

Figure 5 Rotaspreader



Figure 6 Rear discharge spreader



Figure 7 Dual purpose spreader



Preparing for spreading

The MAFF Codes of Good Agricultural Practice for the Protection of Water, Air and Soil provide guidance on avoiding water pollution, soil contamination, odours and ammonia losses.

Draw up a *farm waste management plan* to help you decide when, where and at what rate to spread slurry and solid manure on your farm. You can get further information on farm waste management plans by reading the Water Code, obtaining the MAFF step-by-step guide or contacting a consultant on the National Farm Waste Management Plan Register (see page 17).

Management of stored manures: even the most efficient systems for handling and spreading manures will fail if they are not carefully matched to storage and treatment systems. To make the most of your spreading system, the following points should be considered.

- Don't allow loose concrete, bricks, wire, timber, etc. to get into reception pits or stores; they may damage machinery and can be a safety hazard.
- If the handling system is designed to work only with slurry, exclude waste bedding and feed from reception pits and stores to avoid blockages.
- Mechanical separation of slurry removes coarse solids, enabling the slurry to be pumped more easily. Separated slurry does not crust or settle in the store and so requires less mixing.
- If mixing is required, it is advisable to begin mixing the contents of slurry stores a few days before emptying. Mixing enables complete emptying of the store and removes the crust from the slurry surface, as well as producing a more uniform slurry for spreading.
- Completely empty slurry stores at least once a year, especially if there is a crust or if sediment has accumulated.

Protecting the environment: Wherever possible, use a band spreader, trailing shoe spreader or injector to apply slurry. Where this is not possible, use a broadcast slurry spreader that gives a low trajectory and large droplets. After surface application of slurry or solid manure to bare land, incorporate the material into the soil within twenty-four hours of spreading and, where practical, within four

hours. Band spreaders, trailing shoe spreaders, injectors or rapid incorporation will reduce odours and ammonia losses, whereas low trajectory broadcast spreaders will only reduce some of the odours.

When spreading, the following key points will help you to avoid pollution and possible associated fines.

Do not spread . . .

- within at least 10 metres of a ditch or watercourse or within 50 metres of a spring, well or borehole that supplies water for human consumption or the farm dairy;
- more than 50 m³ per hectare or 50 tonnes per hectare at one time, to reduce the risk of runoff. Reduce these rates as necessary, so that the amount of total nitrogen applied from organic manures does not exceed 250 kg per hectare per year. Poultry manure will usually reach this loading at 5 to 15 tonnes per hectare;
- when soils are frozen hard, that is, frozen for 12 hours or longer in the preceding 24-hour period;
- when the field is snow-covered;
- when the soil is cracked down to field drains or backfill;
- when fields have been pipe or mole drained, or sub-soiled over existing drains within the last 12 months.

Timing of application: for optimum use of the available nutrients in manures, they should be spread as close as possible before maximum crop growth and nutrient uptake occur. For further information, see Booklets 1 and 2.

Remember, many people complain about unpleasant smells from farms. Therefore, consider the following points before spreading.

- Do not spread in the evenings or at weekends, when people are more likely to be at home.
- Pay attention to wind direction in relation to neighbouring houses.
- Avoid spreading under warm, humid conditions.
- Use spreading systems which minimise the production of dust or fine droplets.

Sampling slurry and solid manure for analysis

Why correct sampling is important: the nutrient content of slurry can vary considerably within a store due to settlement and crusting. 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 by a rapid on-farm method, it is important that the sample taken represents an 'average' of what is found in the store or heap.

General principles of sampling: it is important, where this is practical and safe, to take a number of samples. Take these from a range of positions within the store or heap, bulk them together, mix them and then take a representative sub-sample. You can send the final sample to the laboratory for analysis or test it with a slurry N meter or slurry hydrometer on-farm.

Slurries: take at least five sub-samples of 2 litres, pour into a larger container, stir thoroughly and pour a 2-litre sample immediately into a smaller clean container to provide the sample for analysis.

- **Above-ground stores:** ideally, slurry should be fully agitated and sub-samples taken from the reception pit. If this is not possible, and **provided there is safe access from an operator's platform**, the five sub-samples can be taken at a range of positions, using a weighted 2-litre container attached to a rope.
- **Below-ground pits:** it may be possible to obtain sub-samples at various positions using a weighted container as above, **but never enter the pit, as lethal gases may be present.**
- **Earth-banked lagoons:** if the slurry has been well agitated, you can obtain sub-samples from the tanker or irrigator as outlined below. **Do not attempt to sample direct from the lagoon unless there is a secure operator's platform that provides safe access.**
- If the tanker is fitted with a suitable valve, it may be possible to take five sub-samples from the stationary slurry tanker at intervals while field spreading is in progress.

Solid Manures: take at least ten sub-samples of about 1 kg each, taken as described below, and place on a clean, dry tray or sheet. Break up any lumps and thoroughly mix the sample and then take a representative sample of around 2 kg for analysis.

- **Heaps:** provided the manure is dry and safe to walk on, identify at least ten locations which appear to be representative of the heap. Having cleared away any weathered material with a spade or fork, dig a hole approx 0.5 metres deep and take a 1 kg sample from each point. Alternatively, take sub-samples 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. Sub-samples may be taken from the face of the heap once emptying has commenced.

Sampling during spreading: trays placed in the field can be used to collect samples from the slurry or solid manure spreading system while the material is being spread. Take care to avoid the possibility of injury from stones and other objects which may be flung out by the spreading mechanism.

Sample analysis: the sample should be analysed for Dry Matter (DM), Total Nitrogen (N), Ammonium-N ($\text{NH}_4^+\text{-N}$), Phosphorus (P), Potassium (K), Sulphur (S) and Magnesium (Mg). There are further details on sample analysis in Booklets 1 and 2.

If you analyse slurry using an on-farm rapid method, do this immediately after sampling, making sure that the sample taken is well mixed. If you send slurry to a laboratory for analysis, samples should be dispatched in clean screw-topped 2-litre plastic containers. Leave at least 5 cm of airspace to allow the sample to be shaken in the laboratory.

With manures, use 500-gauge polythene bags and expel excess air from the bag before sealing. Clearly label the samples on the outside of the container or bag and dispatch them immediately or within a maximum of seven days if kept in a refrigerator.

Calibrating and operating spreaders

Application rate: to reduce the risk of pollution, the MAFF Water Code advises limits for nutrient loading and volume applied. For example, the total N applied from organic manures should not exceed 250 kg per ha per year. However, this is the maximum limit and lower limits may be appropriate. Booklets 1 and 2 contain further information on application rates. Once the desired application rate is known, it is important to apply slurry or solid manure as accurately and as evenly as possible.

How to estimate/measure application rate: there are international standards for calibrating slurry and solid manure spreading systems. The full calibration procedure determines the application rates achievable by the spreader and how evenly slurry or solid manure is distributed. This is expressed as the coefficient of variation or C of V. The equipment necessary to undertake this work is large and expensive, but there are simple tests that can be conducted on farms.

Slurries: the application rate is affected by three factors:

- Discharge rate
- Bout width
- Forward speed.

Once the target application rate has been determined based on crop requirements and available nutrients in the slurry, calculate the required forward speed to achieve the target application rate as follows:

$$\text{Forward speed (km/hr)} = \frac{\text{Discharge rate (m}^3\text{/second)} \times 36000}{\text{Bout width (m)} \times \text{Application rate (m}^3\text{/ha)}}$$

For a vacuum or pumped tanker, the discharge rate can be determined by filling the tanker, of known volume, to its maximum capacity and timing how long the tanker takes to empty under normal conditions, using the same pto speed that would be used when spreading. Alternatively, the tanker could be weighed both full and empty at a local weighbridge or on a farm vehicle weighing system to determine its capacity.

For a pumped tanker fitted with a positive displacement pump, the manufacturer can supply pump performance charts from which the discharge rate can be determined. This method of discharge rate determination can also be used for umbilical systems and irrigators if they are fitted with a positive displacement pump.

If the system is fitted with a centrifugal pump, a flow meter should be used to determine the discharge rate as the flow rate will vary with distance and height pumped and with variation in slurry physical characteristics. However, discharge rate can be easily estimated from the time taken to empty a tank of known volume or weight.

For band spreaders, trailing shoe spreaders and injectors, the bout width is simply the width of the boom or injector toolbar. For broadcast spreaders, it is much more difficult to determine the bout width. Since the distribution of slurry across the full spreading width of a broadcast spreader is not usually even, it is important to overlap the bouts to achieve a low C of V. Generally, the narrower the bout width, the lower the C of V, but as a general rule, the bout width should be half the spreading width (see Figure 8).

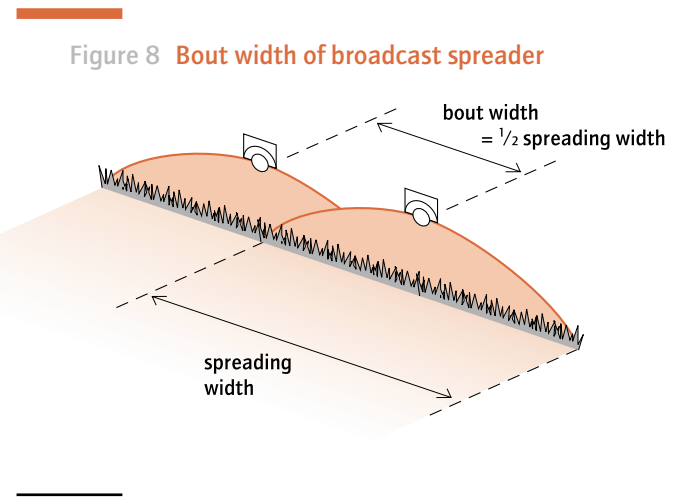


Figure 8 Bout width of broadcast spreader

Solid manures: the application rate is affected by three factors:

- Discharge rate
- Bout width
- Forward speed.

Once the target application rate has been determined, based on crop requirements and available nutrients in the solid manure, calculate the required forward speed to achieve the target application rate as follows:

$$\text{Forward speed (km/hr)} = \frac{\text{Discharge rate (tonnes/second)} \times 36000}{\text{Bout width (m)} \times \text{Application rate (m}^3/\text{ha)}}$$

The discharge rate of a solid manure spreader can be determined by timing how long the spreader takes to empty a complete load. Weigh the spreader both empty and full at a local weighbridge or on a farm vehicle weighing system to calculate the weight of manure. Due to variation in density of different manures, you should calculate the discharge rate for each type of manure.

For rear discharge spreaders, the spread pattern is usually quite even and the bout width can be taken as the spreading width. For both types of side discharge spreader, it is much more difficult to establish the bout width. Generally, the narrower the bout width, the lower the C of V, but as a general rule, the bout width should be half the spreading width.

Example

The target Application Rate is 25 m³/ha. If a 10 m³ vacuum tanker takes 300 seconds to empty, the Discharge Rate would be:

$$\text{Discharge Rate (m}^3/\text{second)} = \frac{10}{300} = 0.033 \text{ m}^3/\text{second}$$

If the tanker was fitted with a 6 m spreading boom, the required Forward Speed to achieve an Application Rate of 25 m³/ha would be:

$$\text{Forward Speed (km/hr)} = \frac{0.033 \times 36000}{6 \times 25} = 8 \text{ km/hr}$$

The correct gear to achieve the required Forward Speed (km/hr) for the given pto speed can then be selected from the gear chart in the tractor cab.

Example

The target Application Rate is 30 tonnes/ha. If an 8 tonne rear discharge spreader takes 300 seconds to empty, the Discharge Rate would be:

$$\text{Discharge Rate (tonnes/second)} = \frac{8}{300} = 0.027 \text{ tonnes/second}$$

If the spreader had a Bout Width of 4 m, the required Forward Speed to achieve an application rate of 30 t/ha would be:

$$\text{Forward Speed (km/hr)} = \frac{0.027 \times 36000}{4 \times 30} = 8 \text{ km/hr}$$

The correct gear to achieve the required Forward Speed (km/hr) for the given pto speed can then be selected from the gear chart in the tractor cab.

For both slurry and solid manure, a crosscheck can be made by counting the number of tanker or spreader loads and multiply by its capacity (m³ or tonnes), to give the amount distributed on a field of known area. These tests, of course, are not a substitute for comprehensive machine calibration, but they will give a good indication of on-farm performance and will allow better use of the available nutrients.

How to obtain more information

The following are available FREE, unless otherwise stated.

- **Fertiliser Recommendations for Agricultural and Horticultural Crops (MAFF, RB 209)** *Comprehensive reference book on use of organic manures and inorganic fertilisers. Seventh edition 2000, available from The Stationery Office – (£15) ISBN 0-11-243058-9.*

Available from ADAS Gleadthorpe Research Centre. Tel: 01623 844331

- **Managing Livestock Manures: Booklet 1 – Making better use of livestock manures on arable land** (*Second edition*). ADAS, IGER, SRI
- **Managing Livestock Manures: Booklet 2 – Making better use of livestock manures on grassland** (*Second edition*). IGER, ADAS, SRI

Available from MAFF. Tel: 020 7238 6220

- **MAFF/WOAD – Farm Waste Management Plan: A step-by-step guide for farmers.**

Available from MAFF publications. Tel: 0645 556000

- **The Water Code (Code of Good Agricultural Practice for the Protection of Water)** – PB 0587. *Information on farm waste management plans and avoiding water pollution.*
- **The Air Code (Code of Good Agricultural Practice for the Protection of Air)** – PB 0618. *Information on farm waste treatment, minimising odours and ammonia losses.*
- **The Soil Code (Code of Good Agricultural Practice for the Protection of Soil)** – PB 0617. *Information on soil fertility, erosion and contamination.*
- **Guidelines for Farmers in NVZs (PB 3277) and Manure Planning in NVZs (PB 3577)**

The following are available free from local Health and Safety Executive offices.

- **HSE Preventing Access to Effluent Storage and Similar Areas on Farms.** HSE Information sheet AIS 9.
- **HSE Managing Confined Spaces on Farms.** HSE Information Sheet AIS 26.
- **HSE Occupational Health Risks from Cattle.** HSE Information Sheet AIS 19.
- **National Farm Waste Management Plan Register** – a list of local consultants who can provide professional advice on waste management planning. Tel: 01398 361566
- **MANNER** (ADAS MANure Nitrogen Evaluation Routine) is a simple, personal computer-based decision-support system, supplied on CD-ROM or disk, with full instructions and a User Guide. It can be obtained free of charge from:
ADAS Gleadthorpe Research Centre, Meden Vale, Mansfield, Nottingham, NG20 9PF
Tel: 01623 844331 Fax: 01623 844472 or www.adas.co.uk/manner

Conversion table

Volumes

1 imperial gallon (gall) = 0.0045 cubic metre (m ³)	1 m ³ = 220 gall
1 imperial gallon (gall) = 4.55 litres (l)	1 litre = 0.22 gallons

Length

1 foot (ft) = 0.31 metre (m)	1 m = 3.28 ft
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Speed

1 mile per hour (mph) = 1.61 kilometres per hour (km/h)	1 km/h = 0.62 mph
1 mile per hour (mph) = 0.45 metres per second (m/s)	1 m/s = 2.24 mph

Application rates

1 imperial gallon per acre (gall/ac) = 0.011 cubic metres per hectare (m ³ /ha)	1 m ³ /ha = 90 gall/ac
1 ton per acre (ton/ac) = 2.50 tonnes/hectare (t/ha)	1 t/ha = 0.40 ton/ac

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Area

1 acre (ac) = 0.405 hectares (ha)	1 ha = 2.47 ac
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Fertilisers

1 unit per acre (unit/ac) = 1.25 kilograms/hectare (kg/ha)	1 kg/ha = 0.8 units/ac
1 kg P = 2.29 kg P ₂ O ₅	1 kg P ₂ O ₅ = 0.44 kg P
1 kg K = 1.20 kg K ₂ O	1 kg K ₂ O = 0.83 kg K
1 kg S = 2.50 kg SO ₃	1 kg SO ₃ = 0.40 kg S
1 kg Mg = 1.66 kg MgO	1 kg MgO = 0.60 kg Mg