Section 3

Soil Fertility and Nutrient **Management**

by **Stan Lalor, James Humphreys**

1. How do I find out and manage my farm's nutrient status?
2. How do I use the information supplied by soil analysis?
3. How important is lime?
4. How much nitrogen should I be using?
5. How do I get the most from clover?
6. How much phosphorus, potassium and or sulphur should I be using?
7. How much fertilizer is in slurry?
8. How important is the choice of fertilizer compound?

Soil Fertility and Nutrient **Management**

Soil fertility management targets

1. Have soil analysis results for the whole farm. Soil tests should be repeated every 3-5 years (four years if applying for a Nitrates Derogation). To spread costs, soil test a portion of the farm every year.
2. Aim to have the whole farm at pH 6.5. Ground limestone should be spread as recommended. Where soil magnesium (Mg) levels are low, dolomitic limestone (contains Mg) can be used to both increase pH and supply Mg.
3. Manage slurry and soiled water to maximise the fertilizer value.
4. Aim to have all fields in Index 3 for phosphorus (P) and potassium (K). Build up soils in Index 1 and 2. Allow Index 4 soils to fall to Index 3.
5. Apply nutrients in the proper balance. Supply enough of each nutrient without oversupplying individual nutrients. Deciding where slurry should be spread, and choosing the correct compound fertilizer is critical.

① How do I find out and manage my farm's nutrient status?

Find out the nutrient status of the soils on the farm by taking soil samples for analysis. The soil sample results will provide information on areas of the farm that have low, medium or high fertility. You will need this information to accurately plan fertilizer and slurry applications.

What does soil analysis do?

- A soil test can be used to obtain information on background soil fertility levels.
- Not all of the total nutrients in the soil are available to plant roots for uptake.
- Soil analysis methods are designed to measure and predict the amount of nutrients in the soil that are available to plants.

What nutrients can be tested for?

- Standard soil testing includes soil pH, lime requirement, P and K.
- Additional tests are also available for Mg and micronutrients.
- There is no suitable soil test for nitrogen (N) or sulphur (S).
- Analysis of herbage can provide additional information on the nutrient status of the sward. Herbage analysis is more reliable than soil analysis for S, and for trace elements such as copper, molybdenum and selenium.

How to

Take soil samples

- Soil test results are of little value if the soil sample taken is not representative of the field or area being sampled.
- Divide the farm into fields or areas that can be easily managed separately when applying fertilizers. As a guide, take one sample to represent between two and four hectares. If the area is very uniform a sample may be taken to represent a larger area. For farms with a Nitrates Derogation, the requirement is that the average soil sample area is not greater than five hectares.
- Take separate samples from areas that are different in soil type, previous cropping history, slope, drainage or persistent poor yields.

Key Risks

- Do not sample a field until three to six months after the last application of P and K. Where lime has been applied allow a time lag of up to two years before sampling for soil pH and lime requirements.
- Sampling depth: ensure that soil is sampled to 10cm. Shallower sampling can give inaccurate results, particularly for P. Where permanent pasture is ploughed for reseeding, re-sample the field as soon as possible after ploughing as the soil ploughed up to the surface may have a different nutrient status to the soil ploughed down.
- Avoid sampling under extreme soil conditions e.g. waterlogged or very dry soils. Sample at the same time of the year to aid comparisons of soil sample results.
- When taking a sample, avoid walking in the lines of fertilizer and lime spreading operations on the field.
- Avoid any unusual spots such as old fences, ditches, drinking troughs, dung or urine patches or where fertilizer /manures or lime have been heaped or spilled in the past.

2 How do I use the information supplied by soil analysis?

Soil Index

- Nutrient advice is based on a simple soil index system.
- Fields or areas can be categorised on a soil index scale of 1 to 4 for each nutrient (P, K, most micronutrients) based on soil test results.
- The index system is based on the expected response to fertilizers.
- There is no index system for N or S in grassland due to the lack to date of a reliable soil test.

Table 1.

Soil Index	Description	Response to fertilizers	Soil test result range for each Index (mg/L)		
			P	K	Mg
1	Very low	Definite	0 – 3.0	0 – 50	0 – 25
2	Low	Likely	3.1 – 5.0	51 – 100	26 – 50
3	Medium	Unlikely	5.1 – 8.0	101 – 150	51 – 100
4	High	None	≥8.1	≥151	≥101

- Nutrient advice is based on a target of maintaining soils in Index 3. At this index, soils have a bank of available nutrients to deliver nutrients to the grass. The objective is to replace the nutrients that are being removed in products such as silage, milk or meat.
- Index 1 and 2 soils have low nutrient levels, and require additional inputs in order to support grass growth and increase the soil fertility to the target Index 3.
- Soils in Index 4 have high nutrient levels and will support the grass sward without additional fertilizers.

How to
Maintain soil fertility when in Index 3

- The approach to maintaining soil fertility is to replace the nutrients removed in product.
- For example, one kg of P is removed from the farm in approximately 1,000 litres of milk or in 100 kg of animal liveweight.
- Nutrient advice rates are based on replacing the nutrient off-take.

How to
Build soil fertility when in Index 1 and 2

- Additional nutrients above those required to replace nutrients removed in products are required to build soil fertility from low Index 1 and 2 levels up to Index 3.
- The length of time required for soil nutrient levels to increase or decrease will depend on the soil type, but can take a number of years. Therefore, apply additional nutrients for soil build up for a number of years until soil analysis indicates increased fertility.

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③ How important is lime?

Soil pH and lime application

- Acidity in soils is measured by soil pH. Acid soils have low pH (<7) and alkali soils have high pH (>7).
- The optimum pH for productivity, biological activity and nutrient availability in grassland soils is 6.5.
- The pH of acid soils can be increased by applying lime.
- The lime requirement of a soil is determined by soil analysis.
- The lime requirement is calculated as the lime required to increase the soil pH to 6.5.
- Lime does not need to be applied every year. Apply enough lime once every 3-5 years to reach a pH of 6.5. This will maintain the soil pH close to the optimum for a number of years.

Spreading lime – How much?

- The rate of application is determined by soil analysis. The lime requirement is shown on the analysis report.
- Don't apply more than 7.5t/ha (3t/acre) in a single application.
- Where lime requirements are greater than 7.5t/ha, apply 7.5t/ha initially, and then apply the remainder after two years.
- In soils that are at risk of having high molybdenum (Mo) status (see Figure 1), reduce the lime requirement by 5t/ha to avoid potential problems with copper (Cu) deficiency. (Mo can make Cu unavailable to animals). The optimum soil pH for high Mo soils is 6.2.

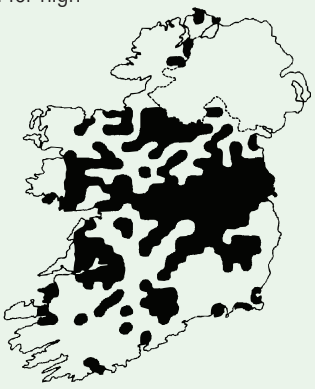

Figure 1. Indicative map showing distribution of potentially high Mo soils in Ireland

Checklist

Lime

Spreading lime – When?

- Lime can be spread all year round.
- Apply to bare swards if possible. Lime should not be applied to swards close to silage harvesting.
- Incorporation of lime into the seed bed is recommended for reseeding.
- Avoid applying urea fertilizer or slurry as nitrogen (N) fertilizers for 3-6 months after lime application, as lime can increase gaseous N losses from urea and slurry.

Spreading lime – How often?

- Conventional ground limestone should be applied as per the lime requirements after soil testing.
- The lime requirement is a once off application, and does not need to be repeated annually.

Spreading lime – Which lime to use?

- Calcium (Ca)-based ground limestone is most common.
- Dolomitic limestone contains both Ca and magnesium (Mg) and is recommended for soils that have low Mg levels.
- Granulated lime products can be applied at lower rates on a 'little and often' basis for soil pH maintenance. The rate applied will depend on the product, but usually lower rates can be used as the material is ground finer than conventional ground limestone and will therefore react faster in the soil. These products offer convenience as they can be applied using standard fertilizer spreaders. However, they are usually more expensive than conventional limestone applied on a 3-5 year cycle, particularly on soils with high lime requirements.

4 How much nitrogen should I be using?

Nitrogen (N) requirements for pasture and silage

- There is no reliable soil test currently available for N. Therefore, there is no soil Index system for N in grassland.
- Recommendations are based on average soil fertility levels.
- Total N application on the farm and time of application must be compliant with nitrates regulations.
- Matching N fertilizer use to stocking density on the farm at different times of the year avoids excessive use.
- Applying N fertilizer 'little and often' during the growing season gives most efficient response in terms of grass growth.

Table 2. Maximum permissible rates of fertilizer N for grassland in different counties

Rates of fertilizer N are shown as kg/ha (units/acre in brackets)

Stocking rate (kg per ha of organic N)	Carlow Cork Dublin Kildare Kilkenny Laois Offaly Tipperary Waterford Wexford Wicklow	Clare Galway Kerry Limerick Longford Louth Mayo Meath Roscommon Sligo Westmeath	Donegal Leitrim	Cavan Monaghan
≤ 170	205 (166)	202 (164)	200 (162)	197 (160)
171 – 210	280 (227)	277 (224)	274 (222)	270 (219)
211 – 250	248 (201)	244 (198)	241 (195)	237 (192)

Table 3. N fertilizer advice

Recommended rates of fertilizer N for grassland during the year where approximately half of the farm is cut for first-cut silage and the amount of second cut is kept to a minimum (0 – 30% of the grassland area). Rates of fertilizer N are shown as kg/ha (units/acre in brackets)

Stocking rate (kg/ha organic N)	Jan/ Feb	Mar	Apr	May	Jun	Jul/Aug	Aug/Sep	Total (kg/ha)	Total (u/ac.)
155 -170	0 (0)	28 (23)	45 (36)	25 (20)	25 (20)	25 (20)	25 (20)	**173**	**140**
170 - 180	28 (23)	28 (23)	45 (36)	25 (20)	25 (20)	25 (20)	25 (20)	**201**	**163**
180 - 190	28 (23)	37 (30)	45 (36)	34 (28)	25 (20)	25 (20)	25 (20)	**219**	**177**
190 - 200	28 (23)	45 (36)	45 (36)	34 (28)	34 (28)	34 (28)	34 (28)	**254**	**205**
200 - 210	28 (23)	45 (36)	50 (40)	45 (36)	34 (28)	34 (28)	34 (28)	**270**	**218**
211 - 250	28 (23)	45 (36)	45 (36)	34 (28)	34 (28)	34 (28)	25 (20)	**245**	**198**

The recommendations in this table are for farms on soils of average natural fertility. At stocking rates less than 200kg organic N/ha substantially more fertilizer N than is recommended in this table can be applied on poorer soils (see Table above for maximum permissible rates). Less than recommended fertilizer N is needed on soils with above average natural fertility or where there is plenty of clover in the sward.

At very high stocking rates of greater than 200kg organic N/ha slightly more fertilizer N (for example 8kg/ha) than is presented in this Table can be applied in southern counties and this should be applied in spring as part of the first or later applications.

When calculating stocking rate, 1 cow = 85kg/ha of organic N.

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Table 4. N for grazed swards

Nitrogen fertilizer for different stocking rates on the area available for grazing during the year. Care is needed when using this table to avoid exceeding nitrates regulations limits. Rates of fertilizer N are shown as kg/ha (units/acre in brackets)

Stocking rate (LU/ha)	N Fertilizer (kg/ha)		Stocking rate (LU/ha)	N Fertilizer (kg/ha)		Stocking rate (LU/ha)	N Fertilizer (kg/ha)			
Mid Mar	Jan/Feb	Mar	May/Jun	Apr	May	Jul/Aug	Jun	Jul	Aug	Sep
<1.2	0	28 (23)	<3.5	28 (23)	17 (14)	<2.0	17 (14)	17 (14)	17 (14)	17 (14)
1.2–1.4	28 (23)	28 (23)	3.5–3.75	28 (23)	26 (21)	2.0–2.5	26 (21)	26 (21)	25 (20)	25 (20)
1.4–1.6	28 (23)	38 (30)	3.75–4.0	38 (30)	34 (28)	2.5–3.0	34 (28)	34 (28)	34 (28)	34 (28)
1.6–1.8	28 (23)	49 (40)	4.0–4.25	49 (40)	42 (35)	3.0–3.5	34 (28)	26 (21)		25 (20)
>1.8	28 (23)	49 (40)	>4.25	45 (36)	50 (40)	>3.5	34 (28)	30 (24)		20 (16)

Checklist

Ten ways to control N fertilizer costs

1. Apply 28 kg/ha for the first application in spring (mid-January to early March, depending on location and soil type etc.). Urea is more cost-effective than CAN in spring.
2. Replace the first application of N fertilizer by an application of slurry. Aim to apply slurry on two-thirds of the farm in late January, allowing 4-6 weeks between application and the expected date of grazing. Umbilical systems can reduce the machinery compaction when applying slurry. Bandspreading/trailing shoe/injection systems reduce herbage contamination.
3. Apply the second application of N fertilizer four to six weeks after the first, usually some time during March. The third application should roughly coincide with closing up for silage in April. Match N fertilizer applications to stocking rates on the farm at various times of the year.
4. Replace some of the N fertilizer for first-cut silage with slurry in late March. The slurry should be applied at least six weeks before the expected silage harvest date. Allow approximately one week between slurry and N fertilizer application.
5. Make as much silage as possible as first-cut. First, work out how much silage is required. Second, depending on requirements, aim to maximise stocking rate on the grazing area during April and May. This makes as large an area as possible available for first-cut silage. There is a very high response to N fertilizer during April and May. First-cut silage yields will be at least 25% higher than second-cut for more or less the same input costs.
6. Dilute slurry with dirty water to increase the efficiency of utilization of N in the slurry applied to silage stubble after first-cut silage. Dilution should only be carried out where it is a convenient way to manage dirty water and at times of the year outside of the closed period for slurry application.
7. Avoid making second-cut silage if possible. Having the whole farm available for grazing from June onwards lowers the requirement for N fertilizer. Apply N fertilizer in line with stocking rate and pasture cover. If pasture cover is above target, lower the amount or increase the interval between applications of N fertilizer. Do not skip applications.
8. Plan to build pasture cover by extending the rotation from late July to mid August. N fertilizer applied in July and August has a greater effect on grass supply in November and in the following spring than applications later in the autumn.
9. Blanket spreading of N fertilizer simplifies record-keeping, and this helps to keep N fertilizer use on the farm under control.
10. White clover has the potential to reduce the amount of N fertilizer used on the majority of grassland farms.

5 How do I get the most from clover?

Over-sowing clover to reduce N costs

- White clover has the ability to manufacture 150 kg/ha of plant available N in the soil.
- Dairy systems research has shown that clover-based grassland receiving N fertilizer input of 90kg/ha in spring can carry up to 2.5 cows/ha producing 1,100kg milk solids per ha per year.
- Over-sowing is a low-cost method of introducing and maintaining clover in swards.

Checklist

Eight steps for successful over-sowing of clover into permanent grassland

1. Soil fertility: Soil pH should be between 6.0 and 6.5, and soil P and K levels should be at Index 3.
2. Open swards: Over-sowing will only work where there is a reasonably open sward as the clover seed has to come in contact with the soil. Reseeding is a better option for old dense swards or swards heavily infested with weeds.
3. Weed control: Eliminate docks and other broad-leaved weeds with a suitable herbicide before over-sowing. Once the clover is established, the range of herbicides that can be used is greatly restricted.
4. Sowing date: Moist soil conditions during and after over-sowing are crucial. On heavy wet soils the ideal time is after harvest of first-cut silage in late May or early June. On light drier soils it is better to over-sow earlier in May; after grazing or a harvest of baled silage. Tight grazing before and afterwards is important to ensure success. Over-sowing during the late summer and autumn is not recommended.
5. Sowing rate: Apply clover seed with 0:7:30 or similar fertilizer at a rate of one and a quarter bags per hectare. Apply 2kg of a mixture of two clover varieties on the recommended list. Pelleted or unpelleted seed can be used with equal success.
6. Broadcasting the mixture: Mix the clover seed with the fertilizer in the field. This will avoid the fertilizer and seed separating out while driving to the field. While pouring in the fertilizer, mix in the seed to ensure an even mixture of fertilizer and seed. Up to five hectares can be done at one time.
7. Post-sowing management: Apply slurry after over-sowing. Apply no N fertilizer for the remainder of the year, as N fertilizer will drive on the grass to the detriment of the clover seedlings. Tight grazing is important. Do not allow covers to get too high (>800 to 1,000kg DM/ha) and graze out to low residuals (<4cm).
8. Over-winter management: Graze tightly before closing up for the winter and do not leave a heavy cover to build up over the winter. Graze tightly again in spring to allow light to penetrate down to the clover stolons. More stolon growth in spring increases the clover content and productivity of swards later in the growing season.

6 How much phosphorus, potassium and or sulphur should I be using?

Phosphorus (P) and potassium (K) requirements for pasture and silage

- P and K can be applied either as a single annual application, or little and often through the year.
- P and K application rates should be based on the soil test and on the usage of the field.
- Requirements for silage are usually higher than for grazing, particularly for K.
- The target soil Index is Index 3. For Index 3 soils replace the P and K removed in product (milk and meat) or as silage.
- P and K requirements increase with increasing stocking rate and production.
- Index 1 and 2 soils require additional P and K to allow soil levels to increase to Index 3.
- Index 4 soils have sufficient P and K to meet the grass requirements, and should receive no fertilizer until the soil test P and K declines to Index 3.
- Total P application on the farm and time of application must be compliant with nitrates regulations.
- There are no restrictions on K application rates and timings.

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Sources of Phosphorus (P)

- P in slurry generated by livestock on the farm.
- P in concentrates fed to livestock.
- P in manufactured fertilizer.
- P in any organic manures (e.g. pig and poultry slurry, dairy sludge etc.) imported onto the farm.

A number of steps need to be taken to interpret available P in terms of the amount of fertilizer P that can be applied on the farm:

1. Determine the soil P status through soil testing. This is compulsory on derogation farms. Where there are no soil test results available on non-derogation farms, it is assumed that the soils on the farm are in soil P Index 3.
2. Deduct the P in slurry generated by farm livestock and stored over the winter. This 'stored slurry' is a notional quantity based on the statutory requirement for slurry storage on the farm (16, 18, 20 and 22 weeks depending on location).
3. Deduct the P in concentrate feed used on the farm. Examples of the quantities of P in concentrate where 0.5 and 1.0t of concentrate are fed per LU are presented at the bottom of the table shown. The default assumption is that concentrate feed contains 5kg of P per tonne. Alternative values can be used for straight feeds or using feed labels for compound rations.
4. Where reseeding takes place on the farm, an additional 15kg/ha of P may be applied over normal requirements, provided the reseeded area is in Index 1, 2 or 3. No additional P is allowed for reseeding on soils in P Index 4.

Example:
Taking a farm in Zone A stocked at between 1.5 and 2.0LU/ha (130–170 kg/ha of organic N) and where soils are tested in Index 3. No organic manure is imported onto the farm in this example. The amount of fertilizer P that this farmer can apply assuming that no concentrate is being fed on the farm is approximately 11.0kg/ha of P (8.9 units of fertilizer P per acre).

If half a tonne of concentrate is fed per LU on the farm, this farmer is allowed to apply 5.9kg/ha of P (4.8 units per acre) - 11.0kg minus 5.1kg - (8.9 units minus 4.1 units in concentrate). If one tonne of concentrate is fed per LU, this farmer is allowed to apply 0.8kg/ha (0.6 of a unit of fertilizer P per acre) – in other words – virtually none at all.

Average concentrate feeding on Irish dairy farms is approximately three-quarters of a tonne per LU. On many autumn-calving dairy farms where more than one tonne of concentrate is being fed per LU, it is likely that no fertilizer P can be applied on the farm unless the soils on the farm have low soil P status (soil P Index 1 or 2). If organic manure is imported onto the farm, the P in this manure is further deducted from the quantity of P allowed under the regulations.

Table 5. Approximate rates* of fertilizer P allowed in different parts of the country after deducting P in slurry generated by livestock but before deducting the P in concentrates fed to livestock. Examples of quantities of P in concentrate are at the bottom of the table. Rates of fertilizer P are shown as kg/ha (units/acre in brackets).

Soil P Index	Grassland stocking rate (kg/ha of organic N per year) ≤130	131 – 170	171 – 210	211 – 250
		Zone A		
1	28.9 (23.4)	31.0 (25.1)	34.1(27.6)	37.2 (30.2)
2	18.9 (15.3)	21.0(17.0)	24.1(19.5)	27.2 (22.1)
3	8.9 (7.2)	11.0(8.9)	14.1(11.4)	17.2 (14.0)
4	0.0	0.0	0.0	0.0
		Zone B		
1	28.1 (22.8)	30.0 (24.3)	32.9 (26.6)	35.8 (29.0)
2	18.1 (14.7)	20.0 (16.2)	22.9 (18.5)	25.8 (20.9)
3	8.1 (6.6)	10.0 (8.1)	12.9 (10.4)	15.8 (12.8)
4	0.0	0.0	0.0	0.0
		Donegal/Leitrim		
1	27.4 (22.2)	29.0 (23.5)	31.6 (25.6)	34.3 (27.8)
2	17.4 (14.1)	19.0 (15.4)	21.6 (17.5)	24.3 (19.7)
3	7.4 (6.0)	9.0 (7.3)	11.6 (9.4)	14.3 (11.6)
4	0.0	0.0	0.0	0.0
		Cavan/Monaghan		
1	26.6 (21.5)	28.0 (22.7)	30.4 (24.6)	32.8 (26.6)
2	16.6 (13.4)	18.0 (14.6)	20.4 (16.5)	22.8 (18.5)
3	6.6 (5.3)	8.0 (6.5)	10.4 (8.4)	12.8 (10.4)
4	0.0	0.0	0.0	0.0
Concentrate (t/LU)	Amount of P in concentrates fed to livestock (this must be deducted from fertilizer P above)			
0.5	3.9 (3.2)	5.1 (4.1)	6.3 (5.1)	7.5 (6.1)
1.0	7.8 (6.3)	10.2 (8.3)	12.7 (10.2)	15.1 (12.2)

*The rates in this table are a rough guideline to permissible rates and are presented for the purposes of example. Rates of P fertilization that can be used on individual farms must be based on the specific details of each farm.

P and K advice for grazed swards

While the previous table indicates average maximum P limits for the farm, the P requirements within the farm will vary depending on stocking rate and usage for grazing or silage. The following advice must be cross checked against the maximum P allowed for the whole farm.

- Rates shown must be deducted to account for P fed to livestock in concentrate feeds.
- To account for P in concentrate feeds, use either actual P content in the feeds used if available, or alternatively, use a default value of 5kg of P per tonne of concentrate feed.
- The P and K rates shown can be supplied by either slurry or fertilizer.

Table 6. Simplified P requirements (kg/ha) of grazed swards on dairy farms. (Rates shown are total P requirements, before deductions for concentrate feeds or organic fertilizers). Rates of fertilizer P are shown as kg/ha (units/acre in brackets)

Soil P Index	Grazed swards Farm stocking rate (kg/ha Org N) < 130	131-170	171-210	>210
1	30 (24)	34 (27)	39 (31)	43 (34)
2	20 (16)	24 (19)	29 (23)	33 (26)
3	10 (8)	14 (11)	19 (15)	23 (18)
4	0	0	0	0

Rates shown in the table above are guideline P rates advised for grazed swards. Allowable application rates will vary depending on the farm specific circumstances and the P allowances under the Nitrates Regulations. These rates may need to be adjusted in order that the whole farm does not exceed the limits for P.

Table 7. Simplified K requirements of grazed swards on dairy farms. (Rates shown are total K requirements, before deductions for organic fertilizers). Rates of fertilizer K are shown as kg/ha (units/acre in brackets)

Soil K Index	Grazed swards Stocking rate (kg/ha Org N) < 130	131-170	171-210	>210
1	85 (68)	90 (72)	95 (76)	100 (80)
2	55 (44)	60 (48)	65 (52)	70 (56)
3	25 (20)	30 (24)	35 (28)	40 (32)
4	0	0	0	0

P and K advice for silage

- Silage crops remove more P and K from fields than grazing.
- Where swards are being harvested for silage, use the rates of P and K shown in Table 8, in addition to the grazing requirements.

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Table 8. P and K requirements of silage. (Rates shown are total requirements, before deductions for organic fertilizers). Rates of fertilizer P and K are shown as kg/ha (units/acre in brackets).

Soil	Cut once		2nd and subsequent cuts	
Index	P (kg/ha)	K (kg/ha)	P (kg/ha)	K (kg/ha)
1	20 (16)	120 (96)	10 (8)	70 (56)
2	20 (16)	120 (96)	10 (8)	55 (44)
3	20 (16)	120 (96)	10 (8)	35 (28)
4	0	0	0	0

Rates of P shown in the table above are guideline P rates advised for silage swards. Allowable application rates will vary depending on the farm specific circumstances and the P allowances under the Nitrates Regulations. These rates may need to be adjusted in order that the whole farm does not exceed the nitrates limits for P.

Sulphur

- Sulphur (S) is an important nutrient for grassland, and is closely associated with N uptake and efficiency.
- There is currently no soil test or soil Index system for S.
- Herbage analysis is the best predictor of S deficiency.
- Lighter soils with low organic matter contents are generally more prone to S deficiency.

Figure 2. Map of Ireland showing sulphur deficient areas of the country. Shaded areas indicate where response to S fertilizer is more likely

S fertilizer advice

- The response to S fertilizer increases as the rate of N fertilizer increases.
- On S deficient soils, apply 20kg/ha per year for grazed swards.
- For silage swards on S deficient soils, apply 20kg/ha of S per cut.
- Avoid S application to soils not deficient in S, as excess S may affect the trace element nutrition of plants and animals.
- S can be applied by using any of a number of straight or compound fertilizers that contain S.

7 How much fertilizer is in slurry?

Key fact

Slurry is a fertilizer

Slurry and soiled water produced on the farm can be a valuable source of nutrients for grass. The following guidelines will ensure that soiled water and slurry are used to maximum potential:

1. Where to spread?
   - Most of the fertilizer value is due to the P and K content.
   - Decide which fields have the highest P and K requirements and spread slurry on these fields.
   - This may mean transporting slurry for long distances to outfarms, but this will usually pay for itself through savings in fertilizer costs.
2. When and how to spread.
   - The N value of the slurry is affected by timing and method of application.
   - N can be lost to the air as ammonia in warm and dry conditions.
   - Apply in cool moist weather conditions where possible. Light mist is ideal.
   - Application in spring normally gives better results than summer.
   - Applying with trailing shoe or bandspreader will improve the N value compared to splashplate.

3. Dilute slurry and soiled water.

- Soiled water and dilute slurries have lower total nutrient contents than undiluted slurry.
- Dilution increases the availability of N in slurry.
- Application method and timing have less effect as slurry becomes more dilute.

Table 9. Fertilizer value of slurries and soiled water. Values are shown as kg/m^3 (units per 1,000 gallons in brackets)

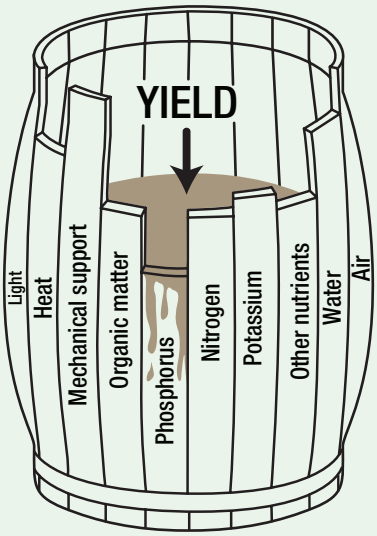
Slurry type	Application		Fertilizer value (kg/m^3)		
	Timing	Method	N	P	K
Undiluted slurry	Spring	SP	0.7 (6)	0.6 (5)	4.3 (38)
		BS/TS	1.1 (10)		
	Summer	SP	0.4 (3)		
		BS/TS	0.7 (6)		
Soiled water			0.5 (4)	0.1 (0.7)	0.6 (5)

Multiply by 9 to convert kg/m^3 to units/1,000 gallons
SP = splashplate
TS/BS = trailing shoe or bandspreader

8 How important is the choice of fertilizer compound?

Nutrient balance

- Applying nutrients in the correct proportion is key to maximising grass production with minimal costs.
- Response to fertilizers is determined by the law of the minimum.
- This means that the limiting nutrient determines yield. For example, additional N application is of no benefit if P or K is the limiting factor.
- Therefore, balanced nutrient applications are very important.



How to

Choose a suitable fertilizer compound

- Fertilizers are available in a number of forms.
- Straight N, P or K fertilizers contain only one nutrient, while compound fertilizers (e.g. 18-6-12, 0-10-20, etc) contain a combination of nutrients.
- It is important to apply the fertilizer products that best supply the nutrient requirements in each field.
- A single compound fertilizer will not be suitable in every field.