

Written by **ADAS Brian Chambers, Nick Nicholson and Ken Smith**  
**Institute of Grassland and Environmental Research Brian Pain**  
**Silsoe Research Institute Trevor Cumby and Ian Scotford**



## Spreading systems for slurries and solid manures

Booklet **3**



- Booklet 1 Making better use of livestock manures on arable land
- Booklet 2 Making better use of livestock manures on grassland
- Booklet 3 Spreading systems for slurries and solid manures

Funded by the Ministry of Agriculture, Fisheries and Food

Copies available from:

**ADAS Gleadthorpe Research Centre**  
**Meden Vale**  
**Mansfield**  
**Notts**  
**NG20 9PF**

**Telephone: 01623 844331**  
**Fax: 01623 844472**  
**Email: [glyn.scrimshire@adas.co.uk](mailto:glyn.scrimshire@adas.co.uk)**

## Why read this booklet?

Slurries and solid manures are valuable fertilisers but may also be potential sources of pollution. With increasing economic and environmental pressures on farm businesses, it makes sense to exploit the fertiliser value of manures, while taking action to prevent pollution.

**The booklets in this series will assist in achieving these aims by providing practical advice so that you can:**

- save on the cost of inorganic fertiliser
- operate machinery effectively
  - minimise management problems
  - comply with the MAFF Codes of Good Agricultural Practice.

The booklets have been produced jointly by IGER, ADAS and SRI and are available free of charge. The information they contain is based largely on research conducted by these three organisations over the past ten years, much of which was paid for by MAFF.

**This booklet explains how to:**

- select the right spreading system
- prepare for field spreading
  - organise slurry and manure sampling
  - calibrate spreaders.

**Handling of slurries and solid manures creates certain safety hazards for both operators and the public. You must comply with relevant legislation. Key sources of information are listed on page 17.**

In this booklet, **manures** refer to organic materials which supply organic matter to the soil, together with plant available nutrients (in relatively small concentrations compared to inorganic fertilisers). They may be either **slurries** or **solid manures**.

**Slurries** consist of excreta produced by livestock in a yard or building mixed with rainwater and wash water and, in some cases, waste bedding and feed. Slurries can be pumped or discharged by gravity.

**Solid manures** include farmyard manure (FYM) and comprise material from covered straw yards, excreta with a lot of straw in it, or solids from mechanical slurry separators. Most poultry systems produce solid manure. Solid manures can generally be stacked.

Booklet

3

## Contents

02	Why controlled application is important
02	Understanding nutrient losses
02	Slurry: selecting the right handling and spreading system
06	Solid manure: selecting the right spreader
09	Preparing for spreading
	Management of stored manures
	Protecting the environment
	Timing of application
11	Sampling slurry and solid manure for analysis
	Why correct sampling is important
	General principles of sampling
	Sample analysis
13	Calibrating and operating spreaders
	Application rate
	How to estimate/measure application rate
17	How to obtain more information
18	Conversion table

01

## Why controlled application is important

To ensure that the intended amount of nutrients in slurry and solid manure has been applied to the crop, it is important that the machinery used is chosen, calibrated and operated to give accurate application. This means that it should be capable of being set up to apply the intended rate in m<sup>3</sup>/ha or tonnes/ha, and to produce an acceptably even spread pattern.

Coefficient of variation (C of V) is a measure of the uniformity of spread achieved, both laterally and longitudinally. A high number indicates a poor uniformity. With granular fertiliser, a C of V of less than 15% is normally considered acceptable. Research suggests that slurry tankers and manure spreaders should be chosen and operated to give a C of V of less than 25%. Using an appropriate bout width is critical in achieving a reasonably uniform spread.

## Understanding nutrient losses

Gaseous emissions from land application of slurries and solid manures account for a large proportion of the total ammonia emissions from agriculture. It is very important to minimise losses at this stage because any ammonia saved during livestock housing or manure storage will be lost if it is not controlled by appropriate field application techniques. Reducing ammonia losses from slurries and solid manures means more nitrogen is potentially available for grass and crop uptake.









## Slurry: selecting the right handling and spreading system

There are four main types of slurry transport systems (see Table 1).

- **Vacuum tanker** – the slurry is sucked into the tanker by using an air pump to evacuate the air from the tank to create a vacuum; the tanker is emptied using the air pump to pressurise the tanker, so forcing the slurry out.

- **Pumped tanker** – the slurry is pumped into and from the tanker using a slurry pump, either a centrifugal (e.g. impeller type) or positive displacement (e.g. lobe type) pump.
- **Umbilical hose** – the slurry is fed by a drag hose to the distribution system fitted to the tractor; the hose is supplied with slurry usually direct from the slurry store by a centrifugal or positive displacement pump.
- **Irrigator** – this is a self-travelling machine with flexible or reeled-in hoses usually fed from a network of underground pipes, with a centrifugal or positive displacement pump, situated near the slurry store.

Table 1 Slurry transport systems

	Vacuum tanker	Pumped tanker	Umbilical hose	Irrigator
Range of dry matter	up to 12%	up to 12%	up to 8%	up to 3%
Requires separation or chopping	No	No (centrifugal) Yes (PD pump)	No (centrifugal) Yes (PD pump)	Yes
Work rate	→ → →	→ →	→ → → → →	→ → (depends on field size/shape)
Accuracy of application rate	✓	✓ ✓ (centrifugal) ✓ ✓ ✓ (PD pump)	✓ ✓ (centrifugal) ✓ ✓ ✓ (PD pump)	✓ ✓
Soil compaction				
Capital costs	£	£ (centrifugal) £ £ (PD pump)	£ £ £	£ £
Labour requirement per m <sup>3</sup>				
Comments	Versatile – can be used for most slurry transport jobs	Generally better spreading precision than vacuum tankers. More maintenance required for PD pumps	Possible crop damage as hose drags across ground, hose damage and wear can be a problem on abrasive or flinty ground	Suitable for semi-automatic operation, but anti-pollution safeguards needed (e.g. pressure + flow switches)

Note: PD = positive displacement



There are four main types of slurry distribution systems. (See **Table 2.**) Each can be fitted onto a vacuum tanker, pumped tanker or used with an umbilical system. Self-travelling irrigators cannot be used with injectors.

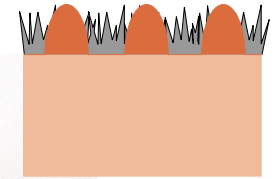
- **Broadcast spreader** (splash plate or nozzles) – the slurry is forced under pressure through a nozzle, often onto an inclined plate to increase the sideways spread (see **Figure 1**).

Figure 1 Vacuum tanker fitted with splash plate



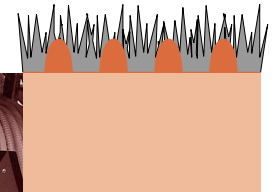
- **Band spreader** – the boom of the spreader has a number of hoses connected to it, distributing the slurry close to the ground in strips or bands. It is fed with slurry from a single pipe, thus relying on the pressure at each of the hose outlets to provide even distribution. Advanced systems use rotary distributors to proportion the slurry evenly to each outlet (see **Figure 2**).
- **Trailing shoe spreader** – this is a similar configuration to the bandspreader with a shoe added to each hose allowing the slurry to be deposited under the crop canopy onto the soil (see **Figure 3**).
- **Injector** – slurry is injected under the soil surface. There are various types of injector but each fits into one of two categories: either open slot shallow injection, up to 50 mm deep; or deep injection over 150 mm deep (see **Figure 4**).

Figure 2 Band spreader fitted with rotary distributor to improve lateral distribution



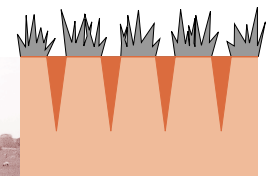
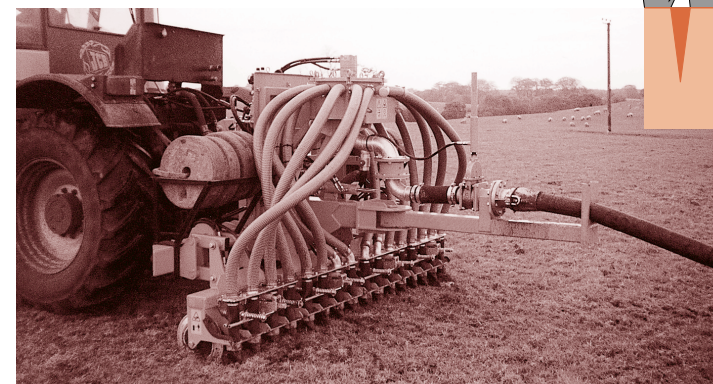
Slurry is placed in narrow bands

Figure 3 Trailing shoe spreader



Slurry is placed under the crop canopy

Figure 4 Open slot shallow injector



Slurry is placed in shallow open slots

Table 2 Slurry distribution systems

	Broadcast spreader	Band spreader	Trailing shoe	Shallow injector	Deep injector
Typical range of dry matter	up to 12%	up to 9%	up to 6%	up to 6%	up to 6%
Requires separation or chopping	No	up to 6% No over 6% Yes	Yes	Yes	Yes
Relative work rate	→ → → →	→ → →	→ → →	→ →	→
Uniformity across spread width	✓	✓ (simple) ✓ ✓ ✓ (advanced)	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Ease of bout matching	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Crop damage					
Relative level of odours and ammonia emissions					
Capital costs	£	££	£££	££££	£££££

auger or other mechanism fitted in the base of the spreader and a sliding gate controls the flow rate of the material onto the rotor (see Figure 7).

Table 3 compares the relative performance of the three types of solid manure spreader.

Table 3 Solid manure spreaders

	'Rotaspreader' or open side discharge spreader	Rear discharge spreader	'Dual purpose spreader' or side impeller discharge spreader
Suitable for slurry	No <sup>(a)</sup>	No <sup>(a)</sup>	Yes
Work rate	→ →	→ → →	→ → →
Accuracy of discharge rate	✓	✓ ✓ ✓	✓ ✓
Lateral precision	✓	✓ ✓ ✓	✓ ✓
Ease of bout matching	✓	✓ ✓ ✓	✓ ✓
Soil compaction			
Relative costs	£	££	£££

## Solid manure: selecting the right spreader

Three main types of solid manure spreaders are commonly used.

- **'Rotaspreader'** – a side discharge spreader which features a cylindrical body and a pto-driven shaft fitted with flails running along the centre of the cylinder. As the rotor spins, the flails throw the solid manure out to the side (see Figure 5).
- **Rear discharge spreader** – a trailer body fitted with a moving floor or other mechanism which delivers solid manure to the rear of the spreader. The spreading mechanism can have either vertical or horizontal beaters, plus in some cases spinning discs (see Figure 6).
- **'Dual purpose spreader'** – a side discharge spreader with an open top V-shaped body capable of handling both slurry and solid manure. A fast spinning impeller or rotor, usually at the front of the spreader, throws the material from the side of the machine. The rotor is fed with material by an

### Notes

(a) Some of these machines can be fitted with slurry guards or gates but they are usually purchased for spreading solid manure.