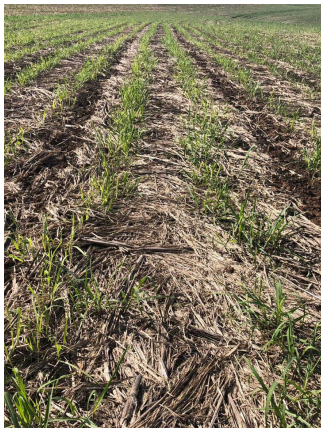
Information Sheet

7.18 Organic amendments - Manures

Manures from animal excrement contain high amounts of organic material and varying amounts of nutrients and moisture. A large proportion of the nutrients supplied to farm animals is excreted in their manure. Where these types of products are available, they should be used to offset the nutrient requirements of the sugarcane crop, as well as to supply organic matter to the soil. The most commonly available manures include chicken (poultry litter) and kraal manures from cattle, but may also include manures from goats, sheep, horses and slurries from piggery and dairy. In some cases, manures may be composted with other organic materials, providing a high-quality organic amendment for soils.

However, for the optimal benefit of applying manure, it is important to consider how it will be used in your nutrient management programme (See Information Sheet 7.1: Designing a nutrient management programme). It is important to know what it is composed of and the moisture content so that the right amounts can be applied, while knowledge of the form of the nutrients will improve practices related to placement and timing of applications. This information sheet considers key aspects of the composition and beneficial use of the main types of manure.

Benefits of applying manures

- Supply nutrients and can reduce fertiliser costs.
- Add organic matter to the soil, which improves soil biological functions.
- Improve aeration, thus drainage and infiltration.
- Improves water retention properties of soils.
- Some manures have liming properties.

Disadvantages and risks of manure application

- Some products can be bulky and wet thus difficult to store and handle.
- Composition may vary affecting application rates.
- Raw products may have odour and pathogens.
- Excessive use can lead to over-supply of nutrients.
- Excessive applications and the slower release of N can lead to delays in ripening and lower sucrose and promote eldana infestation.

Types of manures

Farmyard manures are broadly divided into chicken litter manure and kraal manure (from cattle holding/feeding areas). Others include manures from other livestock (goats, horses), or slurries from cleaning of piggery and dairy operations. In some instances, manures are composted or blended and composted along with organic materials.

Chicken litters and manures

Also called poultry, battery, or fowl manure, is sourced from the production of chickens and eggs. Chicken litter is sourced from broiler houses, where the bedding material (usually sawdust, called litter) is mixed with chicken excrement. This litter absorbs the droppings, remaining reasonably dry with minimal loss of nutrients through fermentation, and is thus relatively easy to handle. Battery manure is collected from egg production from beneath the egg laying cages (usually without mixing with sawdust). This material tends to be wet and lumpy and prone to making handling more difficult. It is also prone to anaerobic fermentation leading to loss of nitrogen.

Kraal/Feedlot manures

These are sourced from cattle holding or feeding areas (kraals, pens) and is a mix of cattle manure, urine, bedding materials, feed and sometimes soil material where the floor is exposed. Kraal manure can vary in composition depending on the animal diet and bedding materials used.

Composted manures

Composting of manures (often with other organic materials) can create a more uniform and stable organic product. Composting is a controlled process that breaks down the unstable organic matter in the material into more stable organic forms. This process tends to reduce the odour of the material and reduces pathogens and weed seeds. The compost also tends to have a lower rate of nutrient release than raw manures (acts as a slow-release fertiliser).

Other manures

In some cases, manures from pig, goats, sheep and horses are available. While the composition will vary depending on animal type, feed and bedding, their management tends to be similar to that of other chicken and kraal manures. Where manures have been collected from washed areas, then slurries (liquid manure) are generated (most often piggery and dairy manure). These are usually collected into holding ponds or tanks and can be sprayed onto fields after mixing. Transporting of slurries in tankers is often not economically feasible due to high moisture content and low nutrient levels.

Nutrient content

The nutrient levels vary depending on the nutrition of animals and what other materials were mixed with the animal waste (such as sawdust). Furthermore, if the material is stored for long periods, or blended with other organic products and composted, the nutritional profile will also change. Sources of manures must be regularly tested to ensure optimal nutrition management. The table below provides average values for some common manures.

Product	Typical Composition (%)						
	N	P	K	Ca	Mg	C:N	Moisture
Chicken manure	2.5 (25)	1.5 (15)	1.6 (16)	6 (60)	0.9 (9)	6:1-15:1	±40%
Chicken litter	3.3 (33)	1.6 (16)	1.8 (18)	3 (30)	0.7 (7)	10:1-14:1	±20%
Farmyard or kraal manure	2.4 (24)	0.9 (9)	1.5 (15)	1.2 (12)	0.8 (8)	17:1	fresh ±35% dry ±15%
Composted manures	0.7 (7)	0.1 (1)	0.6 (6)	0.6 (6)	0.2 (2)	15:1 to 20:1	±55%

*Values in brackets indicate amount (kg) of nutrient per ton of material.

As a general rule, about 50 - 60% of the nitrogen (N) and 45% of the phosphorus (P) is considered available during the first year after application for chicken litter and kraal manures, though exact amounts will vary depending on the nature of the product, the soil properties, the method of application and incorporation and prevailing temperature and moisture conditions. In the case of chicken manure, the values are higher at about 80 and 65 % for N and P respectively. In the case of composted manures, due to the stabilising effect of composting on organic matter and nutrient release, nutrient availability tends to decrease in the short term, though acting as a slow-release supply over the longer term. The availability of potassium (K) is usually high for all these products. When adjusting nutrient requirements for organic amendments, it is typical to use an availability factor of 50 to 60% in the year of application, while for most conditions the residual effects are expected to decline within three years of application. Thus, depending on the application rate in the first year, there is potential to reduce application rates in the following years to prevent over supply of nutrients. Periodic soil and leaf testing are essential to verify adequate supply and to compensate for lower or greater release of nutrient from prior applications.

The form of N in most manures is derived from urine and thus in the form of urea (or ammonium). As with urea fertilisers, this form of N is prone to volatilisation losses (gaseous losses). This is a particular problem for chicken litter and manure.

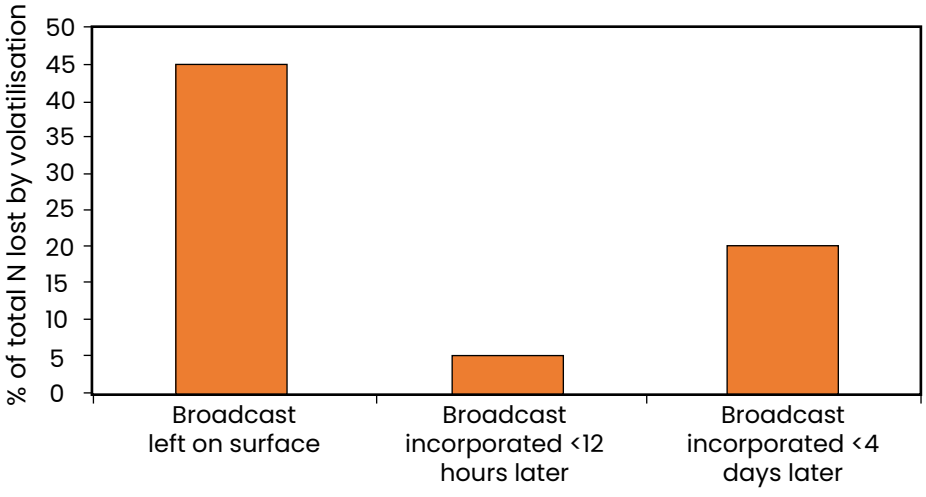
Chicken manure also often has high calcium (Ca) levels and high pH, this derived from lime materials used in the feed rations. This can provide considerable amount of Ca to soils and have a liming effect in acidic soils. Manures usually also contain adequate supplies of micronutrients depending on the source and are thus a useful supply to the sugarcane crop. While deficiencies are unlikely, where these products are used, periodic soil and leaf tests can be used to check that thresholds are met, and no imbalances are being caused.

The carbon: nitrogen ratio (C:N ratio) is an indicator of how readily available the N will be from decomposition of organic matter. High C:N ratios >20 mean the N is not readily available and will be released slowly and may result in short term N immobilisation. C:N ratios of 12 - 15 are considered ideal and are typical of many soils. Very low ratios (<10) suggest high availability of N, thus practices to minimise leaching and gaseous losses or reduce excessive crop uptake must be used.

Application of manures

Typically, 2 to 8 (and up to 12) tons of manure can be applied per hectare to the planting furrow, which will provide adequate amounts of N and P on most soils, but K may be inadequate. Care should also be taken to cover manure with soil before planting seedcane because of its high N content, which may 'burn' the buds if placed in direct contact with the manure.

Where the manure is broadcast and incorporated before planting, then about twice the in-furrow rate will be required (with some applications as high as 30 t/ha). Due to the risk of high N losses from surface applied manures, especially from chicken manures, it is advisable to bury or incorporate the manure as soon as possible after application (see figure for example of N lost from poultry manure using different application methods).



Apply caution to prevent over-use

Excessive application rates (>20 ton/ha) should be avoided (or undertaken with caution) to ensure that nutrients are not over applied. Sucrose content may be negatively affected at high application rates of manures. This is because of its high N content and the fact that N is released gradually, which may delay the ripening of cane. When using manures, the rate of applied inorganic fertiliser N must be reduced in category 1 and 2 soils, which have a low to medium N mineralising potential. In category 3 and 4 soils, which mineralise substantial amounts of N, particularly in the Midlands, additional N fertiliser will seldom be required. It has also been reported that delayed N release from excessive application of manures can trigger eldana infestations, thus, ensuring balanced nutrition is important (in particular K nutrition) to minimise such negative impacts. High and long-term repeated application of manures can also lead to excessive build-up of P in many soils. Excessive P can reduce tillering and lead to lock up of micronutrients in the soil, while also presenting a pollution risk to waterbodies.

Sampling manures for analysis

Due to the variable nutrient content of manures, it may be necessary to balance the crop nutrient requirement with inorganic fertilisers. For this reason, it is strongly recommended that representative samples be analysed to allow for adjustments to rates and top-up fertilisers.

Where the material has been piled or stored in large heaps or windrows, the following sampling procedure is advised:

- As there can be high variation in the piled or heaped material, it is preferred that the piles/heaps be thoroughly mixed before sampling.
- Several samples from different sampling locations and depths in the heaps must be collected.
- Collect the sample as close to the time of field application for accurate results of composition.
- Samples can be collected using a spade or auger. Avoid galvanised sampling instruments as these can introduce zinc into the sample.
- Avoid collecting samples too close to the soil surface where the heap is located as soil can be introduced into the sample. Even a small amount of soil can provide anomalous results.
- Subsamples (20 – 30) can be placed and thoroughly mixed in a bucket before subsampling (about 500 grams) for analysis.
- Break-up large chunks/aggregates into finer pieces before mixing.
- Place subsamples for analysis in a heavy-duty/thick-walled plastic-bag, squeezing all air from the bag before sealing tightly.
- Label the sample with relevant information required by the laboratory to ensure proper identification of the sample.
- If the sample cannot be sent for analysis immediately, then store in a cool dark place (ideally in the fridge or cooler box with ice).

Where the material is spread-out across a large area (e.g. kraal floor, chicken house floor) it is preferable to collect the material into a large well-mixed pile or heap before following the above sampling procedure. Where this is not possible, then collect 20 – 30 subsamples in a zigzag pattern from the area and composite into a single sample for subsampling. Special care must be taken not to scrape soil or floor material when collecting the subsamples.

If sampling from bags, then subsample each bag and thoroughly mix to create a single composite sample. Subsample about 500 grams for submission.

Louis Titshall (Senior Soil Scientist)

June 2021