested will contribute approximately 22.5units N/acre.
- This leaves 57.5 units N to be applied using artificial fertiliser. Using a 27% N product you need to apply 2 bags/ac.

How much will it cost to grow this crop?

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- Based on previous calculation we need 4.7 bags/ac to grow 2 cuts of silage.
- In 2021 27%N was £300/t equivalent to £15/bag.
- In 2022 27%N is £600/t equivalent to £30/bag.
- Therefore 4.7 bags applied per acre @ £30/bag = £70.50 /acre over 2 cuts.
- Aiming to achieve 14t fresh weight silage in the pit/acre = £70.50/14t = an extra £5/tonne to grow this crop.
- We need 9.4t 27% N fertiliser @ £600/t = £5640 of fertiliser to be purchased.
- **Can you afford to do this?**
- **Can you afford not to do this!!!**

Grazing

- Need to ensure that we are making the most of our grazed grass.
- Implement a paddock grazing system.
- Use of rising plate meter and associated technology to aid the decision making process and maximise grass utilisation.
- Apply nitrogen in correct conditions at the right time within the grazing season to achieve the best response.
- Consider the scope that you have to extend the grazing season on your farm.
- Check for areas of compaction on land as this will affect nutrient uptake and subsequent growth.

Grazing system, yield and utilisation

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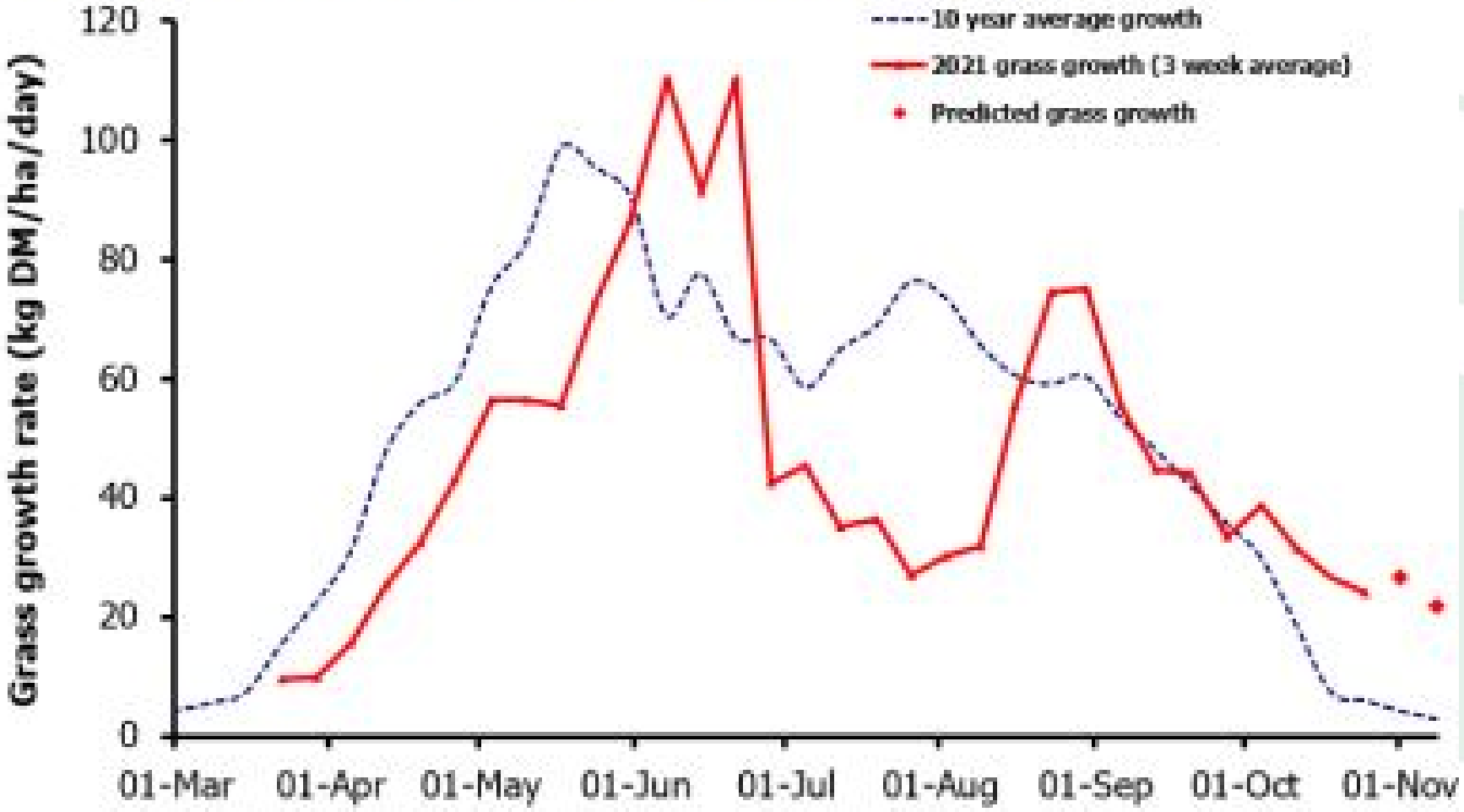
System	Annual Yield (tDM/ha)	Utilisation (%)	Usable yield (%)	% Increase
Set stocking	8.5	50	4.3	
Rotational	10.2	65	6.6	56%
Paddock	10.2	80	8.2	**92%**

Pay attention to the grass growth curve



Ask yourself

- Do you know how much fertiliser you used last year and how it was distributed across your farm?
- How much grass is your farm growing/ha?
- Is the artificial N that I am purchasing and applying working as efficiently as it could?
- Can I use LESSE to apply slurry to maximise nitrogen availability?
- What is the pH status of the soil across your farm?
- Do you have a liming programme in place?
- Is there scope to reduce grass or silage demand?

Summary

- Well managed grass remains the cheapest feed available on livestock farms.
- Plan ahead to make the most of this valuable resource.
- Maximise availability of nutrients in organic manures.
- Target your artificial fertiliser applications.
- Use of the CAFRE crop nutrient calculator should be viewed as an essential tool when it comes to fertiliser planning this year.
- Expenditure on fertiliser must be clearly thought out.

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Reducing reliance on fertiliser N

David Patterson

Jan 2022

afbini.gov.uk

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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advantages 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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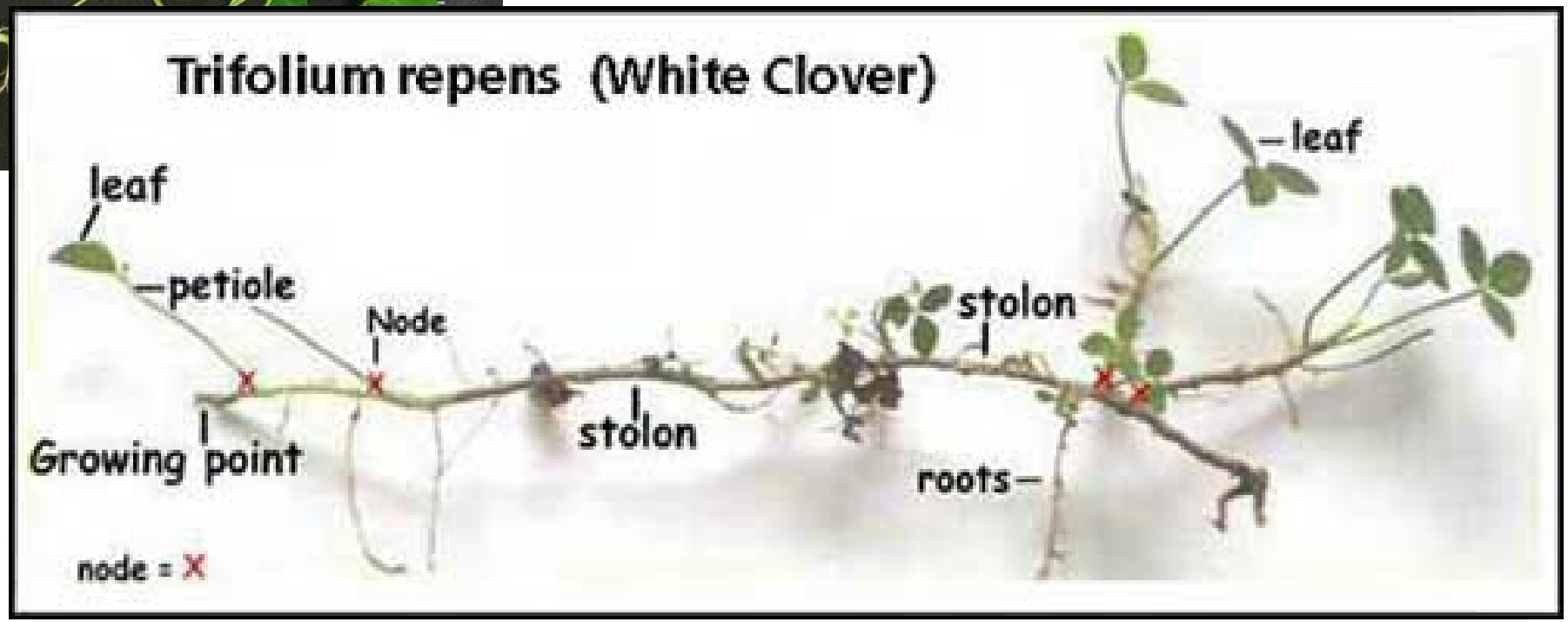

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features of red clover

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

How do grass/clover swards perform in beef farming systems?

- **4 year study**
  G/WC **+** 50 kgN/ha **≈** 86% yield of G **+** 360 kgN/ha

- **5 year study**
  G/WC **+** 0 kgN/ha **≈** 85% stocking rate of G **+** 400 kgN/ha

- **3 studies**
  G/WC **+** 50 kgN/ha **≈** 90% carcass gain/ha of G **+** 220 kgN/ha

(AFBI & Teagasc)

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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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What about environmental impact?

- **Free N:** Rhizobia bacteria fix atmospheric nitrogen (N)
  Fixed N is considered as carbon and energy neutral

- **GHGs:** much reduced use of chemical fertiliser - main source of (N_2O) emissions from fertilised grassland

- **Carbon footprint:** LCA comparison of dairy origin beef finishing system using grass/clover vs grass +150kgN/ha showed a **19% reduction in C footprint**

(Dawson et al., 2009)

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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

1st February	Arable Conference: Understanding Carbon in Arable Rotations
2nd February	Sheep Conference: Pasture Productivity
3rd February	GrassCheckGB Conference
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