Ecosystem Health and Sustainable Agriculture

Sustainable Agriculture

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Solid manure can be spread in spring or in autumn. In the Baltic countries and Scandinavia, application (spreading) of solid manure in spring is currently a problematic issue. Manure spreading is not allowed on land that is frozen or snow-covered. As in spring soil properties are altering swiftly and the optimum sowing time is short, the period for proper spreading and incorporation of solid manure into the soil remains too short. One possibility for using solid manure in spring is its application and incorporation into newly established grasslands.

Solid manure is widely used for fertilising fallows. During the period of fallow cultivation the average diurnal air temperature is still relatively high, therefore manure should be incorporated rapidly in order to reduce nutrient losses, especially those of ammonia.

It is most appropriate to use solid manure in autumn. Nutrient losses are minimal when solid manure is incorporated as late as possible before autumn ploughing but before November 1st (Figure 16.1) (Jakobsson and Lindén, 1991; Claesson and Steineck, 1996).

The importance of liquid manure/slurry in manure management is continuously increasing. Compared with solid manure, there are more possibilities for using it. Depending on technology, it is possible to spread liquid manure in spring and autumn before ploughing the soil, or on already growing plants (max. height of plants 25-30 cm).

In order to get precise results of fertilisation, manure must be analysed for its content of essential nutrients before application to land. The samples of liquid manure should be taken from homogenised (stirred) manure as the nutrient content of unstirred liquid manure in different layers varies in a wide range.

Before application, liquid manure must be homogenised (stirred). Stirring of stored manure with a small amount of sediment should begin at least four hours before the start of application. The thicker the sediments, the longer the period of stirring needed.

**Solid Manure Application Systems**

The dry matter content of manure applied with a solid manure spreading device should be at least 15%. A common disadvantage of different solid manure spreaders is
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their relatively low capacity due to quite narrow spreading width. Accurate dosing of solid manure is difficult due to its uneven consistency. Three main types of solid manure spreaders are commonly used:

a) Rotaspreaders (Figure 16.2). A rotaspread is a side-discharge spreader which features a cylindrical body and a power take-off-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.

b) Rear discharge spreaders (Figure 16.3). The spreader has 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 two or four either vertical or horizontal beaters. The modern spreaders of this type which allow exact dosing have spinning discs as well.

c) Dual purpose spreaders (Figure 16.4). Such spreaders are capable of handling both liquid manure and solid manure. The spreader is a side discharge machine with a V-shaped body. A fast-spinning rotor throws manure from the side of the machine. The rotor is fed with manure by a special mechanism (an auger etc.).

Liquid Manure Application Systems

The advantages of liquid manure application are high capacity (spreading width can be 8-24 m, depending on the machine), less intensive trafficking of soil, especially if tramlines are established in the field, and precision dosing. Disadvantages are the higher transportation cost and intensive odour and ammonia emissions (Table 16.1).

The main types of liquid manure application systems:

a) Broadcast spreaders (Figure 16.5). These combine a tractor and a tanker with a liquid manure spreading device at the rear. The liquid manure is forced under pressure through a discharge nozzle, onto an inclined splash plate to increase the sideways spread.
Broadcast spreading of manure has a number of disadvantages:
- High nitrogen loss due to ammonia emissions.
- High odour emissions.
- Uneven spreading, inconvenient dosing.
- Problems in application to growing plants, especially grasslands – it is not possible to prepare a high quality silage (hay) from plants polluted with manure, and the intake of such herbage is reduced in grazing or as a green fodder.

There is a specific type of broadcasting system for liquid manure with very low dry matter content (dilute) – a hose-reel irrigator with ‘raingun’ (Figure 16.6). The area to be irrigated or fertilised must be located near the manure storage (maximum distance 300 m). Liquid manure of sufficiently low dry matter content is usually stored in large lagoons open to rainfall or in tanks into which the cleaning water from barn equipment and facilities and rainfall collected from the farmyard are directed.

b) Band or trailing hose spreaders (Figure 16.7). Band spreaders consist of a liquid manure tank and hose system, a series of hanging or trailing pipes attached to a boom. The width of a band spreader is typically 12 m, with about 30 cm between bands. Band spreaders discharge liquid manure just above ground level and rapid contact with the soil significantly reduces ammonia emissions. The technique is applicable to grass and arable land (growing crops). Band spreaders are less suitable for fertilising grasslands intended for silage making or grazing, as contamination of grass by liquid manure may occur. Because of the width of the machine, the technique is not suitable for small, irregularly shaped fields or steeply sloping land.

c) Trailing shoe spreaders (Figure 16.8). This is a similar configuration to the band spreader with or without a shoe added to each hose allowing the liquid manure to be deposited directly into the soil surface, reducing the pollution risk of the vegetative parts of plants. The technique is applicable to grass and arable land (growing crops). The standard width of a trailing shoe spreader is 7 to 8 m. The technique is not suitable for small, irregularly shaped fields or steeply sloping land. Stones on the soil surface should be avoided.
d) *Open slot injectors* (Figure 16.9). The system injects liquid manure into the soil at a depth of 50 to 150 mm. Special knives and disc coulters are used to cut vertical slots in the soil. The spacing between the slots is typically 20 to 40 cm, with a working width of 6 m. The application rate must be adjusted so that excessive amounts of liquid manure do not spill out of the open slots onto the soil surface. The injectors are mainly used for fertilising pasture and grassland (growing plants). With proper dosing the plants are not polluted with manure. Ammonia emission is not high. The technique is not applicable on very stony soil or on very shallow or compacted soils, where it is impossible to achieve uniform penetration of the knives or disc coulters to the required working depth. Injectors have a larger need of tractive power and at the same time have a smaller working width.

![Figure 16.9. Open-slot shallow injector. Photo IPPC.](image)

d) *Closed slot injectors*. This system injects liquid manure into the soil at a depth of 50 to 200 mm. Liquid manure is covered after injection by closing the slots with press wheels or rollers fitted behind the injection tines. Tine spacing is typically 25 to 50 cm. Closed slot injectors are the most environmentally friendly liquid manure spreading devices as ammonia and odour emission is minimal. The use of deep injection increases the risk of nitrate leaching, while crop productivity may decrease because of mechanical damage to underground parts of herbage grasses. The use of deep injection is restricted mainly by the soil conditions. It is not applicable on soils with high clay and stone content. The injectors need a high draught force, requiring a large tractor and higher fuel consumption.
Chapter 13


Chapter 14


Chapter 15
