

# Nutrient Management Guide (RB209)

Updated May 2017





## Using the Nutrient Management Guide (RB209)

This latest revision of RB209 is based on research carried out since the previous edition was published in 2010. The revision includes updated recommendations, including those for additional crops and information on the nutrient content of additional organic materials.

RB209 was first published in 1973 and was the first comprehensive set of fertiliser recommendations from the Ministry of Agriculture, Fisheries and Food (MAFF). RB209 stands for Reference Book 209.

To improve the accessibility of the recommendations and information AHDB's Nutrient Management Guide (RB209) is published as seven sections that will be updated individually.

### Further information

The Nutrient Management Guide (RB209) will be updated regularly.

Please email your contact details to AHDB so that we can send you updates when they are published - [comms@ahdb.org.uk](mailto:comms@ahdb.org.uk)



### RB209: Nutrient Management

Download the app for Apple or Android phones to access the current version of all sections of the guide. With quick and easy access to videos, information and recommendations from the guide, it is practical for use in the field.

**Section 1** Principles of nutrient management and fertiliser use

**Section 2** Organic materials

**Section 3** Grass and forage crops

**Section 4** Arable crops

Cereals

Oilseeds

Sugar beet

Peas and beans

Biomass crops

**Section 5** Potatoes

**Section 6** Vegetables and bulbs

**Section 7** Fruit, vines and hops

This section provides guidance on the use of organic materials. For each material, the content of nitrogen (N), phosphate ( $P_2O_5$ ), potash ( $K_2O$ ), magnesium (MgO), and sulphur ( $SO_2$ ) are given in kilograms per tonne (kg/t) or cubic metre ( $kg/m^3$ ).

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## Summary of main changes from previous edition

1. Overall presentation
  - a. Nutrient content of organic materials is now presented as Section 2: Organic materials that incorporates the relevant appendices.
2. Updated nutrient content
  - a. The availability of sulphur from organic materials (Table 2.1)
  - b. Total nitrogen, sulphur and magnesium content of horse FYM (Table 2.2 and 2.4)
  - c. Potash content of cattle FYM (Table 2.4)
  - d. Total sulphur and magnesium content of sheep FYM (Table 2.4)
  - e. Total magnesium content of duck FYM (Table 2.4)
  - f. Nutrient content of poultry manure is presented according to dry matter content (Tables 2.5–7)
  - g. Potash content of cattle slurry (Table 2.10)
  - h. Phosphate and potash content of pig slurry (Table 2.13)
  - i. Dry matter, phosphate, potash and sulphur contents of biosolids (Table 2.16)
  - j. Phosphate, potash and sulphur content of compost (Table 2.17)
3. Added materials
  - a. Goat FYM
  - b. Farm-sourced and food-based anaerobic digestate (page 34)
4. Removed materials
  - a. Information on digested liquid biosolids has been removed due to the small volume of material applied to land (less than 1% of total biosolids)

## Regulation, codes of practice and assurance schemes

Organic materials applied to agricultural land, such as livestock manures, biosolids, composts, anaerobic digestates and waste derived materials are valuable sources of most major plant nutrients and organic matter. Careful recycling to land allows their nutrient value to be used for the benefit of crops and soil fertility, which can result in large savings in the use of manufactured fertilisers.

However, organic materials can present a considerable environmental risk if not handled carefully. Guidance on avoiding pollution, including manure management planning, is given in **Protecting our Water, Soil and Air: A Code of Good Agricultural Practice for farmers, growers and land managers**.

For all organic materials, it is important to check their use complies with contracts, relevant assurance schemes and animal by-product regulation.

### Nitrate Vulnerable Zones (NVZs)

England

[www.gov.uk/guidance/nutrient-management-nitrate-vulnerable-zones](http://www.gov.uk/guidance/nutrient-management-nitrate-vulnerable-zones)

Scotland

[www.gov.scot/Topics/farmingrural/Agriculture/Environment](http://www.gov.scot/Topics/farmingrural/Agriculture/Environment)

Wales

[gov.wales/topics/environmentcountryside](http://gov.wales/topics/environmentcountryside)

Northern Ireland

[www.daera-ni.gov.uk/articles/nitrates-directive](http://www.daera-ni.gov.uk/articles/nitrates-directive)

### Further information

Protecting our Water, Soil and Air: A Code of Good Agricultural Practice for farmers, growers and land managers

[www.gov.uk](http://www.gov.uk)

## Sampling livestock manures

For nutrient management planning, it is important to know the nutrient content of manures applied to land. The tables in this section give typical values of the total nutrient content of manures based on the analysis of samples from a wide range of sources.

However, the nutrient content of livestock manures is likely to vary significantly, depending on the source and management of the material. For example, the nutrient content will be influenced by farm-specific feeding and bedding practices, and digestate nutrient content will vary on a site by site basis depending on feedstock used in the digestion process. The livestock manures produced may have a nutrient content that is consistently different from the values given in the tables.

It can, therefore, be worthwhile having the nutrient content of representative manure samples determined by analysis. Rapid on-farm kits (eg Agros, Quantofix) can reliably assess the ammonium-N content of liquid manures (eg cattle slurries and digestates) but laboratory analysis is necessary for other nutrients. Laboratory analyses should include dry matter (DM), organic matter, total nitrogen (N), total phosphate ( $P_2O_5$ ), total potash ( $K_2O$ ), total sulphur ( $SO_3$ ), total magnesium MgO and ammonium-N ( $NH_4-N$ ).

Additionally, nitrate-N ( $NO_3-N$ ) should be measured in well-composted farm yard manure (FYM) and poultry manures, and uric acid-N in poultry manures. Hydrometers can be used to measure the dry matter content of liquid manures and, where dry matter varies, adjust previous laboratory results or the typical values in the following tables.

The nutrient content of liquid manures can vary considerably within a store due to settlement and crusting. In particular, pig slurry can 'settle out' in storage, with a higher dry matter layer being at the base of the store and a lower dry matter layer occupying the mid/upper, which, during store emptying, can markedly affect slurry dry matter and associated nutrient contents.

Similarly, the composition of solid manure in a heap can vary depending on the amount of bedding and losses of nutrients during storage. If stored materials are to be analysed either in a laboratory or using a rapid on-farm method

### Further information

Adding value from pig manures and slurries  
[pork.ahdb.org.uk/environment-buildings](http://pork.ahdb.org.uk/environment-buildings)

(eg using Agros or Quantofix slurry-N meters), it is important that the sample taken represents an 'average' of what is found in the heap or store.

It is important that sampling is carried out carefully and that representative samples are provided for analysis. The optimum sampling frequency will vary depending on how manures are managed on the farm, but at least two samples per year are recommended, coinciding with the main spreading periods.

### Taking a representative sample of a liquid manure

#### Health & Safety

When sampling enclosed liquid manure stores (pits or tanks) never climb down or lean into the store because of the risk of inhaling toxic gases which can be lethal.



- Collect at least five subsamples of two litres each and pour into a large container
- Thoroughly mix the bulked sample
- On-farm rapid analysis of slurries should be carried out immediately
- If a sample is to be sent to a laboratory 250 ml should be dispatched in a clean, screw topped, plastic container (normally available from the laboratory)
- Leave 2–3 cm of airspace to allow the sample to be shaken in the laboratory
- Label the sample clearly, providing as much information as possible
- As soon as possible, send the sample first class to the laboratory (prepaid envelopes are normally available from the laboratory)

**Above ground stores**

Ideally, the liquid manure should be fully agitated before sampling. If this is not possible and, provided there is safe access from an operator's platform, the five subsamples can be taken at a range of positions, using a weighted two litre container attached to a rope.

**Below ground pit**

It may be possible to obtain subsamples at various positions using a weighted container.

**Earth-banked lagoons**

Do not attempt to sample direct from the lagoon unless there is a secure operator's platform that provides safe access. If the slurry has been well agitated, subsamples can be obtained from the slurry tanker or irrigator. If the tanker is fitted with a suitable valve, it may be possible to take five subsamples from this stationary tanker at intervals during filling or while field spreading is in progress.



▶ [How to sample farmyard manure](#)



▶ [How to sample slurry](#)

Videos on how to sample farmyard manure and slurry are available at [www.ahdb.org.uk/rb209](http://www.ahdb.org.uk/rb209)

or



SCAN THE IMAGES WITH THE RB209: NUTRIENT MANAGEMENT APP TO WATCH THE VIDEOS

**Taking a representative sample of a solid manure****Health & Safety**

You should wear rubber gloves and protective clothing when collecting samples. Remember to wash hands and forearms thoroughly after taking samples and before eating or drinking.



- Take at least 10 subsamples of about 1 kg each as described below
- Place on a clean, dry tray or sheet
- Break up any lumps and thoroughly mix the sample
- Take a representative sample of around 500 g for analysis
- Samples should be dispatched in 500 gauge polythene bags (normally available from the laboratory), expel excess air from the bag before sealing
- Label samples clearly, providing as much information as possible

**Manure heaps**

- Provided the manure is dry and safe to walk on, identify at least 10 locations which appear to be representative of the heap
- After clearing away any weathered material with a spade or fork, either:
  - dig a hole approximately 0.5 metres deep and take a 1 kg sample from each point
  - use a soil auger to obtain subsamples from at least 50 cm in to the heap
- Alternatively, take subsamples from the face of the heap at various stages during spreading

**Weeping wall stores**

Do not attempt to take samples before the store is emptied as it is not safe to walk on the surface of the stored material. Subsamples may be taken from the face of the heap once emptying has commenced.

## Calculations and interpretation of laboratory analysis results

Laboratories differ in the way that the analysis results are expressed and conversion of the results is often needed. Analysis results are variously reported:

- On a dry weight (DW or 100% DM) or fresh weight (FW) basis
- In units of grams or milligrams per kilogram (g/kg, mg/kg), grams per 100 grams (g/100 g), percent (%), grams or milligrams per litre (g/l, mg/l), kilograms per tonne (kg/t) or kilograms per cubic metre (kg/m<sup>3</sup>)
- As the nutrient element (N, P, K, Mg, S) or the nutrient oxide (P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, MgO, SO<sub>3</sub>)

If in doubt about how your results are expressed, as a first step you should confirm with the laboratory.

Use the following conversions if analysis results need to be converted.

### Nutrients

To convert nutrient element to nutrient oxide	P	x	2.291	=	P <sub>2</sub> O <sub>5</sub>
	K	x	1.205	=	K <sub>2</sub> O
	Mg	x	1.658	=	MgO
	S	x	2.5	=	SO <sub>3</sub>

### Solid manures (DM expressed as %)

$$\text{To convert mg/kg nutrient in DM to kg/t FW: } \frac{\text{mg/kg nutrient}}{1000} \times \frac{\% \text{ DM}}{100}$$

$$\text{To convert g/kg nutrient in DM to kg/t FW: } \text{g/kg nutrient} \times \frac{\% \text{ DM}}{100}$$

$$\text{To convert g/100g nutrient in DM to kg/t FW: } \text{g/100g nutrient} \times \frac{\% \text{ DM}}{10}$$

$$\text{To convert \% nutrient in DM to kg/t FW: } \% \text{ nutrient} \times \frac{\% \text{ DM}}{10}$$

### Solid manures (DM expressed as g/kg)

$$\text{To convert mg/kg nutrient in DM to kg/t FW: } \frac{\text{mg/kg nutrient}}{1000} \times \frac{\text{g/kg DM}}{1000}$$

$$\text{To convert g/kg nutrient in DM to kg/t FW: } \text{g/kg nutrient} \times \frac{\text{g/kg DM}}{1000}$$

$$\text{To convert g/100g nutrient in DM to kg/t FW: } \text{g/100g nutrient} \times \frac{\text{g/kg DM}}{100}$$

$$\text{To convert \% nutrient in DM to kg/t FW: } \% \text{ nutrient} \times \frac{\text{g/kg DM}}{100}$$

### Liquid manures

$$\text{To convert mg/l nutrient to kg/m}^3: \frac{\text{mg/l nutrient}}{1000}$$

$$\text{To convert g/l nutrient to kg/m}^3: \text{g/l nutrient (no change)}$$

#### Example 2.1

Digested sludge cake with 27% DM, and 4.0% N and 3.0% P in DM.

$$4.0\% \text{N} \times \frac{27\% \text{ DM}}{10} = 10.8 \text{ kg N/t in FW}$$

$$3.0\% \text{P} \times \frac{27\% \text{ DM}}{10} \times 2.29 = 18.6 \text{ kg P}_2\text{O}_5\text{/t in FW}$$

## Principles of nitrogen supply and losses

Nitrogen is present in organic materials in two main forms:

- **Readily available nitrogen (ie ammonium-N as measured by N meters, nitrate-N and uric acid-N) is the nitrogen that is potentially available for rapid crop uptake**
- **Organic-N is the nitrogen contained in organic forms, which are broken down slowly to become potentially available for crop uptake over a period of months to years**

Crop available nitrogen is the readily available-N that remains for crop uptake after accounting for any losses of nitrogen. This also includes nitrogen released from organic forms.

Following the application of organic materials to land, there can be losses of nitrogen as follows:

- **Ammonium-N can be volatilised to the atmosphere as ammonia gas**
- **Following the conversion of ammonium-N to nitrate-N, further losses may occur through nitrate leaching and denitrification of nitrate to nitrous oxide and nitrogen gas under warm and wet soil conditions**

To make best use of their nitrogen content, organic materials should be applied at or before times of maximum crop growth – generally during the late winter to summer period.

## Ammonia volatilisation

Typically, around 40% of the readily available nitrogen content of organic materials can be lost following surface application to land. Ammonia loss and odour nuisance can be reduced by ensuring that organic materials are rapidly incorporated into soils (within six hours of application for liquid materials and 24 hours for solid materials to tillage land).

For liquid materials, shallow injection and band spreading techniques are effective application methods that reduce ammonia emissions (typically by 30–70%) compared with broadcast application. Band spreading (trailing shoe and trailing hose) and shallow injection application techniques increase the number of spreading days, and cause less sward contamination than surface broadcast applications. These practices will also increase the amount of nitrogen available for crop uptake. Ammonia losses are generally smaller from low dry matter liquid materials, because they more rapidly infiltrate into the soil.

Higher dry matter liquid materials remain on the soil/crop surface for longer, leading to greater losses. Losses are also higher when they are applied to dry soils under warm weather conditions.

## Nitrate leaching

The amount of nitrogen leached following land application is mainly related to the soil type, the application rate, the readily available-N content and the amount of rainfall after application. As ammonium-N is rapidly converted in the soil to nitrate-N, organic material applications during the autumn or early winter period should be avoided, as there is likely to be sufficient overwinter rainfall to wash a large proportion of this nitrate out of the soil before the crop can use it.

Delaying applications until late winter or spring will reduce nitrate leaching and increase the efficiency of utilisation of manure nitrogen. This is particularly important for organic materials with a high content of readily available nitrogen.

## Release of crop-available nitrogen from organic materials

The organic nitrogen content of organic material is released (mineralised) slowly over a period of months to years. Where the nitrogen mineralised from the material is not taken up by the crop in the season following application, nitrate may be lost by leaching during the following overwinter period or accumulate in soil organic matter, allowing further long-term savings in nitrogen fertiliser inputs. Around 5% of the total nitrogen content of organic material may become available for the second crop following application.

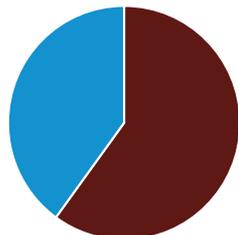
### Points to consider

- In NVZs, there are mandatory closed spreading periods for high readily available nitrogen organic materials (eg cattle slurries, poultry manures and digestates), which typically have greater than 30% of their total nitrogen content present as readily available nitrogen

Figure 2.1 Typical proportions of different forms of nitrogen in organic materials

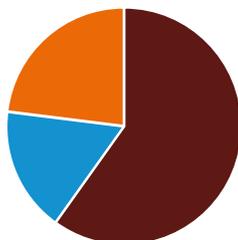
**Cattle slurry (6% dry matter)**

- Organic-N
- Ammonium-N



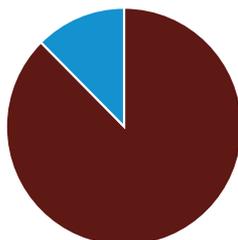
**Poultry manure**

- Organic-N
- Ammonium-N
- Uric acid-N



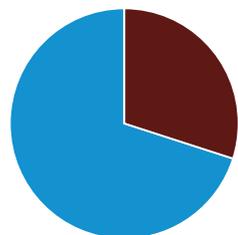
**Cattle FYM**

- Organic-N
- Ammonium-N



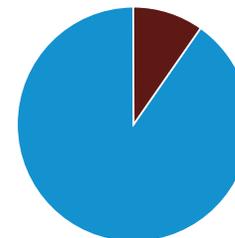
**Pig slurry (4% dry matter)**

- Organic-N
- Ammonium-N



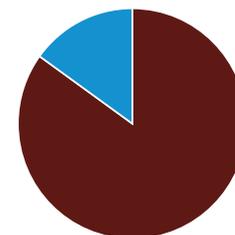
**Whole digestate**

- Organic-N
- Ammonium-N



**Biosolid digested cake**

- Organic-N
- Ammonium-N



The Farm Crap App is a free app that enables you to visually assess manures and slurry applications (rates) and calculate what is being provided in terms of total and crop available nutrients. You can select different seasons, types of manure(s) and crops growing to see what the manure will provide in terms of fertiliser value. The app is available on Apple and Android devices, through the iTunes or Google Play stores.



MANNER-NPK is a free practical software tool that provides farmers and advisers with a quick estimate of crop available nitrogen, phosphate and potash supply from applications of organic materials. MANNER-NPK is applicable in England, Wales, Scotland and Northern Ireland  
[www.planet4farmers.co.uk/manner](http://www.planet4farmers.co.uk/manner)

## Phosphate, potash and magnesium

Organic materials are valuable sources of other nutrients as well as nitrogen, although not all of the total nutrient content is available for the next crop.

Typical values for the total and available phosphate and potash contents of organic materials are given in this guide.

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 grown (typically 50–60%) is lower than from water-soluble phosphate fertilisers. However, around 90% of manure potash is readily available for crop uptake.

Where crop responses to phosphate or potash are expected (eg soil Indices 0 or 1 for combinable crops and grassland) or where responsive crops are grown (eg potatoes or vegetables), the available (not total) phosphate and potash content of the organic material should be used when calculating the nutrient contribution. Soils at Index 0 will particularly benefit from organic material applications.

Where the soil is at target Index (usually Index 2) or above for phosphate or potash, the total phosphate and potash content of the organic material should be used in nutrient balance sheet calculations.

For most arable crops, typical organic material application rates can supply the phosphate and potash requirement. At soil P Index 3 or above, 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 Index reaching an unnecessarily high level. It is important to manage organic material applications to ensure phosphate and potash is used through the crop rotation.

## Sulphur

Organic materials contain valuable amounts of crop-available sulphur and recent research has quantified sulphur supply from livestock manures and biosolids applications (Table 2.1). Sulphur from autumn applications may be lost via overwinter leaching. The quantity leached will depend on soil type and overwinter rainfall and is likely to be higher on light textured soils in high rainfall areas.

Table 2.1 Sulphur availability from organic materials

Organic material	% total SO <sub>2</sub> available
<b>Autumn applied</b>	
Livestock manures	5–10%
Biosolids	10–20% <sup>a</sup>
<b>Spring applied</b>	
Cattle FYM	15%
Pig FYM	25%
Poultry manure	60%
Cattle/pig slurry	35%
Biosolids	20%

a. 20–35% before oilseed rape.

## Using organic materials and fertilisers together

You should plan to utilise as much as possible of the nutrient content of organic materials. Not adequately allowing for these nutrients, particularly nitrogen, not only wastes money because of unnecessary fertiliser use but also can reduce crop yields and quality; eg lodging in cereals, poor fermentation in grass silage and low sugar levels in beet.

- Step 1 Calculate the quantity of crop available nutrients supplied by each application of organic material.
- Step 2 Identify the fields that will benefit most from the application of organic material. This will need to take account of the accessibility and likely soil conditions in individual fields and the application equipment that is available. Crops with a high nitrogen demand should be targeted first. Fields at low soil P or K Indices will benefit more than those at high Indices. Silage fields should be separated in preference to grazing only fields.
- Step 3 Plan the application rates for each field taking account of the phosphate content of organic material over the crop rotation to avoid excessive enrichment of soil phosphorus levels. Make sure that plans adhere to NVZ rules. As far as possible, apply organic materials in the late-winter to summer period – this will make best use of the nitrogen content.
- Step 4 Aim for the organic material application to supply no more than 50–60% of the total nitrogen requirement of the crop, and use manufactured fertiliser to make up the difference. This approach will minimise the potential impact of variations in nitrogen supply from organic materials on crop yields and quality.

Step 5 Calculate the nutrient requirement of the crop, then deduct the nutrients supplied from organic materials. This will give the balance that needs to be supplied as manufactured fertiliser.

Step 6 Make sure that application equipment is well maintained and suitable for applying the organic material in the most effective way, minimising losses of ammonia-N and soil or crop damage. The equipment should be routinely calibrated for the type of organic material being applied.

### Practical aspects of organic material use

Organic materials are commonly applied to arable stubbles in the autumn prior to drilling winter cereals. To make best use of organic material nitrogen and to minimise nitrate leaching losses, materials should, if possible, be applied in the late-winter to summer period.

Band spreaders and shallow injection (5–7 cm deep) equipment allow accurate top-dressing of liquid materials across full tramline widths, without causing crop damage. An additional benefit of these application methods is that odour nuisance and ammonia emissions are reduced by 30–70% compared with conventional ‘splash-plate’ surface application. Herbage contamination is also reduced.

Organic material applications before spring-sown crops (eg root crops, cereals and oilseed rape) should be made from late winter onwards to minimise nitrate leaching losses, particularly where high readily available nitrogen manures are applied.

In NVZs, applications of organic material with a high readily available nitrogen content (eg slurry, poultry manure and digestate) are subject to closed-spreading periods to reduce the risks of nitrate leaching losses. Rapid soil incorporation on tillage land (eg within six hours following surface broadcast application) will minimise ammonia losses and increase crop available nitrogen supply.

Organic material applications to grassland are best made to fields intended for silage or hay production. Cattle slurry and FYM contain large amounts of potash relative to their readily available nitrogen and total phosphate contents, and are ideally suited to this situation. However, take care to ensure that the potash supply does not increase the risk of grass staggers (hypomagnesaemia) in stock through reduced herbage magnesium levels.

Application rates of solid material should be carefully controlled to avoid the risk of sward damage and contamination of conserved grass, which can adversely affect silage quality. To encourage a low pH and good fermentation, grass cuts following solid material or late slurry applications should be wilted before ensiling, or an effective silage additive used.

Where slurry and solid manure applications are made to grazed grassland, the pasture should not be grazed for at least four weeks following application, or until all visible signs of slurry or digestate solids have disappeared. This will minimise the risk of transferring disease to grazing livestock.

Forage crops, particularly forage maize, provide an opportunity to apply organic materials prior to drilling in late spring. Organic material application rates should be carefully controlled and where possible the material should be rapidly incorporated into the soil to minimise ammonia-N emissions and odour nuisance.

Where organic material applications are made before “ready-to-eat crops” (crops that are generally not cooked before eating), relevant industry guidance should be followed to minimise the risks of pathogen transfer (eg The Safe Sludge Matrix or The Renewable Fertiliser Matrix).

### Further information

The Safe Sludge Matrix  
[www.gov.uk](http://www.gov.uk)

The Renewable Fertiliser Matrix  
[www.wrap.org.uk/content/renewable-fertiliser-matrix](http://www.wrap.org.uk/content/renewable-fertiliser-matrix)

## Application management

It is important that organic materials are applied evenly and at known application rates. The most important causes of uneven application on farms are the incorrect setting of bout widths and poor attention to machinery maintenance.

For both liquid and solid manures, the evenness of spreading is usually better with rear discharge spreaders than side discharge machines. Top-dressing liquid manures to arable crops in spring can be carried out using tankers or umbilical systems, with boom applicators (fitted with nozzles or trailing-hoses) operating from tramlines.

The aim should be to apply all manure types evenly with a coefficient of variation of less than 25%. This is achievable with commonly used types of manure application equipment, provided they are well maintained and calibrated.

Application rates can be calculated simply from a knowledge of the capacity of the tanker or solid manure spreader (by weighing both full and empty machines on a weighbridge), the number of loads applied per field and the field area. An accurate flow meter should be used to measure the slurry application rate of umbilical and irrigation systems.

## Livestock manures

The nutrient content of livestock manures will depend on a number of factors, including the type of livestock, the diet and feeding system, the volume of dirty water and rainwater entering storage facilities, and the amount of bedding used. Consequently, the nutrient content of manures produced on any particular unit may vary significantly from the typical values in the tables.

Therefore, although the following tables provide useful information on the typical nutrient content of livestock manures, it can be worthwhile analysing representative samples (page 6).

### Further information

Think Manures

[www.nutrientmanagement.org](http://www.nutrientmanagement.org)

Managing nutrients for better returns

[beefandlamb.ahdb.org.uk](http://beefandlamb.ahdb.org.uk)

Grass+

[dairy.ahdb.org.uk](http://dairy.ahdb.org.uk)

Adding value from pig manures and slurries

[pork.ahdb.org.uk/environment-buildings/nutrient-management](http://pork.ahdb.org.uk/environment-buildings/nutrient-management)

## Cattle, pig, sheep, duck, horse and goat farmyard manure (FYM)

Table 2.2 Typical total nitrogen content of FYM (fresh weight basis)

	Dry matter %	Total nitrogen kg N/t <sup>a</sup>
Cattle FYM	25	6.0
Pig FYM	25	7.0
Sheep FYM	25	7.0
Duck FYM	25	6.5
Horse FYM	25	5.0
Goat FYM	40	9.5

a. The crop-available nitrogen supply will depend on the application timing and the delay between application and incorporation.

Duck farmyard manure is included here because the availability of its nitrogen is generally lower than that of other poultry manures.

To convert kg/t to units/ton, multiply by 2.

Table 2.3 Percentage of total nitrogen available to next crop following FYM applications

	Autumn <sup>a</sup> (Aug–Oct, 450 mm rainfall to end March)		Winter <sup>a</sup> (Nov–Jan, 250 mm rainfall to end March)		Spring <sup>a</sup> (Feb–Apr)	Summer <sup>a</sup> use on grassland
	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	All soils	All soils
<b>Surface applied (ie not soil incorporated)</b>						
FYM (old and fresh)	5	10	10	10	10	10
<b>Soil incorporated 24 hours after application<sup>c</sup></b>						
FYM						
Old <sup>d</sup>	5	10	10	10	10	N/A
Fresh <sup>e</sup>	5	10	10	10	15	N/A

N/A = Not applicable

- The nitrogen availability estimates assume 450 mm of rainfall (after autumn application) and 250 mm (after winter application) up to the end of soil drainage (end of March). Where rainfall differs from these amounts, intermediate values of nitrogen availability should be used. For spring or summer applications, rainfall is not likely to cause movement of agronomically important amounts of nitrogen to below crop rooting depth.
- Sandy/shallow = light sand soils and shallow soils. Medium/heavy = medium, deep fertile silt and deep clay soils. Use this category for organic and peaty soils.
- The values assume incorporation by ploughing. Cultivation using discs or tines is less effective in minimising ammonia losses and intermediate values of nitrogen availability should be used.
- Old<sup>d</sup> = manure which has been stored for three months or more and has an estimated ammonium-N and nitrate-N content of 10% (cattle and sheep FYM) or 15% (pig and duck FYM) of the total nitrogen.
- Fresh<sup>e</sup> = manure which has not been stored prior to land application and has an estimated ammonium-N content of 20% (cattle and sheep FYM) or 25% (pig and duck FYM) of total nitrogen.

Table 2.4 FYM – phosphate, potash, magnesium and sulphur (fresh weight basis)

	Dry matter %	Phosphate			Potash <sup>a</sup>			Sulphur <sup>b</sup>	Magnesium
		Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Availability %	Available phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Availability %	Available potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
Cattle FYM	25	3.2	60	1.9	9.4	90	8.5	2.4	1.8
Pig FYM	25	6.0	60	3.6	8.0	90	7.2	3.4	1.8
Sheep FYM	25	3.2	60	1.9	8.0	90	7.2	4.0	2.8
Duck FYM	25	5.5	60	3.3	7.5	90	6.8	2.6	2.4
Horse FYM	25	5.0	60	3.0	6.0	90	5.4	1.6	1.5
Goat FYM	40	4.5	60	2.7	12.0	90	10.8	2.8	1.9

ND = no data.

a. Values of potash may be lower for FYM stored for long periods in the open.

b. For crop available sulphur supply refer to Table 2.1 on page 12.

## Poultry manure

Table 2.5 Typical total nitrogen content of poultry manure (fresh weight basis)

Dry matter %	Total nitrogen <sup>a</sup> kg N/t
20	9.4
40	19.0
60	28.0
80	37.0

To convert kg/t to units/ton, multiply by 2.

a. Typically, greater than 30% of the total nitrogen content of poultry manure is present as readily available N. As a result, poultry manure is subject to the closed-spreading period in Nitrate Vulnerable Zones. The crop available nitrogen supply will depend on the application timing and the delay between application and incorporation.

Table 2.6. Percentage of total nitrogen available to next crop following poultry manure applications (% of total nitrogen)

Surface applied (ie not incorporated)	Autumn <sup>a</sup> (Aug–Oct 450 mm to end March)		Winter <sup>a</sup> (Nov–Jan, 250 mm rainfall to end March)		Spring <sup>a</sup> (Feb–Apr)	Summer <sup>a</sup> use on grassland
	Sandy/Shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	All Soils	All Soils
20% DM	15 [20]	25 [30]	25	25	35	35
40% DM	10 [15]	25 [30]	20	25	30	30
60% DM	10 [15]	25 [30]	20	25	30	30
80% DM	10 [15]	25 [30]	20	25	30	30
<b>Soil incorporated 24 hours after application<sup>c</sup></b>						
20% DM	15 [20]	35 [40]	25	40	50	N/A
40% DM	10 [15]	30 [35]	20	30	40	N/A
60% DM	10 [15]	30 [35]	20	30	40	N/A
80% DM	10 [15]	30 [35]	20	30	40	N/A

N/A = Not applicable

[ ] = use for grassland and winter oilseed rape cropping

a. The nitrogen availability estimates assume 450 mm of rainfall (after autumn application) and 250 mm (after winter application) up to the end of soil drainage (end March). Where rainfall differs from these amounts, intermediate values of nitrogen availability should be used. For spring or summer applications, rainfall is not likely to cause movement of agronomically important amounts of nitrogen to below crop rooting depth.

b. Sandy/shallow = light sand soils and shallow soils. Medium/heavy = medium, deep fertile silt and deep clay soils. Use this category for organic and peaty soils.

c. The values assume incorporation by ploughing. Cultivation using discs or tines is less effective in minimising ammonia losses and intermediate values of nitrogen availability should be used.

Table 2.7 Phosphate, potash, magnesium and sulphur content of poultry manure (fresh weight basis)

Dry matter %	Phosphate			Potash			Sulphur <sup>a</sup>	Magnesium
	Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Availability %	Available phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Availability %	Available potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
20	8.0	60	4.8	8.5	90	7.7	3.0	2.7
40	12	60	7.2	15	90	14	5.6	4.3
60	17	60	10.2	21	90	19	8.2	5.9
80	21	60	12.6	27	90	24	11	7.5

To convert kg/t to units/ton, multiply by 2.

a. For crop-available sulphur supply refer to Table 2.1 on page 12.

## Cattle slurry and dirty water

Table 2.8 Total nitrogen content of cattle slurry and dirty water (fresh weight basis)

	Dry matter %	Total nitrogen <sup>b</sup> kg N/m <sup>3</sup> or /t
<b>Slurries/liquids</b>		
Cattle	2	1.6
	<b>6<sup>a</sup></b>	<b>2.6<sup>a</sup></b>
	10	3.6
Dirty water	0.5	0.5
<b>Separated cattle slurries (liquid portion)</b>		
Strainer box	1.5	1.5
Weeping wall	3	2.0
Mechanical separator	4	3.0
<b>Separated cattle slurry (solid portion)</b>	20	4.0

- a. Typical dry matter and nitrogen contents of cattle slurry are shown in bold.
- b. Cattle slurry and the liquid portion of separated cattle slurry are high readily available nitrogen manures with typically greater than 30% of their total nitrogen content present as readily available nitrogen and will be subject to closed spreading periods in Nitrate Vulnerable Zones. The crop available nitrogen supply from manures will depend on the application timing, application method and the delay between application and incorporation.

To convert kg/m<sup>3</sup> to units/1,000 gallons, multiply by 9.

Table 2.9 Percentage of total nitrogen available to next crop following cattle slurry and dirty water applications (% of total nitrogen)

	Autumn <sup>a</sup> (Aug–Oct, 450 mm rainfall to end March)		Winter <sup>a</sup> (Nov–Jan, 250 mm rainfall to end March)		Spring <sup>a</sup> (Feb–Apr)	Summer <sup>a</sup> use on grassland
	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	All soils	All soils
<b>Cattle slurry – liquid</b>						
<b>Surface applied (ie not soil incorporated)</b>						
2% DM	5 [10]	30 [35]	30	30	45	35
<b>6% DM</b>	<b>5 [10]</b>	<b>25 [30]</b>	<b>25</b>	<b>25</b>	<b>35</b>	<b>25</b>
10% DM	5 [10]	20 [25]	20	20	25	20
<b>Soil incorporated 6 hours after application<sup>c</sup></b>						
2% DM	5 [10]	35 [50]	25	35	50	N/A
<b>6% DM</b>	<b>5 [10]</b>	<b>30 [35]</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>N/A</b>
10% DM	5 [10]	25 [30]	15	25	30	N/A
<b>Band spread</b>						
2% DM	5 [10]	30 [35]	30	30	50	40
<b>6% DM</b>	<b>5 [10]</b>	<b>25 [30]</b>	<b>25</b>	<b>25</b>	<b>40</b>	<b>30</b>
10% DM	5 [10]	20 [25]	20	20	30	25
<b>Shallow injected</b>						
2% DM	5 [10]	30 [35]	35	35	55	45
<b>6% DM</b>	<b>5 [10]</b>	<b>25 [30]</b>	<b>30</b>	<b>30</b>	<b>45</b>	<b>35</b>
10% DM	5 [10]	20 [25]	25	25	35	30
<b>Dirty water (surface applied)</b>	<b>10 [15]</b>	<b>35 [40]</b>	<b>35</b>	<b>35</b>	<b>50</b>	<b>30</b>
<b>Separated cattle slurry – solid portion</b>						
<b>Surface applied (ie not soil incorporated)</b>						
	5	10	10	10	10	10
<b>Soil incorporated 24 hours after application<sup>d</sup></b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>15</b>	<b>N/A</b>

[ ] = use for grassland and winter oilseed rape cropping

N/A = not applicable.

For separated cattle slurry (liquid portion), use the values for 2% dry matter slurry.

a. The nitrogen availability estimates assume 450 mm of rainfall (after autumn application) and 250 mm (after winter application) up to the end of soil drainage (end March). Where rainfall differs from these amounts, intermediate values of nitrogen availability should be used. For spring or summer applications, rainfall is not likely to cause movement of agronomically important amounts of nitrogen to below crop rooting depth.

b. Sandy/shallow = light sand soils and shallow soils. Medium/heavy = medium, deep fertile silt and deep clay soils. Use this category for organic and peaty soils.

c. The values assume incorporation by ploughing. Cultivation using discs or tines is less effective in minimising ammonia. Where slurry has been applied in spring or summer and incorporated more quickly than six hours or has been deep injected, nitrogen availability will be similar to the shallow injected values.

d. The values assume incorporation by ploughing. Cultivation using discs or tines is less effective in minimising ammonia losses and intermediate values of nitrogen availability should be used.

Table 2.10 Phosphate, potash, magnesium and sulphur content of cattle slurry and dirty water (fresh weight basis)

	Dry matter %	Phosphate			Potash			Sulphur <sup>a</sup>	Magnesium
		Total phosphate kg P <sub>2</sub> O <sub>5</sub> /m <sup>3</sup> or /t	Availability %	Available phosphate kg P <sub>2</sub> O <sub>5</sub> /m <sup>3</sup> or /t	Total potash kg K <sub>2</sub> O/m <sup>3</sup> or /t	Availability %	Available potash kg K <sub>2</sub> O/m <sup>3</sup> or/t	Total sulphur kg SO <sub>3</sub> /m <sup>3</sup> or /t	Total magnesium kg MgO/m <sup>3</sup>
<b>Slurries/liquids</b>									
Cattle	2	0.6	50	0.3	1.7	90	1.5	0.3	0.2
	<b>6<sup>b</sup></b>	<b>1.2</b>	<b>50</b>	<b>0.6</b>	<b>2.5</b>	<b>90</b>	<b>2.3</b>	<b>0.7</b>	<b>0.6</b>
	10	1.8	50	0.9	3.4	90	3.0	1.0	0.9
Dirty water	0.5	0.1	50	0.05	1.0	100	1.0	0.1	0.1
<b>Separated cattle slurries (liquid portion)</b>									
Strainer box	1.5	0.3	50	0.15	1.5	90	1.4	ND	ND
Weeping wall	3	0.5	50	0.25	2.3	90	2.1	ND	ND
Mechanical separator	4	1.2	50	0.6	2.8	90	2.5	ND	ND
<b>Separated cattle slurry (solid portion)</b>	20	2.0	50	1.0	3.3	90	3.0	ND	ND

a. For crop-available sulphur supply refer to Table 2.1 on page 12.

b. Typical dry matter and nitrogen contents of cattle slurry are shown in bold.

ND = No data

To convert kg/m<sup>3</sup> to units/1,000 gallons, multiply by 9.

## Pig slurry

Table 2.11 Typical total nitrogen content of pig slurry (fresh weight basis)

	Dry matter %	Total nitrogen <sup>b</sup> kg N/m <sup>3</sup> or /t
Pig slurry – liquid	2	3.0
	<b>4<sup>a</sup></b>	<b>3.6<sup>a</sup></b>
	6	4.4
Separated pig slurry (liquid portion)	3	3.6
Separated pig slurry (solid portion)	20	5.0

- a. Typical dry matter and nitrogen contents of pig slurry are shown in bold.
- b. Pig slurry and the liquid portion of separated pig slurry are in high readily available N manures with typically greater than 30% of their total nitrogen content present as readily available N and will be subject to closed-spreading periods in Nitrate Vulnerable Zones. The crop available nitrogen supply from manures will depend on the application timing, application method and the delay between application and incorporation.

To convert kg/m<sup>3</sup> to units/1000 gallons, multiply by 9.

Table 2.12 Percentage of total nitrogen available to next crop following pig slurry applications (% of total nitrogen)

	Autumn <sup>a</sup> (Aug–Oct, 450 mm rainfall to end March)		Winter <sup>a</sup> (Nov–Jan, 250 mm rainfall to end March)		Spring <sup>a</sup> (Feb–Apr)	Summer <sup>a</sup> use on grassland
	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	All soils	All soils
<b>Pig slurry – liquid Surface applied (ie not soil incorporated)</b>						
2% DM	10 [15]	35 [40]	40	40	55	55
<b>4% DM</b>	<b>10 [15]</b>	<b>30 [35]</b>	<b>35</b>	<b>35</b>	<b>50</b>	<b>50</b>
6% DM	10 [15]	25 [30]	30	30	45	45
<b>Soil incorporated 6 hours after application<sup>c</sup></b>						
2% DM	10 [15]	40 [45]	35	50	65	N/A
<b>4% DM</b>	<b>10 [15]</b>	<b>40 [45]</b>	<b>30</b>	<b>45</b>	<b>60</b>	<b>N/A</b>
6% DM	10 [15]	40 [45]	25	40	55	N/A
<b>Band spread</b>						
2% DM	10 [15]	35 [40]	40	40	60	60
<b>4% DM</b>	<b>10 [15]</b>	<b>35 [40]</b>	<b>35</b>	<b>35</b>	<b>55</b>	<b>55</b>
6% DM	10 [15]	30 [35]	35	35	50	50
<b>Shallow injected</b>						
2% DM	10 [15]	40 [45]	45	45	65	65
<b>4% DM</b>	<b>10 [15]</b>	<b>35 [40]</b>	<b>40</b>	<b>40</b>	<b>60</b>	<b>60</b>
6% DM	10 [15]	30 [40]	40	40	55	55
<b>Separated pig slurry – solid portion Surface applied (ie not soil incorporated)</b>						
	5	10	10	10	10	10
<b>Soil incorporated 24 hours after application<sup>d</sup></b>	5	10	10	10	15	N/A

[ ] = Use for grassland and winter oilseed rape cropping

N/A = Not applicable

a. The nitrogen availability estimates assume 450 mm of rainfall (after autumn application) and 250 mm (after winter application) up to the end of soil drainage (end March). Where rainfall differs from these amounts, intermediate values of nitrogen availability should be used. For spring or summer applications, rainfall is not likely to cause movement of agronomically important amounts of nitrogen to below crop rooting depth.

b. Sandy/shallow = light sand soils and shallow soils. Medium/heavy = medium, deep fertile silt and deep clay soils. Use this category for organic and peaty soils.

c. The values assume incorporation by ploughing. Cultivation using discs or tines is less effective in minimising ammonia losses. Where slurry has been applied in spring or summer and incorporated more quickly than six hours or has been deep injected, nitrogen availability will be similar to the shallow injected values.

d. The values assume incorporation by ploughing. Cultivation using discs or tines is less effective in minimising ammonia losses and intermediate values of nitrogen availability should be used.

For separated pig slurry (liquid portion), use the values for 2% dry matter slurry.

Table 2.13 Phosphate, potash, magnesium and sulphur content of pig slurry (fresh weight basis)

	Dry matter %	Phosphate			Potash			Sulphur	Magnesium
		Total phosphate kg P <sub>2</sub> O <sub>5</sub> /m <sup>3</sup> or/t	Availability %	Available phosphate kg P <sub>2</sub> O <sub>5</sub> /m <sup>3</sup> or/t	Total potash kg K <sub>2</sub> O/m <sup>3</sup> or/t	Availability %	Available potash kg K <sub>2</sub> O/m <sup>3</sup> or/t	Total sulphur <sup>b</sup> kg SO <sub>3</sub> /m <sup>3</sup> or /t	Total magnesium kg MgO/m <sup>3</sup>
Pig slurry – liquid	2	0.8	50	0.4	1.8	90	1.6	0.4	0.4
	<b>4<sup>a</sup></b>	<b>1.5</b>	<b>50</b>	<b>0.8</b>	<b>2.2</b>	<b>90</b>	<b>2.0</b>	<b>0.7</b>	<b>0.7</b>
	6	2.2	50	1.1	2.6	90	2.3	1.0	1.0
<b>Separated pig slurry (liquid portion)</b>	3	1.1	50	0.6	2.0	90	1.8	ND	ND
<b>Separated pig slurry (solid portion)</b>	20	3.7	50	1.9	2.0	90	1.8	ND	ND

a. Typical dry matter and nitrogen contents of pig slurry are shown in bold.

b. For crop-available sulphur supply refer to Table 2.1 on page 12.

ND = no data

To convert kg/m<sup>3</sup> to units/1000 gallons, multiply by 9.

## Understanding the value of livestock manure applications

### Example 2.2

30 m<sup>3</sup>/ha of cattle slurry (6% dry matter) is surface applied in early spring before first-cut silage. The soil is at P Index 2 and K Index 2-. Where the slurry is surface applied in the spring, the application saves up to £83/ha on manufactured fertiliser costs. This potential saving will be less following autumn or winter application, or where soil P or K Indices are above maintenance levels.

	Nitrogen (N) <sup>e</sup>	Phosphate (P <sub>2</sub> O <sub>5</sub> ) <sup>e</sup>	Potash (K <sub>2</sub> O) <sup>e</sup>	Financial saving £/ha
<b>1. Estimated total nutrients in slurry (kg/m<sup>3</sup>)</b>	2.6	1.2	2.5	
<b>2. Estimated available nutrients in slurry (kg/m<sup>3</sup>)</b>	0.9 <sup>a</sup>	0.6	2.3	
<b>3. Nutrients supplied by slurry that are equivalent to manufactured fertiliser (kg/ha)</b>				
30 m <sup>3</sup> /ha supplies 78 kg/ha total N and 27 kg/ha crop available N	27	36 <sup>b</sup>	75 <sup>b</sup>	
Potential saving from manure use				<b>£83/ha<sup>d</sup></b>
<b>4. Nutrient requirements for first-cut silage to produce a yield of 6+ t DM/ha (kg/ha)</b>				
<b>Section 3: Grass and forage crops</b>	120	40 <sup>c</sup>	80 <sup>c</sup>	
<b>5. Manufactured fertiliser needed for the silage crop (kg/ha)</b>				
Stage 4 minus Stage 3	93	4	5	
Actual saving for silage crop from manure use				<b>£83/ha</b>
<b>6. Surplus manure nutrients for subsequent crops that are equivalent to manufactured fertiliser (kg/ha)</b>				
Stage 3 minus Stage 4		NIL	NIL	
Saving for subsequent crops from manure use				<b>NIL</b>

a. Crop-available nitrogen is 35% of total nitrogen.

b. Total phosphate and potash content used in calculations to maintain soil Indices.

c. Nutrients required for spring application (soil P Index 2 and K Index 2-).

d. Saving for next crop plus value of surplus manure phosphate and potash which will contribute to the nutrient requirement of future crops.

e. Analyses of representative sample or typical values from Tables 2.8, 2.9 and 2.10 on pages 19–21.

Assumed fertiliser costs: Nitrogen 60 p/kg; phosphate 60 p/kg; potash 60 p/kg.

**Example 2.3**

35 t/ha of pig FYM is applied in autumn to a clay soil before drilling winter wheat (8 t/ha grain yield, straw baled). It is NOT rapidly incorporated. The soil is at P Index 2 and K Index 2-. Where the FYM is surface applied in the autumn, the application saves up to £309/ha on manufactured fertiliser costs. This potential saving will be less where soil P or K Indices are above maintenance levels.

	Nitrogen (N)	Phosphate (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	Financial saving £/ha
<b>1. Estimated total nutrients in FYM (kg/t)</b>				
Analysis of representative sample or typical total values (Table 2.2 and 2.2)	7.0	6.0	8.0	
<b>2. Estimated available nutrients in FYM (kg/t)</b>				
Nitrogen (Table 2.3)	0.7 <sup>a</sup>			
Phosphate and potash (Table 2.4)		3.6	7.2	
<b>3. Nutrients supplied by FYM that are equivalent to manufactured fertiliser (kg/ha)</b>				
35 t/ha supplies 245 kg/ha total N and 25 kg/ha crop available N	25	210 <sup>b</sup>	280 <sup>b</sup>	
Potential saving from manure use				<b>£309/ha<sup>d</sup></b>
<b>4. Nutrient requirements for winter wheat (kg/ha)</b>				
<b>Section 4: Arable crops</b> (Table 4.15 and 4.12)	220	65 <sup>c</sup>	85 <sup>c</sup>	
<b>5. Manufactured fertiliser needed for the wheat crop (kg/ha)</b>				
Stage 4 minus Stage 3	195	NIL	NIL	
Actual saving for next crop from manure use				<b>£108/ha</b>
<b>6. Surplus manure nutrients for subsequent crops that are equivalent to manufactured fertiliser (kg/ha)</b>				
Stage 3 minus Stage 4		140	195	
Saving for subsequent crops from manure use				<b>£201/ha</b>

a. Crop-available nitrogen is 10% of total nitrogen.

b. Total phosphate and potash content used in calculations to maintain soil Indices.

c. Nutrients required for maintenance of soil reserves (soil P Index 2 and K Index 2-).

d. Saving for next crop plus value of surplus manure phosphate and potash which will contribute to the nutrient requirement of future crops.

Assumed fertiliser costs: Nitrogen 60 p/kg; phosphate 60 p/kg; potash 60 p/kg

## Biosolids

Biosolids (treated sewage sludge) are valuable fertilisers and soil conditioners, which have undergone processes to create an agriculturally beneficial product. However, applications must comply with several regulations and best practice guidance.

### Points to consider

- [The Biosolids Nutrient Management Matrix provides a useful overview of regulation and guidance](#)
- [Seek support, guidance and nutrient analysis from the biosolids suppliers](#)
- [Contract and assurance scheme conditions](#)

### Further information

The Sludge (Use in Agriculture) Regulations 1989  
[www.legislation.gov.uk](http://www.legislation.gov.uk)

The Sludge (Use in Agriculture) (Amendment) Regulations 1990  
[www.legislation.gov.uk](http://www.legislation.gov.uk)

Code of Practice for Agricultural Use of Sewage Sludge (1996)

The ADAS Safe Sludge Matrix (2001)

Biosolids Nutrient Management Matrix  
[www.adas.uk](http://www.adas.uk)

## Nutrient content of biosolids

Most biosolid applications apply more phosphate than is taken off by the following crop which may lead to increases in soil phosphate levels. The phosphate supplied by a biosolids application should be considered over the whole crop rotation by managing inputs in relation to crop offtake and soil analysis. On fields receiving biosolid applications, soil sampling every 3–5 years is essential.

Biosolids only contain small amounts of potash but useful quantities of sulphur and magnesium. Lime-stabilised biosolids also have value as liming materials with a neutralising value typically in the range of 2–6% per tonne fresh weight.

Biosolids contain heavy metals such as copper, lead, mercury, nickel or zinc but at lower concentrations than in the past. Heavy metals are elements that are potentially toxic to mammals above critical levels. However, copper, nickel and zinc are required by plants in very small amounts (micronutrients).

Where biosolids are used there is a statutory requirement to analyse topsoil for metals before land spreading to ensure that concentrations are below maximum permissible soil levels, and to control annual additions of metals. Analysis is typically carried out by the supplier. Limits for soil concentrations and permitted rates of addition of heavy metals are given in the Defra Code of Practice for Agricultural Use of Sewage Sludge.

Table 2.14 Typical total nitrogen content of biosolids (fresh weight basis)

	Dry matter %	Total nitrogen kg N/t
Digested cake	25	11
Thermally dried	95	40
Lime stabilised	25	8.5
Composted	40	11

To convert kg/m<sup>3</sup> to units/1,000 gallons, multiply by 9.

To convert kg/t to units/ton, multiply by 2.

Table 2.15 Percentage of total nitrogen available to next crop following biosolid applications (% of total nitrogen)

	Autumn <sup>a</sup> (Aug–Oct, 450 mm rainfall to end March)		Winter <sup>a</sup> (Nov–Jan, 250 mm rainfall to end March)		Spring <sup>a</sup> (Feb–Apr)	Summer <sup>a</sup> use on grassland
	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	Sandy/shallow <sup>b</sup>	Medium/heavy <sup>b</sup>	All soils	All soils
<b>Surface applied (ie not soil incorporated)</b>						
Digested cake	10	15	15	15	15	15
Thermally dried	10	15	15	15	15	15
Lime stabilised	10	15	15	15	15	15
Composted	10	15	15	15	15	15
<b>Soil incorporated after application – 6 hours for liquids and 24 hours for solids<sup>c</sup></b>						
Digested cake	10	15	15	15	20	N/A
Thermally dried	10	15	15	15	20	N/A
Lime stabilised	10	15	15	15	20	N/A
Composted	10	15	15	15	15	N/A

N/A = Not applicable

- The nitrogen availability estimates assume 450 mm of rainfall (after autumn application) and 250 mm (after winter application) up to the end of soil drainage (end March). Where rainfall differs from these amounts, intermediate values of nitrogen availability should be used. For spring or summer applications, rainfall is not likely to cause movement of agronomically important amounts of nitrogen to below crop rooting depth.
- Sandy/shallow = light sand soils and shallow soils. Medium/heavy = medium, deep fertile silt and deep clay soils. Use this category for organic and peaty soils.
- The values assume incorporation by ploughing. Cultivation using discs or tines is likely to be less effective in minimising ammonia losses and intermediate values of nitrogen availability should be used.

Table 2.16 Phosphate, potash, magnesium and sulphur content of biosolids (fresh weight basis)

	Dry matter %	Phosphate			Potash			Sulphur <sup>a</sup>	Magnesium
		Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Availability %	Available phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Availability %	Available potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
Digested cake	25	11	50	5.5	0.6	90	0.5	8.2	1.6
Thermally dried	95	55	50	28	2.0	90	1.8	23	6.0
Lime stabilised	25	7	50	3.5	0.8	90	0.4	7.4	2.4
Composted	40	10	50	5.0	3.0	90	2.7	6.1	2.0

a. For crop-available sulphur supply refer to Table 2.1 on page 12.

To convert kg/m<sup>3</sup> to units/1000 gallons, multiply by 9.

To convert kg/t to units/ton, multiply by 2.

## Understanding the value of biosolid applications

### Example 2.4

20 t/ha of digested cake is applied in autumn before winter wheat (8 t/ha grain yield, straw baled), grown on a medium soil following a previous cereal crop. The sludge is rapidly incorporated. The soil is at P Index 2 and K Index 2-. Where the digested cake is surface applied in the autumn, the application saves up to £243/ha on manufactured fertiliser costs. This potential saving will be less where soil P or K Indices are above maintenance levels.

Stage and calculation procedure	Nitrogen (N)	Phosphate (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	Financial saving £/ha
<b>1. Estimate total nutrients in digested cake (kg/t)</b>				
Analysis provided by biosolids supplier or typical values from (Table 2.14 and 2.16)	11	11	0.6	
<b>2. Estimate available nutrients in digested cake (kg/t)</b>				
Nitrogen (Table 2.15)	1.7 <sup>a</sup>			
Phosphate and potash (Table 2.16)		5.5	0.5	
<b>3. Nutrients supplied by digested cake that are equivalent to manufactured fertiliser (kg/ha)</b>				
20 t/ha supplies 220 kg/ha total nitrogen and 33 kg/ha of crop available N	33	220 <sup>b</sup>	12 <sup>b</sup>	
Potential saving from biosolids use				<b>£159/ha<sup>d</sup></b>
<b>4. Nutrient requirements for winter wheat (kg/ha)</b>				
<b>Section 4: Arable crops</b>	220	65 <sup>c</sup>	85 <sup>c</sup>	
<b>5. Manufactured fertiliser needed for the wheat crop (kg/ha)</b>				
Stage 4 minus Stage 3	187	NIL	73	
Actual saving for wheat crop due to biosolids use				<b>£69/ha</b>
<b>6. Surplus digested cake phosphate for subsequent crops that is equivalent to manufactured fertiliser (kg/ha)</b>				
Stage 3 minus Stage 4		150	NIL	
Saving for subsequent crops due to biosolid use				<b>£90/ha</b>

a. Crop-available nitrogen is 15% of total nitrogen.

b. Total phosphate and potash content used in calculations to maintain soil P and K Indices.

c. Nutrients required for maintenance of soil reserves (soil P Index 2 and K Index 2-)

d. Saving for next crop plus value of surplus biosolids phosphate which will contribute to the nutrient requirement of future crops.

Assumed fertiliser costs: Nitrogen 60 p/kg; phosphate 60 p/kg; potash 60 p/kg.

## Compost

Compost is both a soil conditioner and a source of major plant nutrients produced by the controlled biological decomposition of either 'green waste' (eg landscaping and garden waste) or from a mix of green waste and food waste, in the presence of oxygen. Compost usually contains little readily available nitrogen but repeated use over time can increase soil organic matter levels, improving workability and water retention properties.

Compost that is certified under the Compost Certification Scheme does not normally need an environmental permit or exemption to be in place for application to land. Non-certified compost is usually applied to land under the Environmental Permitting Regulations. The Compost Certification Scheme sets baseline quality specifications, set by the British Standards Institution Publicly Available Specification 100 (PAS100). While the PAS scheme specifies minimum quality criteria, they also allow customers to specify higher quality thresholds. It is important to check whether customers have any additional quality requirements before compost is applied.

### Points to consider

- The nutrient content of compost products will vary depending on the source materials and treatment process
- PAS100 compost should be supplied with specific nutrient content data and other relevant information

### Further information

Digestate and compost in agriculture  
[www.wrap.org.uk](http://www.wrap.org.uk)

### Nutrient supply from compost

The available field experimental data indicate that green compost supplies only very small amounts of crop available nitrogen and that manufactured fertiliser nitrogen application rates should not be changed for the next crop grown. In the case of green/food compost, the available experimental data indicate that around 5% of the total nitrogen applied is available to the next crop grown (irrespective of application timing). Following the repeated use of green and green/food composts, long-term soil nitrogen supply will be increased.

As little work has been done on the availability of compost phosphate to crops, it is appropriate to extrapolate from work on livestock manures and sewage sludge, which suggests that around 50% of the phosphate will be available to the next crop grown, with the remainder released slowly over the crop rotation. Around 80% of compost potash is in a soluble form and is readily available for crop uptake. Composts also supply useful quantities of sulphur and magnesium, although there are no data on availability to the next crop grown.

Table 2.17 Typical total nutrient content of compost (fresh weight basis)

Compost type	Dry matter %	Total nitrogen kg N/t	Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
Green	60	7.5	3.0	6.8	3.4	3.4
Green/food	60	11	4.9	8.0	5.1	3.4

## Understanding the value of compost applications

### Example 2.5

30 t/ha of green compost is applied in autumn to a sandy soil before drilling winter barley (8 t/ha grain yield, straw baled). The soil is at P Index 2 and K Index 2-. Allowing for the green compost nutrient supply saves up to £153/ha. This potential saving will be less where soil P or K Indices are above maintenance levels.

Stage and calculation procedure	Nitrogen (N)	Phosphate (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	Financial saving £/ha
<b>1. Estimated total nutrients in green compost (kg/t)</b>				
Analysis provided by green compost supplier or typical values from (Table 2.17)	7.5	3.0	6.8	
<b>2. Estimated available nutrients in green compost (kg/t)</b>				
Nitrogen	NIL <sup>a</sup>			
Phosphate and potash (Table 2.17)		1.5	5.4	
<b>3. Nutrients supplied by green compost that are equivalent to manufactured fertiliser (kg/ha)</b>				
30 t/ha supplies 225 kg/ha total nitrogen	NIL <sup>a</sup>	90 <sup>b</sup>	204 <sup>b</sup>	
Potential saving from green compost use				<b>£176/ha<sup>d</sup></b>
<b>4. Nutrient requirements for barley (kg/ha)</b>				
<b>Section 4: Arable crops</b>	200	65 <sup>c</sup>	95 <sup>c</sup>	
<b>5. Manufactured fertiliser needed for the barley crop (kg/ha)</b>				
Stage 4 minus Stage 3	200	NIL	NIL	
Actual saving for next crop due to green compost use				<b>£99/ha</b>
<b>6. Surplus compost phosphate and potash for subsequent crops that is equivalent to manufactured fertiliser (kg/ha)</b>				
Stage 3 minus Stage 4	NIL	20	109	
Saving for subsequent crops due to green compost use				<b>£77/ha</b>

- a. Crop available nitrogen is negligible or, for practical purposes, nil.  
 b. Total phosphate and potash content used in calculations to maintain soil P and K Indices.  
 c. Nutrients required for maintenance of soil reserves (soil P Index 2 and K Index 2-).

- d. Saving for barley crop plus value of surplus compost phosphate and potash which will contribute to the nutrient requirement of future crops.  
 Assumed fertiliser costs: Nitrogen 60 p/kg; phosphate 60 p/kg; potash 60 p/kg.

## Digestate

Digestate is one of the products of anaerobic digestion, which is the controlled biological decomposition of biodegradable materials such as food wastes, animal manures and crops (eg maize and rye) in the absence of oxygen. Digestate is also known as ‘biofertiliser’ if it meets Biofertiliser Certification Scheme standards.

Digestate that is certified under the Biofertiliser Certification Scheme and farm-sourced digestate does not normally need an environmental permit or exemption to be in place for application to land. Non-certified digestate from non-agricultural sources is usually applied to land under the Environmental Permitting Regulations.

The Biofertiliser Certification Scheme sets baseline quality specifications, set by the British Standards Institution Publicly Available Specification 110 (PAS110). While the PAS scheme specifies minimum quality criteria, they also allow customers to specify higher quality thresholds. It is important to check whether customers have any additional quality requirements before digestate is applied.

### Further information

Digestate and compost in agriculture  
PAS110

[www.wrap.org.uk](http://www.wrap.org.uk)

Biofertiliser Certification Scheme  
[www.biofertiliser.org.uk](http://www.biofertiliser.org.uk)

Digestate is normally produced ‘whole’ (a slurry-like material with a dry matter content of around 5%), but this can be separated into fibre and liquor fractions. Typically, whole digestate and digestate liquor contain significantly more nitrogen in the readily available form than cattle slurry. Usually 80–90% of the nitrogen in whole and liquor digestate is in the readily available form and applications would be subject to closed-spreading periods in Nitrate Vulnerable Zones.

In separated fibre (typically 25% dry matter), usually less than 30% of the total nitrogen is in the readily available form and applications would not be subject to closed spreading periods in Nitrate Vulnerable Zones, although this should be checked. Separated fibre contains considerably more phosphate than whole and liquor digestate.

The nutrient content of the digestate is controlled by the feedstock used in the digestion process. Food-based digestates will typically have much higher nutrient contents than farm-sourced (eg crop and manure based) digestate. The values in Tables 2.18 and 2.19 are indicative and nutrient contents are likely to vary considerably between sites.

PAS110 digestate will have been sampled and analysed regularly during production and should be supplied with specific nutrient content data. It is recommended that application rates of high readily available nitrogen digestates are carefully controlled to reduce the risk of excessive nitrogen applications.

### Points to consider

- The nutrient content of digestate products will vary depending on the source materials and treatment process
- PAS110 digestate should be supplied with specific nutrient content data and other relevant information

Table 2.18 Typical total nutrient contents for food-based digestate

Type	Dry matter %	Total N	Total P <sub>2</sub> O <sub>5</sub>	Total K <sub>2</sub> O	Total MgO	Total SO <sub>3</sub>
	kg/m <sup>3</sup> or kg/t					
Whole	4.1	4.8 <sup>a,b</sup>	1.1	2.4	0.2	0.7
Separated liquor	3.8	4.5 <sup>a,b</sup>	1.0	2.8	0.2	1.0
Separated fibre	2.7	8.9 <sup>c</sup>	10.2	3.0	2.2	4.1

- a. Crop-available nitrogen supply from spring applications is around 55% of total nitrogen applied. Crop-available nitrogen supply following autumn applications to winter cereals is around 15% of total nitrogen applied.
- b. For autumn applications to grass or oilseed rape assume a crop-available nitrogen supply of 35% of total nitrogen applied.
- c. For autumn applications assume crop-available nitrogen supply of 10% of total nitrogen applied and 15% of total nitrogen applied for spring applications.

**Nutrient supply from digestate**

The amount of crop available nitrogen from digestate will depend on how much of the nitrogen applied is lost following application by ammonia emissions and nitrate leaching.

Information from research studies has shown that ammonia emissions from applications of whole and liquid digestate can be greater than from cattle slurries. Ammonia emissions from liquid digestate applications can be reduced by using precision application equipment such as band spreaders or shallow injectors or, where appropriate, be incorporated rapidly into the soil. Precision application equipment allows digestate to be spread evenly, increasing the nutrient use efficiency.

Table 2.19 Typical total nutrient contents for farm-sourced digestate

Type	Dry matter %	Total N	Total P <sub>2</sub> O <sub>5</sub>	Total K <sub>2</sub> O	Total MgO	Total SO <sub>3</sub>
	kg/m <sup>3</sup> or kg/t					
Whole	5.5	3.6 <sup>a,b</sup>	1.7	4.4	0.6	0.8
Separated liquor	3.0	1.9 <sup>a,b</sup>	0.6	2.5	0.4	<0.1
Separated fibre	24.0	5.6 <sup>c</sup>	4.7	6.0	1.8	2.1

- a. Crop-available nitrogen supply from spring applications is around 55% of total nitrogen applied. Crop-available nitrogen supply following autumn applications to winter cereals is around 15% of total nitrogen applied.
- b. For autumn applications to grass or oilseed rape assume a crop-available nitrogen supply of 35% of total nitrogen applied.
- c. For autumn applications assume crop-available nitrogen supply of 10% of total nitrogen applied and 15% of total nitrogen applied for spring applications.

Spring applications are likely to supply more crop available nitrogen than autumn timings as a result of reduced nitrate leaching losses. Data from the DC-Agri project indicate that crop available nitrogen supply from spring applications of food-based digestate to cereal crops was 55% of total nitrogen compared with 10% of total nitrogen applied from autumn applications. The use of precision application is recommended to ensure even application.

As little work has been done on the availability of digestate phosphate and potash to crops, it is appropriate to extrapolate from work on cattle slurries which suggests that around 60% of the phosphate and 90% of potash will be available to the next crop grown, with the remainder released slowly over the crop rotation. Some digestates also supply useful quantities of sulphur and magnesium, although there are no data on availability to the next crop grown.

### Understanding the value of digestate applications

**Example 2.6**

30 m<sup>3</sup>/ha of whole food-based digestate is applied using a band spreader in spring to winter wheat on a sandy soil (8 t/ha grain yield, straw baled, previous crop – cereal). The soil is at P Index 2 and K Index 2-. Allowing for the digestate nutrient supply saves £110/ha. This potential saving will be less where soil P or K Indices are above maintenance levels.

Stage and calculation procedure	Nitrogen (N)	Phosphate (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	Financial saving £/ha
<b>1. Estimated total nutrients in food-based digestate (kg/t)</b>				
Typical values	4.8	1.1	2.4	
<b>2. Estimated available nutrients in food-based digestate (kg/t)</b>				
Nitrogen (assuming 55% availability from spring application)	2.6			
Phosphate and potash		0.7	2.2	
<b>3. Nutrients supplied by digestate that are equivalent to manufactured fertiliser (kg/ha)</b>				
30 m <sup>3</sup> /ha supplies 145 kg/ha total nitrogen	78	33 <sup>a</sup>	72 <sup>a</sup>	
Potential saving from whole food-based digestate use				<b>£110/ha<sup>d</sup></b>
<b>4. Nutrient requirements for winter wheat (kg/ha)</b>				
<b>Section 4: Arable crops</b>	180	65 <sup>b</sup>	85 <sup>b</sup>	
<b>5. Manufactured fertiliser needed for the winter wheat crop (kg/ha)</b>				
Stage 4 minus Stage 3	102	32	13	
Actual saving for winter wheat crop due to whole food-based digestate use				<b>£110/ha</b>
<b>6. Surplus digestate phosphate and potash for subsequent crops that is equivalent to manufactured fertiliser (kg/ha)</b>				
Stage 3 minus Stage 4	NIL	NIL	NIL	
Saving for subsequent crops due to digestate compost use				<b>NIL</b>

a. Total phosphate and potash content used in calculations to maintain soil P and K Indices.  
 b. Nutrients required for maintenance of soil reserves (soil P Index 2 and K Index 2-)

c. Saving for current crop.  
 d. Assumed fertiliser costs: Nitrogen 60 p/kg; phosphate 60 p/kg; potash 60 p/kg.

## Waste-derived materials

The recycling of industrial wastes to agricultural land is controlled by environmental permitting regulations. These regulations allow the spreading of some industrial wastes onto agricultural land under a permit or an exemption provided that certain conditions are met, including demonstration that they provide agricultural benefit or ecological improvement.

The application of such wastes must be registered with the Environment Agency who will supply advice on the regulations and their interpretation. Industrial waste materials are supplied to farmers with specific nutrient content data and advice on how to best manage these materials to the benefit of soils and crops. The typical nutrient content of selected industrial 'waste' materials that are commonly recycled to farmland are summarised below.

### Paper crumble

Table 2.20 Typical total nutrient content of paper crumble (fresh weight basis)

	Dry matter %	Total nitrogen kg N/t	Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
Chemically/physically treated	40	2.0	0.4	0.2	0.6	1.4
Biologically treated	30	7.5	3.8	0.4	2.4	1.0

To convert kg/t to units/ton, multiply by 2.

Following the application of chemically/physically treated paper crumble nitrogen, 'lock-up' commonly occurs due to the high carbon:nitrogen ratio of the paper crumble which immobilises soil nitrogen. As a general rule, around 0.8 kg of inorganic nitrogen is required per tonne (fresh weight) of paper crumble applied to compensate for the nitrogen 'lock-up' in the soil. As biologically treated paper crumble has a lower carbon:nitrogen ratio, nitrogen 'lockup' is not usually experienced following land spreading.

### Spent mushroom compost

Table 2.21 Typical total nutrient content of spent mushroom compost (fresh weight basis)

	Dry matter %	Total nitrogen kg N/t	Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
Spent mushroom compost	35	6.0	5.0	9.0	ND	ND

To convert kg/t to units/ton, multiply by 2.

#### Further information

Environmental permitting regulation

[www.gov.uk/topic/environmental-management/environmental-permits](http://www.gov.uk/topic/environmental-management/environmental-permits)

## Water treatment cake

Table 2.22 Typical total nutrient content of water treatment cake (fresh weight basis)

	Dry matter %	Total nitrogen kg N/t	Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
Water treatment cake	25	2.4	3.4	0.4	5.5	0.8

To convert kg/t to units/ton, multiply by 2.

## Food industry wastes

Table 2.23 Typical total nutrient content of food industry wastes (fresh weight basis)

	Dry matter %	Total nitrogen kg N/t	Total phosphate kg P <sub>2</sub> O <sub>5</sub> /t	Total potash kg K <sub>2</sub> O/t	Total sulphur kg SO <sub>3</sub> /t	Total magnesium kg MgO/t
Dairy	4	1.0	0.8	0.2	ND	ND
Soft drinks	4	0.3	0.2	Trace	ND	ND
Brewing	7	2.0	0.8	0.2	ND	ND
General	5	1.6	0.7	0.2	ND	ND

To convert kg/t to units/ton, multiply by 2.

## Glossary

<b>Available (nutrient)</b>	Form of a nutrient that can be taken up by a crop immediately or within a short period so acting as an effective source of that nutrient for the crop.	<b>Digestate</b>	Organic material produced by anaerobic digestion of biodegradable organic materials. May be separated into liquid and fibre fractions after digestion.
<b>Biosolids</b>	Treated sewage sludge.	<b>Dirty water</b>	Lightly contaminated run-off from lightly fouled concrete yards or from the dairy/parlour that is collected separately from slurry. It does not include liquids from weeping-wall stores, strainer boxes, slurry separators or silage effluent which are rich in nitrogen and regarded as slurries.
<b>Clay</b>	Finely divided inorganic crystalline particles in soils, less than 0.002 mm in diameter.	<b>FACTS</b>	UK national certification scheme for advisers on crop nutrition and nutrient management. Membership renewable annually. A FACTS Qualified Adviser has a certificate and an identity card.
<b>Coefficient of variation (CV)</b>	Measure of the unevenness of application of fertilisers or manures. CV of 0% indicates perfectly even spreading, unachievable in practice. Correct operation of a well set up spreader should give a CV of 10% for fertilisers and 25% for manures under field conditions.	<b>Farmyard manure (FYM)</b>	Livestock excreta that is mixed with straw bedding material that can be stacked in a heap without slumping.
<b>Compost</b>	Organic material produced by aerobic decomposition of biodegradable organic materials.	<b>Fertiliser</b>	See Manufactured fertiliser.
<b>Content (nutrient)</b>	Commonly used instead of the more accurate 'concentration' to describe nutrients in fertiliser or organic manure. For example, 6 kg N/t often is described as the nitrogen content of a manure.	<b>Incorporation</b>	A technique (discing, rotovating, ploughing or other methods of cultivation) that achieves some mixing between an organic manure and the soil. Helps to minimise loss of nitrogen to the air through volatilisation, and nutrient run-off to surface waters.
<b>Crop available nitrogen</b>	The total nitrogen content of organic manure that is available for crop uptake in the growing season in which it is spread on land.	<b>Layer manure</b>	Poultry excreta with little or no bedding.
<b>Denitrification</b>	Microbial conversion of nitrate and nitrite in anaerobic soil to nitrogen gas and some nitrous oxide.		

<b>Leaching</b>	Process by which soluble materials such as nitrate or sulphate are removed from the soil by drainage water passing through it.	<b>Neutralising Value (NV)</b>	Percentage calcium oxide (CaO) equivalent in a material. 100 kg of a material with a neutralising value of 52% will have the same neutralising value as 52 kg of pure CaO. NV is determined by a laboratory test.
<b>Livestock manure</b>	Dung and urine excreted by livestock or a mixture of litter, dung and urine excreted by livestock, even in processed organic form. Includes FYM, slurry, poultry manure, separated manures, and granular or pelletised manures.	<b>Nitrate Vulnerable Zones (NVZs)</b>	Areas designated by Defra as being at risk from agricultural nitrate pollution.
<b>Manufactured fertiliser</b>	Any fertiliser that is manufactured by an industrial process. Includes conventional straight and NPK products (solid or fluid), organo-mineral fertilisers, rock phosphates, slags, ashed poultry manure, and liming materials that contain nutrients.	<b>Nitrous oxide (N<sub>2</sub>O)</b>	A potent greenhouse gas that is emitted naturally from soils. The amount emitted is related to supply of mineral nitrogen in the soil so increases with application of manures and fertilisers, incorporation of crop residues and growth of legumes. It is greater in organic and peaty soils than in other soils.
<b>Manure</b>	See Livestock manure and Organic manure.	<b>Offtake</b>	Amount of a nutrient contained in the harvested crop (including straw, tops or haulm) and removed from the field. Usually applied to phosphate and potash.
<b>Micronutrient</b>	Boron, copper, iron, manganese, molybdenum and zinc that are needed in very small amounts by crops. Cobalt and selenium are taken up in small amounts by crops and are needed in human and livestock diets.	<b>Organic materials (manure)</b>	Livestock manures and all other nitrogen-containing organic materials, such as sewage sludge, composts, food wastes and organic wastes (treated and untreated).
<b>Mineralisation</b>	Microbial breakdown of organic matter in the soil, releasing nutrients in crop-available, inorganic forms.	<b>Peaty soil (peat)</b>	Soil containing more than 20% organic matter.
		<b>Poultry manure</b>	Excreta produced by poultry, including bedding material that is mixed with excreta, but excluding duck manure with a readily available nitrogen content of 30% or less.

<b>Prilled fertiliser</b>	Fertiliser in which particles (prills) are formed by allowing molten material to fall as droplets in a tower. Droplets solidify during the fall and tend to be more spherical and somewhat smaller than granules.	<b>Soil organic matter</b>	Often referred to as humus. Composed of organic compounds ranging from undecomposed plant and animal tissues to fairly stable brown or black material with no trace of the anatomical structure of the material from which it was derived.
<b>Readily available nitrogen</b>	Nitrogen that is present in livestock and other organic manures at the time of sampling in molecular forms that can be taken up immediately by the crop (ammonium or nitrate, or in poultry manure uric-acid N). High in slurries and poultry manures (typically 35–70% of total N) and low in FYM (typically 10–25%).	<b>Soil type</b>	Description based on soil texture, depth, chalk content and organic matter content.
<b>Sand</b>	Soil mineral particles larger than 0.05 mm.	<b>Solid manure</b>	Organic manure which can be stacked in a freestanding heap without slumping.
<b>Silt</b>	Soil mineral particles in the 0.002–0.05 mm diameter range.	<b>Target Index</b>	Lowest soil P or K Index at which there is a high probability crop yield will not be limited by phosphorus or potassium supply. See Soil Index (P, K or Mg).
<b>Slurry</b>	Excreta of livestock (other than poultry), including any bedding, rainwater and washings mixed with it, which can be pumped or discharged by gravity. The liquid fraction of separated slurry is also defined as slurry.	<b>Tillage land</b>	Land that is not being used for grass production and is sown with a crop.
<b>Soil Index (P, K or Mg)</b>	Concentration of available P, K or Mg, as determined by standard analytical methods, expressed in bands or Indices.	<b>Volatilisation</b>	Loss of nitrogen as ammonia from the soil to the atmosphere.
<b>Soil Nitrogen Supply (SNS)</b>	The amount of nitrogen (kg N/ha) in the soil that becomes available for uptake by the crop in the growing season, taking account of nitrogen losses.	<b>Water-soluble phosphate</b>	Phosphate, expressed as $P_2O_5$ , that is measured by the statutory method for fertiliser analysis. Not necessarily a measure of available phosphate – high water solubility indicates high availability but low water solubility does not necessarily indicate low availability.







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### Greenhouse Gas Action Plan:

The industry-wide Greenhouse Gas Action Plan (GHGAP) for agriculture focuses on improving resource use efficiency in order to enhance business performance whilst reducing GHG emissions from farming. 

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### Contact us

AHDB  
Stoneleigh Park  
Warwickshire  
CV8 2TL

### For specific AHDB nutrient management guide (RB209) enquiries:

[nutrient.management@ahdb.org.uk](mailto:nutrient.management@ahdb.org.uk)  
024 7647 8784

### To order printed publications:

[cereals.publications@ahdb.org.uk](mailto:cereals.publications@ahdb.org.uk)  
0845 245 0009

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