

## Alternative Slurry Spreading Systems

by

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### Nutrient losses from slurry spreading

In Northern Ireland most slurry is land spread by the splash plate method. This method of application can result in up to 80% of the available Nitrogen (N) applied in the slurry being lost to the atmosphere in the form of ammonia. Not only does this result in a loss of this valuable nutrient but it also causes atmospheric pollution. Following surface spreading, approximately 30% of the total ammonia loss takes place in the first hour and the 80% above within the first 12 hours. A basic concept to minimise such losses is to reduce the surface area of the spread slurry that is exposed to the air.

### Grassland slurry spreading systems

Systems of slurry spreading that minimise the surface area of the spread slurry exposed to air and lower ammonia loss are widely used across Europe. These alternatives include:

- Band spreading;
- Trailing-shoe application;
- Injection (shallow and deep).

Deep injection (150 mm; 6 inches) is limited by soil texture, soil moisture, stone content and slope. Therefore, in Northern Ireland deep injection is only suitable for a relatively small area. Research at Hillsborough has shown that injection of slurry into shallow channels is likely to be suitable for more land than deep injection and has potential to improve efficiency of nitrogen use from slurry. Band spreading of slurry reduces the surface area of slurry exposed to the air. In addition, the machinery used for band spreading can achieve a more uniform spread pattern and less contamination of herbage by slurry solids. A development of band spreading is the trailing-shoe application system in which a metal shoe parts the herbage and slurry is deposited in bands on the soil surface, with the minimum of herbage contamination.

## Benefits of alternative slurry spreading systems

In Germany, research has shown that application of slurry by trailing-shoe leads to lower ammonia losses, better N use efficiency and higher crop yields than either splash plate or band spreading. In Holland, slurry applications by trailing-shoe, shallow injection and deep injection have resulted in 69%, 86% and 99% less ammonia emissions respectively than splash plate spreading.

Recent research at AFBI-Hillsborough has compared slurry application by splash plate, trailing-shoe and band spreading methods in May after the first silage harvest. Slurry was applied 9, 17 and 23 days following the first silage harvest. Average application rate was 50 m<sup>3</sup>/ha. Compared with the conventional splash plate method, the band spreading and trailing-shoe methods increased grass yield by 19 and 21% respectively averaged over the three spreading periods (Table 1). The increased yields obtained with the band spreading and trailing-shoe methods were equivalent to applying inorganic fertiliser N at, on average, 79 kg/ha compared with 18 kg/ha when slurry was applied with the splash plate. In addition, the ability to apply slurry up to 23 days after silage harvest is a major advantage (see below).

**Table 1. Effects of slurry applications after first harvest on 12 May on grass yields (t DM/ha) at second harvest.**

Time of application			Method of Application (Grass yield (t DM/ha))				
Slurry application date	Harvest date	Days between application and harvest	No slurry	Splash plate	Band spread	Trailing-shoe	Slurry average
21 May	27 June	37	4.26	4.88	5.09	5.63	5.20
29 May	2 July	34	3.87	4.60	5.70	5.47	5.26
4 June	3 July	29	4.04	4.06	5.33	5.30	4.90
<b>Average</b>			<b>4.06</b>	<b>4.51</b>	<b>5.37</b>	<b>5.47</b>	

## Grass contamination from slurry

There have been some suggestions that the application of slurry to grassland can lower silage quality. There is no research evidence to suggest that application of cattle slurry by either splash plate or band spreader at moderate rates makes grass more difficult to preserve as silage due to poor fermentation. However, heavy slurry contamination of grass leaves, at the time of harvest, may affect fermentation and the intake potential of the silage. In recent research at Hillsborough, observations at the time of harvest indicated less contamination of herbage when slurry was spread by trailing-shoe rather than by splash plate. Similarly, research in England has shown that slurry can be applied six weeks before a silage harvest by the trailing-shoe method with no contamination of the herbage or adverse effects on silage quality.

## Practicalities of alternative slurry spreading systems

Any system that involves pumping slurry through relatively small-bore pipes will be prone to blockage. Therefore with band spreading, trailing-shoe and injection equipment it is necessary to remove any solids that might cause blockage. This can be achieved by mechanical separation of slurry through a slurry separator or by chopping the slurry at the point of fill and/or point of discharge with a macerator. Developments in macerator technology have led to reliable systems that seldom block. Many macerators at the point of discharge include means for separating out foreign bodies, such as stones, as well as chopping and evenly distributing the slurry. In order to ensure even distribution most tankers are fitted with equal length hoses. Table 2 summarises the relative features of different spreading systems.

**Table 2. Features of alternative slurry spreading systems.**

	Splash plate	Band spreader with macerator	Trailing shoe with macerator	Shallow injector with macerator	Deep injector with macerator
Requires mechanical separation or macerator	No	Yes	Yes	Yes	Yes
Work rate	* * * *	* * *	* * *	* *	*
Even spreading	No	Yes	Yes	Yes	Yes
Ammonia loss	* * * *	* * *	* *	* *	*
Purchase cost	£	£ £	£ £ £	£ £ £	£ £ £ £

Source: Chambers 2001

Positive displacement pumps are common on slurry tankers in Europe. Since flow rates of slurry through positive displacement pumps are proportional to pump speed, this type of pump offers a means for controlling application rate. More recently, flow rate control systems have been fitted to vacuum tankers that allow constant and consistent application rates.

**Work rates of alternative slurry spreading systems**

Spreading widths for band spreaders can be between 6m (20ft) and 27m (88 ft). To ensure practical transport widths the booms are designed to fold manually or hydraulically. Cut off of slurry flow to the hoses is typically by boom inversion or by pinching the hoses. Work rates in the field at the wider widths should be similar to splash plate spreading, provided pump capacity is sufficient. Spreading widths for trailing-shoe spreaders are typically 3-9m. Work rates in fields for trailing-shoe spreaders are lower than with splash plate tankers. However, since the most time consuming aspect of slurry spreading is likely to be transport to and from fields, a slower work rate in the field will not result in a proportionally slower overall work rate. For example, information presented in Table 3 indicates that a 50% increase in spreading time in the field for a tractor and tanker traveling 1km (0.6 miles) each way to and from a field at 18kph (11mph), results in only a 9% decrease in the volume of slurry spread over eight hours.

**Table 3. Slurry tanker loads per eight hours at two different work rates in the field.**

	Travel time to field from slurry store	Time to spread slurry in field	Travel time to slurry store from field	Time to fill tanker at slurry store	Efficiency	Tanker loads per 8 hours
A	4 minutes	<b>4 minutes</b>	4 minutes	4 minutes	80%	<b>24</b>
B	4 minutes	<b>6 minutes</b>	4 minutes	4 minutes	80%	<b>22</b>
Difference A-B	0	<b>+50%</b>	0	0	0	<b>-9%</b>

Source: Derived from Lenehan 2004

Shallow injector spreading widths are typically 3 - 9m. The comments above on maceration, even distribution and work rates apply to shallow channel injection.

## Window of opportunity for spreading

Research in England and at Hillsborough has shown that it is possible to spread slurry with a trailing-shoe system much later after silage harvest than is feasible with a splash plate. The AFBI work indicated yield benefits from spreading up to 3 weeks after the first grass harvest (see Table 1 above). Whilst the shallow channel injector gives similar possibilities, dry weather after spreading could result in significant sward damage through damage to grass roots resulting in sward die-back.

## Financial benefits of alternative slurry spreading systems

Based on N fertiliser at a cost of £160 per tonne for 27% Calcium Ammonium Nitrate (CAN, 27-0-0), the slurry plot trials outlined in Table 1 above indicate the value of the nitrogen gained by applying slurry with a trailing-shoe to be £36 per hectare more than if the same slurry was applied with a splash plate.

Table 4 below summarises the potential savings in chemical fertiliser costs following application of average cattle slurry (6% dry matter) at an application rate of 50 m<sup>3</sup>/ha. Using trailing-shoe application systems rather than splash plate spreading, the chemical fertiliser required to supplement the available N from slurry for second cut silage could be reduced by 27 kg per hectare. This represents a saving in fertiliser costs of £16/ha.

**Table 4. Savings in chemical fertiliser costs from using trailing-shoe slurry application systems.**

<b>Slurry Application System</b>	<b>Splash Plate</b>	<b>Trailing-Shoe</b>
Slurry volume m <sup>3</sup> /ha (gallons/acre)	50 (4500)	50 (4500)
Available N from Slurry (kg N/ha)	30	57
N from Bagged Fertiliser (kg N/ha)	70	43
Total N Available (kg N/ha)	100	100
<b>Savings in fertiliser cost (£/ha)</b>	-	<b>£16 (£6.50/acre)</b>

The net savings from using alternative slurry spreading systems will depend on the additional charges (if any) made by contractors for the use of such equipment. Where a farmer is using his own machinery, the extra operating costs will depend on the specification of the machinery purchased.

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## Conclusions

Slurry is a valuable source of nutrients. Recent research at AFBI-Hillsborough highlights important opportunities to recover more of the nutrients present in livestock slurry. Furthermore, new methods of application can increase the flexibility of slurry management by permitting a longer period of application after a silage harvest. Although these new methods can be more costly, they provide important opportunities to minimize environmental pollution and improve availability of nutrients from slurry for plant uptake.