Technical Note TN652

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Fertiliser recommendations for grassland

SUMMARY

- The main limitations to grass production are temperature, moisture, soil pH, soil drainage and structure, and nitrogen (N).
- Recommendations take account of nutrient management planning in the PLANET Scotland software tool and NVZ Action Programme rules.
- Good soil management is required to optimise nutrient use and maximise grassland productivity.
- Regular soil analysis is essential to manage soil pH and optimise phosphate (P_2O_5) and potash (K_2O) inputs for maximum yields and profitability.
- Considered application of nitrogen to meet grass needs can reduce the loss of harmful greenhouse gases.
- Appropriate use of livestock manures can result in considerable savings on purchased fertilisers.

1. Introduction

The main limitations to grass production are temperature, moisture, soil pH, soil drainage and structure, and nitrogen (N). This technical note shows how to calculate the optimal amount of N that should be applied based on:

- Assessment of "*site class*" (grass growing conditions). This is a measure of the production potential of the farm and determines the area of grass and quantity of fertiliser N needed to produce the grass required for your intended grassland management.
- Prediction from tabulated data of the *annual N use* to support a particular grassland management at a given site class.

Phosphate, potash, and sulphur recommendations have been updated in the light of current advances in understanding of soil nutrient management. Regular soil analysis is essential to optimise phosphate (P_2O_5) and potash (K_2O) inputs for maximum yields and profitability. Soil should be sampled and tested every 4–5 years and prior to establishment. P and K inputs from organic manures reduce annual P and K requirements. Over-use of P is wasteful and can lead to the loss of phosphorus from agricultural land to fresh water and impair water quality.

This technical note can be used along with PLANET Scotland, a software tool designed for routine use by Scottish farmers and consultants to plan and manage nutrient use on individual fields (http://www.planet4farmers.co.uk).

In addition, considered nutrient application will help to reduce the loss of nutrients to the environment; an important factor in terms of protecting water quality and reducing emissions of greenhouse gases such as nitrous oxide (N_20). Injecting slurry, avoiding application on windy days and not applying fertilisers to wet, saturated or compacted soils will all help to minimise the loss of greenhouse gases. Further information on climate change and farming is available at http://www.sac.ac.uk/climatechange/farmingforabetterclimate/

2. Soil Management

The efficient and profitable use of organic and manufactured nutrients in grassland systems requires good soil conditions and effective soil management. The priorities in grassland are soil pH, drainage and soil structure. The profitable use of the maximum levels of nutrient inputs can only be realised when the soil is in good condition.

The optimum availability of most plant nutrients in soil occurs over a small range of soil pH values. Maintaining the optimum pH in the topsoil in all parts of the field is important to achieve optimum yields and consistent quality. Clover is more sensitive to soil acidity than are many grass species and soil pH should be maintained to encourage a clover-rich sward. Aim for an optimum soil pH of 6.0 on mineral soils. Aim lower at pH 5.3 to 5.5 on peaty soils. Liming materials should be purchased on the basis of the price relative to the neutralising value and fineness of the products on offer. The fineness will usually include the maximum size of particles and the amount passing a 150 micron sieve. The finer the grinding of the product the more rapid the rate at which neutralisation occurs.

Soil structure will determine the rooting depth and soil drainage capacity. Compaction of the upper soil layers arising from poaching and wheel ruts limits root development, restricts nutrient uptake and reduces growth potential. Soil compaction should be addressed when identified using a combination of cultivation, ploughing and changes to land management practices. An SAC field guide to identifying soil compaction is available at http://www.sac.ac.uk/mainrep/pdfs/soilstructure.pdf.

Excess soil moisture on heavy land limits the length of the effective growing season. This may require the installation and maintenance of an artificial drainage system to fully justify the use of moderate to high levels of nutrient inputs.

The application of lime, organic fertilisers and more insoluble forms of P, prior to any land work during grass and clover establishment, is an opportunity to directly improve soil fertility below the first few cm of the soil profile.

Soil sampling programme

Soils should be analysed when cultivated or once every 4 to 5 years for soil pH, and extractable P, K and Mg. Grass does not generally respond on moderate PK status soils and sampling time is therefore not crucial, but be aware that the application of fertilisers and manures may influence results for up to 12 weeks after application. Analyses for P and K can vary considerably metre by metre. Taking one average soil test value for a whole field inevitably masks this variation. 'Grid' sampling can help overcome this and identify areas in the field where P and/or K are under- or over-supplied. Identifying major soil types in the field is a key step in establishing the need for grid sampling, but it is not economic to sample soils more intensively than 1 sample/ha.

Target soil P and K levels

Phosphate helps root development and early growth. Newly seeded grass and clover benefit from applied soluble phosphate since their root systems are insufficiently developed to tap the main P reserves in the soil. Clover is more susceptible than grass to P deficiency due, in part, to the grass having a more extensive and finely branched root system that enables the grass to compete more effectively. This difference between grass and clover has resulted in a slightly higher target soil P status for grass/clover swards (9 mg/l - middle of the moderate status) compared to grass only swards (6mg/l - lower end of the moderate status). P deficiency is generally more common in the wetter upland areas than in drier lowland areas, partly because the availability of P is low in acid soils, and acid soils are more widespread in upland areas. Soil P supply to the plant is dependent on soil reserves, which must be converted to a soluble form before being absorbed by plant roots. P availability is reduced at low temperatures such as when growth is beginning in early spring. A fresh boost of soluble P at this time can have a greater impact on growth until soil temperatures rise sufficiently to increase P-release from the soil reserve. Trials in Scotland have shown that an enhanced response to P applied in early spring is obtained on soils of low or very low P status if P is combined with nitrogen. A number of proprietary fertilisers include NP formulations. In all other situations P applications to established grass are aimed primarily at maintaining target P status in the soil rather than increasing grass growth. It is important that the soil P status is not built up over and above the target level. Besides being wasteful, the loss of soluble P in sediment during bouts of surface run-off can contribute to poor water quality.

After nitrogen, potash is the second most important nutrient for grass and maintaining soil potash levels in the lower half of the SAC moderate status must be the objective in good grassland management. The clovers (both red and white) are particularly sensitive to shortages of potash. Under grazing only relatively modest levels of additional potash are required as there is considerable re-cycling of both P and K in dung and urine but it is important not to apply potash to fresh young grass in spring for fear of inducing hypomagnesaemia (grass staggers) in freshly turned-out stock. Heavy dressings of potash in spring can reduce magnesium uptake. Consequently applications to grazed grass should be made mid-season onwards. The situation under conservation for silage and hay is rather different. Offtakes of potash in conserved grass can be considerable (equivalent to 180 – 330kg K_2O /ha from 2 or 3 cuts totalling in excess of 10t DM/ha) and soil potash reserves can quickly become depleted especially on light sandy soils. (Heavy clay soils generally have higher potash reserves). If maximum benefits are to be realised from nutrient application to grassland then it is important to balance the use of nitrogenous fertilisers with potash. Typical application rates for 1st cut silage should be in the order of 60-90 kg K_2O /ha and 50-60 kg /ha for 2nd cut. Exact rates will vary with soil potash status, nitrogen application rates and anticipated grass yields but a useful rule of thumb is to apply 2/3rds kg K_2O / ha for every 1 kg of N applied. Where grass offtakes suggest application rates should be in excess of 90 kg K_2O /ha for 1st cut, any surplus over and above 90kg K_2O / ha should be applied later in the season otherwise luxury uptake can occur. In practice the price of potash fertiliser is likely to make application rates above 80-90kg K_2O /ha uneconomical.

For soils that are above the target levels for P and K, savings can be made in both P and K applications.

Sulphur

As atmospheric deposition of sulphur (S) continues to decline due to reduced emissions from industrial sources, it is likely that the risk of S deficiency will affect an increasingly wide area of grassland. The best guide for assessing the risk of S deficiency is soil type and field location. Sands, shallow soils or sandy loams with low organic matter levels are most prone to deficiency. Swards that receive high levels of nitrogen fertiliser and are cut regularly for silage are also more at risk whereas fields that receive regular applications of bulky organic fertilises, or have organic soils, are less likely to show deficiency. Soil analysis can help identify severely deficient soils but in other situations it is not as reliable a guide as herbage analysis.

3. Assessment of site class and nitrogen recommendations

Grassland production is limited by growing conditions, in particular the quantity of rainfall between April and September and soil type. The combined effect of these factors defines the "*Site Class*" as shown in Table A.

An area of land classified as:

- *Site Class 1* is limited by N not by water supply since N is utilised very efficiently and rainfall is above 500 mm between April and September.
- *Site Class 5* is severely limited by water supply since rainfall is below 350 mm between April and September. The potential yield of grass growing within a Site Class 5 is about half of that growing in a Class 1 site.

Standard or maximum N recommendations for each grass field based upon site class and intended grassland management are given in Table B. In practice, levels of N use may be less than the figures shown in Table B to reflect the level of intensity and production that is required on that particular farm unit. Clearly it makes little sense to produce more grass than can be utilised by the farm. Drought can impair growth and reduce N usage where moisture and not nitrogen limits growth. In NVZs the maximum nitrogen that can be applied to the whole grassland area (Nmax) is calculated by adding up the N requirement for each grass field as given in Table B. If you apply organic manures, you must use N efficiency values to determine the percentage of the total N content that will become available to the grass. This available N content contributes to Nmax and must be deducted from Nmax to calculate the balance that can be applied as manufactured N fertiliser. In some situations, lower application rates than those in Table B may be appropriate e.g. where grass management relies on high clover. Further guidance on NVZ regulations is provided in Scottish Government guidance on NVZs (http://www.scotland.gov.uk/Topics/farmingrural/Agriculture/Environment/NVZintro).

Seasonal distribution of nitrogen for existing swards

1) For Grazing:-
Nitrogen should be applied at regular intervals over the grazing season *at a declining rate to match the falling response to N by the grass*.

- Under optimal conditions grass can utilise approximately 2.5 kg N/ha/day of growth
- The first dressing should be about 6 weeks before turnout (maximum rate 100 kg N/ha) or at the time of 'T-sum 200'
- Should 'T-sum 200' occur much earlier than normal, delaying application until the first period of mild weather will reduce the risk of N loss
- No N should be applied after mid-August. This reduces the risk of winter losses of nitrogen from the soil and winter damage to the grass. The response to N will also be lower after this time
- Fertilisers and manures should never be spread on to frozen, waterlogged, or snow covered soils.

2) For Conservation:-
Based on a daily uptake of 2.5 kg N/ha the optimum rate of N application for the first cut of silage is 120 kg N/ha applied

Table A. Site Classes

Soil texture	Average April-September rainfall (mm)*			
	More than 500	425-500	350-425	Less than 350
	Site class **			
Sands and shallow soils	2	3	4	5
All other soils	1	2	2	3

* Approx. 50% annual rainfall. PLANET Scotland provides annual rainfall estimates for all of Scotland
** Add 1 for farms above 300 m

Table B. Standard or maximum total annual N recommendations in kg/ha for each grass field based upon site class and grass management

Grass management	Site Class 1	Site Class 2	Site Class 3	Site Class 4	Site Class 5
2 or 3 cut silage + grazing	310	300	290	280	270
1 cut silage + grazing	280	270	260	250	240
Grazing with low clover	270	260	250	240	230
Hay + grazing	220	210	200	190	180
Grass with high clover*	100	90	80	70	60

* High clover = 20-30% clover content mid-season

8 weeks before expected date of cutting. Higher rates and delayed application increase the risk of nitrate-N in the grass and poor silage fermentation. A *split dressing* of the optimum N rate may be beneficial in *reducing N losses*, and encouraging earlier growth. If a split dressing is used, apply 40-50 kg N/ha 10 weeks before cutting (i.e. about the same time as the grazing application). Apply the remainder 4 weeks later leaving at least 4 weeks clear before the anticipated cutting date. Applications for second and subsequent cuts of silage should be made as soon as possible after the previous cut. The optimum rate of N for the first cut of hay should be restricted to 80kgN/ha to avoid too leafy a crop & problems with field drying.

Examples of application patterns for a range of annual N rates for both **Conservation** and **Grazing** are given in Table C taken from the PLANET Scotland software. The recommendations in Table C are not exhaustive but are designed to account for specific annual grassland management strategies and are expressed as a set of defoliation sequences with G=Grazing; H= Hay; S=Silage. For example two cuts of silage followed by grazing is represented as SSG. Suggested N rates (kg/ha) are shown for each defoliation in the sequence. For example, if the defoliation sequence is SGG and the N rates 120-60-50, this means 120N for defoliation 1 (Silage), 60N for defoliation 2 (Grazing) and 50N for defoliation 3 (Grazing). More detailed defoliation sequences are available from the PLANET Scotland software.

Fertiliser N rates should be adjusted to take account of the available N in organic fertilisers. Information on the N contents of organic fertilisers can be found in SAC Consulting Technical Note TN650 on "Optimising the application of bulky organic fertilisers".

Nitrogen for grass and clover establishment

Good establishment of grass and clover depends on a number of factors including seedbed preparation, method of sowing, use of cover crops, weed control and level of soil fertility.

The N distribution sequences in Table C are suitable for undersown grass once the cover crop has been removed. Nitrogen recommendations for direct-sown grass (autumn or spring sown) are given in Table D. Note that in NVZs because the "cropping year" goes from autumn and winter through to the following spring and summer, N applied in the autumn must be included as part of the N requirement taking account of grassland management and site class. Autumn N includes N applied in the seedbed to direct-sown grass or applied in late summer to an undersown crop where the cover crop is removed by mid August.

Table C. Appropriate nitrogen rates and sequences (kg/ha) - established grassland

Grass management	Defoliations sequence	Site class 1	Site class 2	Site class 3	Site class 4	Site class 5
Grazing with low clover	G	90	90	90	90	90
	G G	80-60	80-60	80-60	80-60	80-60
	G G G	80-60-50	80-60-50	80-60-50	80-60-50	80-60-50
	G G G G	80-60-50-40	80-60-50-40	80-60-50-40	80-60-50-40	80-60-50-40
1 cut silage + grazing	S	120	120	120	120	120
	S G	120-70	120-70	120-70	120-70	120-70
	S G G	120-60-50	120-60-50	120-60-50	120-60-50	120-60-50
	S G G G	120-60-50-40	120-60-50-40	110-60-50-40	100-60-50-40	100-60-40-40
	G S	40-90	40-90	40-90	40-90	40-90
	G S G	40-90-60	40-90-60	40-90-60	40-90-60	40-90-60
	G S G G	40-90-60-40	40-90-60-40	40-90-60-40	40-90-60-40	40-90-60-40
2 or 3 cuts silage + grazing	S S	120-90	120-90	120-90	120-90	120-90
	S S G	120-90-60	120-90-60	120-90-60	120-90-60	120-90-60
	S S S	120-90-70	120-90-70	120-90-70	120-90-70	110-90-70
	S S S G	120-90-70-30	120-90-60-30	120-90-60-20	110-90-60-20	110-80-60-20
	S S G G	120-90-50-40	120-90-50-40	120-80-50-40	120-80-50-30	110-80-50-30
	G S S	40-100-80	40-100-80	40-100-80	30-100-80	30-100-70
	G S S G	40-100-80-50	40-100-80-50	40-100-80-50	40-100-80-50	40-100-80-50
Hay + grazing	H	80	80	80	80	80
	H G	80-60	80-60	80-60	80-60	80-60
	H G G	80-60-40	80-60-40	80-60-40	80-60-40	80-60-40
	G H G	40-80-60	40-80-60	40-80-50	40-80-40	40-70-40
Grass with high clover, or red clover	G	60	60	60	60	60
	G G	60-40	60-30	50-30	40-30	40-20
	G S	30-70	30-60	30-50	30-40	30-30
	S G	70-30	60-30	60-20	50-20	60-0
	S S	60-40	60-30	50-30	50-20	60-0
	H G	60-40	60-30	50-30	50-20	60-0
	G H	40-60	30-60	30-50	30-40	30-30
	For high clover fields no additional N is recommended beyond the second defoliation. Most systems using red clover will use no N.					

Table D. N recommendations for direct-sown grass and clover (kg/ha).

Timing	Management	N recommendation (kg/ha)
Spring	Grass, grazing	40
	Grass, cutting	60
	Grass/clover	0 - 20
Autumn	Grass, grazing or cutting	40
	Grass/clover	0 - 20

4. Phosphate and potash recommendations

Phosphate and potash recommendations for grass establishment (autumn or spring sown)

Phosphate and potash recommendations for newly sown grass, autumn or spring sown, are given in Table E.

Phosphate and potash recommendations for established grass

On moderate PK soils, apply 'maintenance' PK fertiliser applications to balance the offtake in cut or grazed grass but test soil PK status every 4 – 5 years. PK offtake can be calculated by multiplying grass yield by PK content as given in Table F. The yields in Table F are based on averages over a range of site classes. In order to calculate PK requirements, yields in Table F should be replaced by estimated or actual yields where possible. Drought can impair growth and reduce PK offtake and should be taken into account when assessing PK requirement. As stated earlier in Section 2 potash offtake from silage is high and should be replaced if soil reserves and grass productivity are to be maintained. However the application in spring prior to first cut silage (or hay) should be restricted to 80-90kg K_2O /ha to avoid luxury uptake. Any requirement over and above 80-90 kg K_2O /ha should be applied later in the season.

The PK applied in organic manures should be taken into account when assessing the need for manufactured fertiliser (see section 8 below). The balance between PK offtake and PK applied in organic manures and manufactured fertiliser can then be made at the end of the season. Allowance should be made for any surplus or deficit in PK when planning the following season's fertiliser. In grazing situations most of the P_2O_5 and K_2O is recycled infield by the animal through its dung and urine. The offtake estimates for grazing in Table F makes allowance for this recycling by assuming that 80% P_2O_5 and 95% of the K_2O is recycled. Under grazing to ensure an application of some P & K to all areas and to replace the small offtake apply 15-20 kg/ha P_2O_5 & K_2O per season on soils of moderate P & K status. Where clover is an important constituent of the sward apply the higher recommendation.

If the soil P or K status is below target, apply additional fertiliser to build up to a moderate PK status. By the same token rates of P and K should be reduced where the PK soil status is high. Phosphate and potash adjustments for PK soil status in established grassland are given in Table G. If the PK status is very low or low, then the adjustment should be to defoliation 1 for silage and hay, and defoliation 2 for grazing but note earlier comments about the risks of luxury uptake of potash under cutting and inducing hypomagnesaemia under grazing. Where soil PK status is high, rates of PK should be lower than maintenance at each defoliation e.g. 75% of P offtake on grass with high clover or red clover, and 50% of PK offtake in other grass management options (Table G).

Table E. Phosphate and potash recommendations for grass establishment (autumn or spring sown) in kg/ha

Grass management	P_2O_5 Soil P status				K_2O Soil K status			
	V. low	Low	Mod.	High	V. low	Low	Mod.	High
Grass with high clover, red clover	150	110	70	50	130	90	70	40
All other grass management options	130	90	50	30	110	70	50	20

(Where undersown - use appropriate cereal recommendation plus an additional 40kg P_2O_5 and K_2O /ha)

Table F. Established grass default yields (fresh weight) and standard PK content (fresh weight)

Utilisation	Defoliation position	Yield (t/ha)	P content (kg P_2O_5/t)	P offtake (kg P_2O_5/ha)	K content (kg K_2O/t)	K offtake (kg K_2O/ha)
Silage	1st occurrence	23	1.7	39	6.0	138
Silage	2nd occurrence	12	1.7	20	6.0	72
Silage	3rd occurrence	9	1.7	15	6.0	54
Hay	Any defoliation	7	5.9	41	18.0	126
Grazing	Any defoliation	10	1.4	3*	4.8	2*

* Under Grazing this calculation assumes approximately 80% of the P_2O_5 and 95% of the K_2O is recycled infield by the animal through its dung and urine.

Table G. Phosphate and potash adjustments for PK soil status in established grassland in kg/ha

Grass management	P_2O_5 Soil P status				K_2O Soil K status			
	V. low	Low	Mod.	High	V. low	Low	Mod.	High
Grass with high clover, red clover	+80	+40	0	P offtake x 0.75	+60	+20	0	K offtake x 0.5
All other grass management options	+80	+40	0	P offtake x 0.5	+60	+20	0	K offtake x 0.5

5. Sulphur (S) recommendations

Grass with a high fertiliser N input has a high demand for sulphur (S), and in certain circumstances a profitable response to S application can be obtained in second and third cuts of silage, and mid-season grazing. S deficiency is most likely to occur on light textured sandy soils. Fields that have received regular applications of bulky organic fertilisers, and organic soils, are less likely to show deficiency. S deficiency causes paling of young leaves and crop stunting that can easily be confused with N deficiency (which usually affects older leaves first). A reliable prediction of the likely response to added S can be obtained by chemical analysis to determine the total N: total S ratio in the first cut herbage (Table H). Sampling of silage growth should be carried out within 10 days of the anticipated first silage cut.

Table H. Total N:total S ratio in herbage and response to applied S

Total N:total S	Response to applied S
Less than 13:1	Unlikely
13:1 to 16:1	Insurance dressing required
Greater than 16:1	Response highly likely

If deficiency is expected, the best treatment is to apply sulphur in the spring as water soluble sulphate (SO_4), which is rapidly available for crop uptake. Recommended rates are given as SO_3 (to convert S to SO_3, multiply by 2.5): use 40 kg/ha SO_3prior to the 2nd and 3rd cuts of silage (or 1st and 2nd cuts in drought-prone fields) or mid season under grazing.

6. Magnesium (Mg) recommendations

Grass swards must contain a sufficiently high level of magnesium (Mg) if the risk of hypomagnesaemia (grass staggers) is to be reduced. Soil magnesium (Mg) analysis is used to predict the need for Mg application to grassland. However the uptake of herbage Mg decreases as N and K levels increase and consequently grass staggers can occur when soil Mg appears adequate. In the case of intensively managed grass it is advisable to maintain a high soil Mg status. Where the Mg status is low and soil acidity needs to be corrected, applying magnesian limestone is the best way to maintain soil Mg at a satisfactory level. An application of 5 t/ha of magnesian limestone will add at least 750 kg MgO/ha, and this Mg will become plant-available over many years. However, if used too frequently, care should be taken to ensure that there is sufficient available K in the soil to ensure that there is no risk of K deficiency in the crop being grown. Where the Mg status is low but additional lime is not required, alternative sources of Mg should be used e.g. calcined magnesite (typically 80% MgO) or kieserite (25% MgO). In such cases at least 125kg/ha MgO should be applied.

7. Sodium (Na) recommendations

Sodium will rarely have any effect on grass growth but an adequate amount in the diet is essential for livestock health and can improve the palatability of grass. The Na content of herbage is normally adequate for grazing livestock though it may be reduced if excess potash is applied. Herbage analysis is useful to assess the Na status of grass. Where Na levels are low, mineral supplements may be required for some classes of stock or a fertiliser containing Na may be used e.g. 100kg/ha of agricultural salt.

8. Availability of nutrients in organic fertilisers

If you apply organic manures, you should use the N efficiency values in the SAC Consulting Technical Note TN650 on “Optimising the application of bulky organic fertilisers” to determine the percentage of the total N content that will become available to the crop. A gap between application of inorganic and organic fertilisers is recommended to minimise N_2O emissions.

Organic fertilisers are valuable sources of P, K, S and Mg, although not all of the total nutrient content will be available for the next crop. Nutrients which are not immediately available will mostly become available over a period of years and will usually be accounted for when soil analysis is carried out. The availability of manure phosphate to the next crop is lower than from water-soluble phosphate fertilisers. As a general rule, around 50% of the phosphate in pig and cattle slurries and other (non-agricultural) bulky organic fertilisers will become available to the crop in the year of application. Around 60% of the phosphate in solid animal manures will become available to the crop in the year of application. In some fields, particularly on intensive livestock farms, it may be necessary (or advisable) to limit organic manure applications in order to avoid excessive enrichment of soil P levels. Most of the potash present in bulky organic fertilisers will become quickly available for crop uptake. Around 90% of the potash in bulky organic fertilisers will become available to the crop in the year of application, although potash availability from green composts may be rather lower in the first year (around 80%) and that from dirty water, somewhat higher (estimated to be around 100%).

Where crop responses to phosphate or potash are expected e.g. where soils have very low or low P or K status, the available phosphate and potash content of the manure should be used when calculating the nutrient contribution. Where soil status is at the target level (usually moderate) or above, the total phosphate and potash content of the organic fertiliser should be used in planning the balance that should be applied as manufactured P and K. At high soil P status, take care to ensure that total phosphate inputs do not exceed the amounts removed in crops during the rotation. This will avoid the soil P status reaching an unnecessarily high level. It is important to manage manure phosphate and potash supply over the crop rotation. Organic fertilisers also supply useful quantities of sulphur and magnesium, but there is limited data on their availability for the next crop grown. Sulphur and magnesium inputs from manures should largely be regarded as contributing to the maintenance of soil reserves.

Allowing for the PK content of manures can result in large savings in purchased fertiliser. Assess the nutrient content of the manure using standard 'typical' values, or carefully take some samples and get them analysed (see SAC Consulting Technical Note TN650). Analysis will provide the most accurate information. The NPK content and current financial value of some typical cattle manure is shown in Table I.

Table I. The NPK content and current financial value of some typical cattle manures

	Crop available N[1]	Total phosphate P_2O_5	Total potash K_2O	Approx. financial value[2]
		kg/t or kg/m³		£/t or £/m³
Cattle FYM (fresh)[3]	0.6	3.2	8.0	7.70
Cattle FYM (old)[4]	0.6	3.2	8.0	7.70
Cattle slurry (6% DM)	0.6	1.2	3.2	3.36
Cattle slurry, mechanically separated liquid	0.9	1.2	3.5	3.82
Cattle slurry, separated solids	0.4	2.0	4.0	4.26

[1]The values apply to spring surface application of manures and will be lower from autumn application.
[2]£ value is based on AN @ £325/t (94 p/kg N), TSP @ £360/t (78p/kg P_2O_5), MoP @ £350/t (58p/kg K_2O)
[3]Fresh FYM is manure that has been spread straight from the building.
[4]Old FYM is manure that has been stored for 3 months or more.

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