Planning for high fertiliser prices in a beef system

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The fertiliser price over the last six months has been on an upward trajectory and as we enter the main growing season hope of prices falling fade. Gas is an essential component in the manufacturing process of Urea, with urea driving the price of fertiliser globally. Gas supply and prices, reduced export of urea from China, interruptions to manufacturing due to COVID-19 and rising haulage costs have all contributed to nitrogen prices which are almost 4 times higher than in September 2020, phosphate and potash have also followed the same trend. This will have a substantial impact on input costs and requires careful consideration of several factors to ensure there is a justifiable return on fertiliser investment.

It is anticipated fertiliser prices will remain significantly higher than in 2021 for the foreseeable future so we must look to the actions we can take in the short term and longer term to mitigate the impact this has on forage production and business profitability. Few farms can plan to cut fertiliser use dramatically and expect the same outcome, so planning is required.

Where to start?

With the daunting prospect of a fertiliser bill twice to three times that of last years it is difficult to know where to start to balance the additional cost with achieving the crop yields required. Any changes to your fertiliser policy should consider the following steps:

- Baseline soil fertility with up to date soil samples
- Apply lime to ensure optimum pH and maximum nutrient availability
- Account for N, P and K supplied from livestock manures available on farm
- Only buy the nutrients you need
- Prioritise fertiliser applications to the most productive grassland or crops
- Ensure fertiliser is applied under best growing conditions
- The use of rotational grazing to increase the utilisation of grass
- Use feed budgets early to calculate what fodder you need for winter 2022 and the different ways you can fulfil this such as use of forage crops or buying fodder early
- Increase clover content of pastures for longer term benefits from Nitrogen fixation
- Know your cost of production for grass and silage to evaluate against other fodder sources
- Take advice from a FACTS qualified advisor on preparation of a Nutrient Management Plan

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Taking accurate soil samples

Soil samples give us an accurate measurement of the plant available nutrients in soil solution. Nutrient levels deplete over time so regular analysis helps ensure we are providing optimum nutrition to crops. Below is a guide to taking your own soil samples:

- Twist a gouge or pot corer down to 7.5cm for grassland and 15cm for arable
- Walk the field in a 'W' shape.
- Avoid gateways, feed areas, stock camps or former muck-heap sites
- Collect at least 25 plugs of soil in a clean bucket and mix together
- Seal a well-mixed sub sample in a plastic bag or box and label (0.5kg of soil)

- Avoid sampling when soil is waterlogged or too dry!
- Sample amalgamated fields separately
- Sample problem areas or known soil types separately
- Try to sample at least 2 months after fertiliser applications, 3 months after slurry applications and 12 months after lime applications
- Sample at least every 4 years – more often if justified
- Try to sample the year before sowing a crop to allow time to correct any deficits
- Samples should be taken at the same time of year, by same method and using the same laboratory to minimise the variation in results

Getting soil pH right

A balanced pH encourages the microbial activity of a soil, ensuring the soil is able to recycle nutrients for plants to use, it enhances the availability of nutrients from soil solution to plants and ultimately is the backbone to crop production. The table below demonstrates the impact of varying pH on the availability of core nutrients.

Availability of Nutrients	**N**	**P**	**K**
pH 5 very strong acidic	53%	34%	52%
pH 5.5 strong acidic	77%	48%	77%
pH 6 medium acidic	89%	52%	100%

At a pH of 5.5 and with Nitrogen prices of £675/t, for every 125kg/ha of product applied 23% of that product is not available to the plant, the equivalent cost of £19/ha. Multiply this by 3 applications over the season on a 100-ha farm and it is a total loss of £5,700 to the business—equal to the cost of 167 tonnes of lime @ £34/t. This demonstrates the value of ensuring fields are at an optimum pH for the crop.

Lime applications should be made based on a recent soil sample. For other mineral soils the aim should be to apply liming material to sustain a minimum pH of 6 for productive grass and other forage crops. The amount of lime to apply will depend on the current soil pH, soil texture, soil organic matter and the optimum pH needed. Clay and organic soils need more lime than sandy soils to increase pH by one unit but a sandy soil will require lime applications more frequently than a heavier soil.

- Lime recommendations are based on a 20 cm depth of cultivated soil or a 7 cm depth of grassland soil
- Lime should be applied at least 6 months prior to cultivation in order to allow soil pH to increase before sowing
- Apply Lime well in advance of phosphate application. Applying phosphate and lime in close proximity can lead to phosphate being locked up due to precipitation as calcium phosphate.

Each year natural processes, rainfall, crop uptake, leaching and inorganic Nitrogen result in acidification of soils. Regular sampling should be undertaken to monitor pH and ensure soils are in an optimum nutrient state for crop production. A routine soil sample costs approx. £20 per field so well worth the investment.

Accounting for organic manures

The following table demonstrates the value of sampling manures and also in the savings which can be made from accounting for manures when calculating nutrient applications.

Table O Comparison in fertiliser required where 30 m^3/ha of 2 cattle slurries were applied in May to a 1st cut silage crop

	Nitrogen (N)		Phosphate (P_2O_5)		Potash (K_2O)	
	Slurry 1	Slurry 2	Slurry 1	Slurry 2	Slurry 1	Slurry 2
1. Total Nutrient in slurry (kg/m^3)	2	4.7	1.2	2	3.3	6.1
2. Total NPK applied in 30 m^3/ha (kg/ha)	60	141	36	60	99	183
3. *Availability of NPK from cattle slurry used in planning the balance of NPK crop requirement (%)	30%	30%	50%	50%	90%	90%
4. Estimated NPK contribution from slurry (kg/ha)	18	42	18	30	89	165
5. Total NPK requirement for Silage (kg/ha)	120	120	34	34	120	120
Total Cost of NPK required (£)[1]	£235.20		£57.46		£132	
6. Manufactured NPK fertiliser required in addition to cattle slurry kg/ha (i.e. item 5 minus item 4)	102	78	16	4	31	0
Cost of manufactured NPK required (£)	*£199.92*	*£152.30*	*£27.04*	*£6.76*	*£33.99*	*£0.00*
Actual savings in year 1	*£35.28*	*£82.90*	*£30.42*	*£50.70*	*£128.01*	*£132.00*

Assumptions:
Silage yield is 20t/ha
[1] Based on prices for N, P&K of £1.96, £1.69 and £1.10/kg respectively.
*N availability based on Table G, summer grassland, shallow injected, 10% DM slurry. Availability varies depending on DM content and method of application.

The cost of fertiliser savings of slurry 1 equate to £193.71 per hectare and slurry 2 savings £265.60 per hectare

For further guidance please see TN736 Optimising the application of livestock farmyard manures and slurries.

What fertiliser to buy

Preparation of nutrient management plan using recent soil samples will ensure that the grade of fertiliser you purchase matches the crop and soil requirements for that field. Optimising N, P & K applications will depend upon soil status, grassland management, whether that is grazing or cut for silage, yield offtake, soil type and contributions of P & K applications from organic sources.

In order to create a nutrient management plan to tailor applications and make best use of organic manures a soil analysis is required for each field combined with an accurate prediction of offtake, an organic manure analysis and ability to tailor organic manure application rates.

Table O above takes you through the stages required to come up with individual fertiliser recommendations. The above assumes soils are at target status of moderate. Had soils been of a low or very low status for P or K the availability of P & K from organic manures has to be reduced in accordance with technical note TN736 and additional P & K needs to be added to the recommendation on line 5 in accordance with TN726.

Assuming soils are at target status with slurry 1 the recommendation is 102kgN/ha, 16kgP/ha and 31kgK/ha. This may be made up with a compound such as 24-6-12 at 258kg/ha of product. However this will only contribute 62kg N/ha. An additional 40kgN/ha is required which could be in the form of 116kg/ha of 34.5%N.
The recommendation for slurry 2 shows little P requirement and no requirement for K. Therefore to meet N, 225kg of 34.5%N would be required. This approach should be followed for each field with analysis taken for organic manures.

When to apply fertiliser

Nitrogen is key to growth and plays a significant role in yield and protein quality of grass. Applications are only economical if subsequent grass growth can be utilised.

- Nitrogen should be applied in Spring in suitable ground conditions and when T-sum has been reached or soil temp at 10cm has been above 5^0C for more than 5 consecutive days. Modern ryegrass varieties start growing properly at 5 degrees and rising.
- Applications of Nitrogen should reduce as the season goes on to reflect the diminishing response to N. No applications should be made after Mid August as N is released from mineralisation of soil organic matter.
- During good growing conditions grass can use 2.5kg N/day— for silage fields ensure you have allowed enough days + extra 7 for this N to be used up in the plant before cutting as it will affect the fermentation quality of silage. Similarly high nitrates can cause animal health issues .
- Potash levels will dictate the efficiency of N uptake so ensure soil K levels are at a moderate status.
- Remember when liming to APPLY FERTILISER FIRST! When Lime is applied before Urea and slurry ammonia emissions are increased so apply fertiliser then Lime 10 days later. If applying slurry or Urea wait 3 months before applying Lime. Lime should be washed off grass leaves before allowing stock to graze.

Encouraging productive swards

Perennial ryegrass is the most productive of the modern grass species, typically yielding 20% more than Yorkshire fog, providing the greatest response to Nitrogen fertiliser, highest feed value and growing all year round in some parts of the UK. Fields with a greater proportion of perennial ryegrass in the sward will provide the greatest return on fertiliser applied and provide higher quality feed so should be prioritised to receive well timed fertiliser applications.

Perennial ryegrasses can be split into 3 categories—early, intermediate and late varieties. This reflects their heading date (50% ear emergence) relative to 1st May. There can be 4 weeks of a difference between heading dates of early and late varieties. The order in which varieties head stays relatively consistent whilst the actual heading date varies depending on weather conditions, season and altitude.

Traditionally grass mixtures for silage would be formulated with a short spread of heading dates to enable the crop to be cut with all varieties at a similar growth stage, however this leaves a harvesting windows of around 4 days which with more frequent unpredictable weather patterns can be very difficult to do. Some seed growers are spreading the heading dates in silage mixtures to extend the harvest window with the later leafier varieties balancing out the early varieties which may already have headed. Within each group there is a close relationship between heading date and plant characteristics such as herbage quality, seasonality of growth and persistence.

White clovers are listed in order of leaf size, small medium and large. The small leaved clovers are prostrate types, persistent and suited to continuous grazing, while large leaved clovers are more erect and better suited to cutting or rotational grazing.

The table below demonstrates the difference between various grass species in terms of quality and energy content, highlighting the value of encouraging perennial ryegrasses in swards. Difference in 1 point of D Value can equate to an extra 20g DLWG in lambs, 40g DLWG in cattle, 0.3lts milk/cow/day.

Grass Species	Average D Value	Average ME (MJ/kg DM)
Perennial Ryegrass	73%	11.7
Timothy	68%	10.9
Smooth Meadow Grass	61%	9.8
Red Fescue	61	9.8
Creeping Bent	58	9.3

Managing surplus and deficit growth

Measuring grass and using the data in a software programme to create a feed wedge gives you a snapshot of the grass available and a prediction on future deficits and surpluses and enables you to make management decisions earlier. Grass growth can be variable depending on rainfall, soil temperature and nutrient availability so if you are reducing fertiliser applications it is important to monitor growth closely to ensure you can manage the surplus or plan for a deficit situation effectively. Having a contingency plan will ensure the impact is minimised. Some management options for both scenarios are considered below:

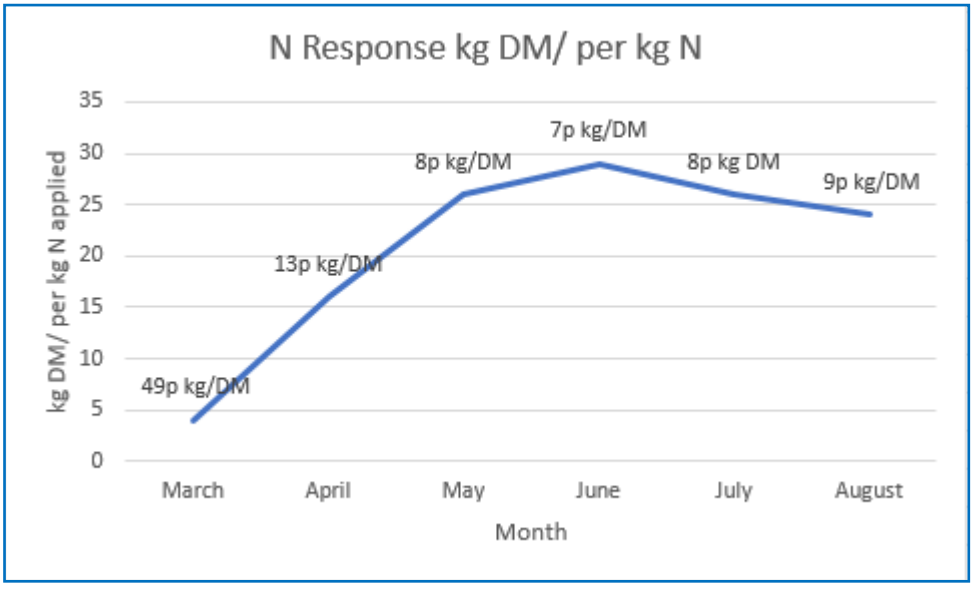
Surplus	**Deficit**
Make extra silage/Hay	Apply fertiliser
If not enough to cut but quality suffering—topping	Sell some tradeable livestock earlier
Take field out for reseeding/forage crops	Wean early and prioritise grass to lambs/priority stock
Take on additional tradeable stock	Look at markets for forward buying forage/feeds
Use rotational grazing to give grass a rest and build grass wedge for deferred grazing in Winter or silage	Use rotational grazing and buffer feeding to give grass a rest

Maximising spring grass

Modern ryegrasses typically start growing once soil temperatures reach 5^0C at 10cm deep for five consecutive days, with clover coming to life at 7 to 8^0C. Nitrogen efficiency is achieved when soil temperatures, soil moisture and sunlight are sufficient for grasses to grow and take up nitrogen to boost growth. The timing of growth peaks varies slightly each year so establishing farming systems which balance grass growth with demand will help to create resource efficiency.

Figure 1 below shows the cost of grass grown (pence per kg DM) based on response to every 1kg N applied using the average grass growth over 10 years from the GrasscheckGB project in Northern Ireland. Figures are based on N @ £675/t.

Figure 1: Cost and daily yield response of grass to N over the season



Source: Grasscheck GB NI

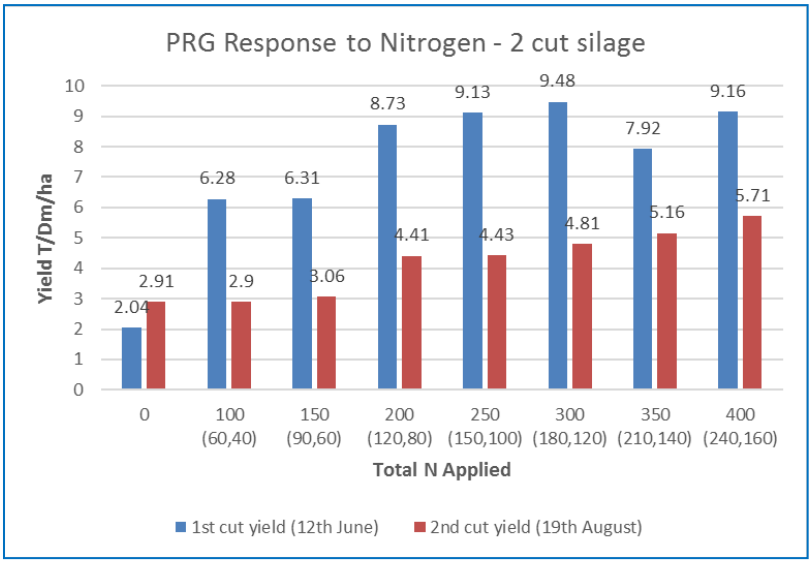
The value of silage

Knowing your cost of growing silage is important, as is realising the value of the silage. Many may be tempted to cut back on bagged fertiliser this year which is good if excess has been applied in previous years but you run the risk of falling short of quantity and quality forage if the recommendations are not met. If stocking density is high and there is a high reliance on silage to carry through the winter months can you afford not to grow enough silage?

Costs of silage	£/ha
Contractors Fees	178
Reseeding costs	37
Fuel	50
Fertiliser	620
Total Costs / ha	885
Yield t/ha	20
Cost per tonne	44
DM	30%
Cost per kg DM	15p

The costs above prepared for a farmer demonstrate that growing silage at 15p per kg DM is cheaper than current price for hay at 18p per kg DM.

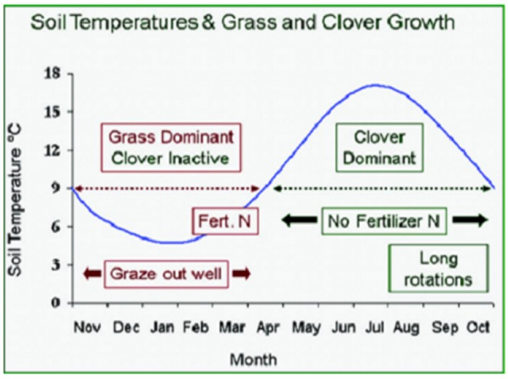
SRUC perennial ryegrass trials in 2019 show the response to Nitrogen applications over 2 cuts of silage. Nitrogen was applied in a 60/40 split on 15th April and 17th June and show the impact of decreasing N rates. There was a 50% decrease in yield when N rate was reduced from 100kg N/ha to 0 and a 30% yield decrease when reduced from 200kg to 100kg N/ha over two cuts.



When considering cutting back Nitrogen rates on silage crops factor in the impact this will have on yield and quality on that crop.

White clover growth

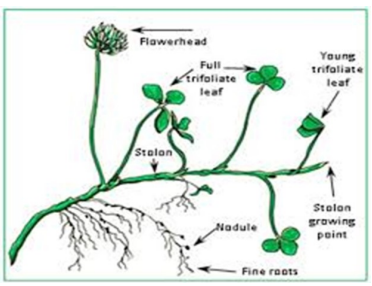
White clover is a perennial herbage legume which has nodules on the clover roots which are capable of converting N from the air into a plant available N. With this in mind tailoring your fertiliser applications to encourage clover growth will promote N fixation (see chart below).



Clover will grow at temperatures 5 degrees higher than that of grass so it will sustain growth through warm spells. Clover is highly digestible so animals will preferentially graze it and with a D value 5% higher than ryegrass alone this will provide high quality grazing. It maintains leaf and nutritious value at a time when grass plants are seeding and reducing in feed quality. Key minerals such as calcium, phosphorous copper and selenium are also greater in clover plants than in ryegrass.

Establishing clover

- Optimum soil pH of 6.0-6.5
- Clover is sensitive to phosphate and potash deficiency and Moderate indices should be maintained
- Clover should be included at between 0.75-1.5kg/ acre with a grass mixture to achieve target establishment
- Seeds should be sown 5-10mm deep
- Clover is ideally sown between April and early August to ensure the plant is producing stolons before the onset of winter
- There are currently no clover friendly herbicides available so weed control will need to be managed through grazing and topping
- Grass is more competitive than clover so if establishing into an existing sward ensure the sward has been well grazed and any dead matter removed through harrowing to enable seed to soil contact
- A higher seed rate of 1.6kg/acre will be required for overseeding
- Grass will need to be managed carefully after sowing to ensure the emerging seedlings do not get shaded out.



Rotational grazing for cattle

- Better use of grass can be made through rotational grazing. During peak growth each new grass leaf takes 7 days to fully emerge so to follow the 3 leaf rule grass should be rested for 21 days before grazing.
- Cattle should be introduced to a field when grass is between 2500-2800kg DM/ha (10-12cm) in the Spring and remove again when grass is at 1500-1600kg DM/ha (4cm). Grass grazed below 4cm will take longer to recover.
- Ensure paddocks have sufficient clean water supply for livestock

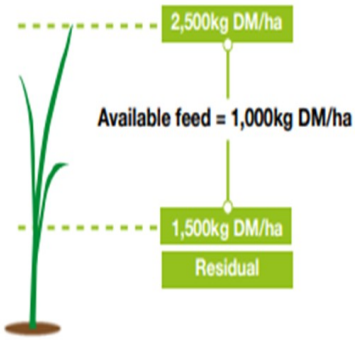
Calculating stocking density

Stock Class		Allocation as % of liveweight
Dry ewe		
Dry cow		
Mature rams or bull		1.5
Late lactation cow		
Late pregnancy ewe		
Late pregnancy cow		2
Finishing cattle		
Early to mid lactation cows		
Mid or late lactation ewes		
Breeding replacements		2.5
Growing cattle		
Early lactation ewes		
Flushing ewes		
Flushing cows		3
Growing lambs		4

When calculating available feed you need to know:

1. **Animal intake requirements** - stock class, weight and stage of pregnancy if applicable.

2. **Feed available** - grass cover less residual grass cover.



To calculate how many days feed is available in a paddock:

$$\frac{\text{available feed}}{\text{total intake requirement.}}$$

Eg. 50 store cattle @ 380kg with 3% of bodyweight intake requirement = 11.4kg DM/head/day x 50 = 570kg DM/day of total feed required

Available feed = 2500kg DM/ha - 1500kg DM/ha = 1000kg DM/ha

$$\frac{1000 \text{ kg DM/ha}}{570} = 1.7 \text{ days}$$

0.6 ha will be needed to provide 1 day of grazing for the 50 store cattle.

Future Fertiliser

Gas and oil prices remain volatile which is having a direct impact on fertiliser, fuel and feed prices. Although fertiliser is expensive with other inputs increasing in cost and disruption to supply chains the importance of home produced forage is highlighted. Ensuring you are getting soil fertility, timing, rates and management correct will help to mitigate some of the short term uncertainty around cost and availability whilst establishing longer term strategies to reduce fertiliser use.

Whilst no-one can predict when prices will rise and fall keeping in touch with your local suppliers will help to make decision on when to buy inputs such as fertiliser.