Using chicken litter to fertilise pastures

Raw chicken litter can be a valuable resource to optimise pasture production. It is mostly organic matter and supplies nutrients, helps hold moisture, improves soil structure and encourages organisms such as earthworms. Chicken litter application has been shown to double grass yield compared to unfertilised pasture.

Chicken litter can be used to fertilise all types of pasture and forage crops where high levels of production are required.

When using chicken litter as a fertiliser, it is essential to apply appropriate management techniques to maximise the benefits and minimise the risk of environmental contamination. This can be achieved by:

- balancing nutrient application with pasture requirements
- employing management strategies to reduce potential risks to cattle and human health, and the environment.

Analysis of chicken litter

Bulk chicken litter is a mixture of manure, bedding material and water, the proportion of each depending on shed management (e.g. bedding type and single or multi-batch litter).

Chicken litter contains the following components:

- The major nutrients nitrogen (N), phosphorus (P) and potassium (K) in mineral and organic forms:
    - the mineral proportions of the N, P and K are immediately available to plants
    - the organic remainder reacts in the soil to change into a form that is available for plant use
    - chicken litter generally supplies too much P compared to N and K so application needs to be managed to prevent excess P building up in soils.
- Trace elements include copper, zinc, manganese, boron and chloride:
    - the availability of these elements is affected by soil pH and texture, with sandy soils having less nutrient build-up than fine-textured soils.
- Organic matter, which improves soil structure and water holding capacity.

The only reliable way to determine litter quality is with a full analysis. A typical analysis is shown in Table 1.

Table 1. Chicken litter analysis

Element	Average	Range
pH	8.1	6.0-8.8
Electrical conductivity* (dS/m)	6.8	2.0-9.8
Dry Matter (DM) %	75	40-90
Nitrogen (N) % of DM	2.6	1.4-8.4
Phosphorus (P) % of DM	1.8	1.2-2.8
Potassium (K) % of DM	1.0	0.9-2.0
Sulphur (S) % of DM	0.6	0.45-0.75
Calcium (Ca) % of DM	2.5	1.7-3.7
Magnesium (Mg) % of DM	0.5	0.35-0.8
Sodium (Na) % of DM	0.3	0.25-0.45
Carbon (C) % of DM	36	28-40

*Electrical conductivity is a measure of salinity measured as a 1:5 suspension.
Salinity is an indicator of total salt in soil including Ca, Mg, K and Na salts.

Key points to consider in analysis

pH

- Litter is normally alkaline (pH about 8) due mostly to ammonia
- Repeated application of chicken litter will maintain or slightly increase soil pH, but to a lesser extent than applying lime

Nitrogen (N)

- Most is available for plant uptake soon after spreading
- Approximately 25% will be lost to the atmosphere unless cultivated or washed into the soil by rain or irrigation within 30 hours of spreading
- Losses to the atmosphere can be reduced by applying chicken litter in cooler times of the day or year and under damp soil conditions
- Most of the remaining N acts similarly to urea fertiliser

Phosphorus (P)

- Approximately 13% is water-soluble, which means it is immediately available for plant use
- The remainder is slowly released as organic fractions of the litter decompose, usually within a year of application
- Leaching is not normally a problem with P because most soils bind P
- When application of chicken litter is based on N needs of the pasture, it leads to over-application of P due to the generally lower N:P ratio of chicken litter compared to most pasture requirements
- Reducing the P content of chicken feed can remove a significant amount of the P that would otherwise end up in the litter
- Chemical treatment of chicken litter to bind P may be useful, however this treatment affects availability of nutrients and is not yet cost-effective

Potassium (K)

- Potassium is readily available to plants
- Some may be lost by leaching into the subsoil if excessive rain or irrigation occurs after spreading chicken litter

Application rate

Application of chicken litter to meet N forage requirements normally results in over-application of P. P binds to soil so with repeated excessive application it will build up to high levels. Therefore application rates should be determined by P requirements. Producers may need to alternate chicken litter with commercial N fertiliser to ensure balanced crop nutrition. Chicken litter is typically spread at a rate of approximately 15 m³ a hectare a year for the first 2 to 3 years after which:

- the soil should be tested to check nutrient levels, especially P
- alternate chicken litter with N or K fertiliser as necessary to avoid over-application of P.

Using the average analysis provided in Table 1, 15 m³ a hectare would supply:

- 160 kg N, equivalent to 350 kg urea
- 111 kg P, equivalent to 1260 kg superphosphate
- 62 kg K, equivalent to 125 kg muriate of potash.

Whether this is the correct amount of fertiliser in any given situation depends on soil type, pasture requirements and the amount of nutrient being removed by grazing, or hay and silage production.

In many situations it would be desirable to split the application of chicken litter into smaller amounts, possibly applied more frequently. The problems with this may be:

- many spreaders are not able to spread smaller amounts (e.g. 6 m³/ha) evenly and efficiently
- excessive expense if contractors are employed to spread the litter.

Observation, soil testing and a nutrient budget are required to determine the rate of chicken litter to apply for optimal production.

Nutrient budgeting

Chicken litter is normally applied where high levels of production are desired. Nutrient budgeting assesses nutrients utilised by pasture growth or for milk production. These nutrients are then replaced by appropriate fertilisation.

Table 2. Nutrients removed from the paddocks by various pastures or milk production

Nutrient	Lucerne kg/t DM*	White clover kg/t DM	Ryegrass kg/t DM	Kikuyu kg/t DM	Milk kg/10,000 L
Nitrogen (N)	40	40	32	24	50
Phosphorus (P)	3.5	3.5	3.5	3.5	9
Potassium (K)	25	24	20	27	14
Sulphur (S)	2.5	2.5	2.5	2.0	4
Calcium (Ca)	15	12.5	3.6	2.7	12
Magnesium (Mg)	3.0	3.0	2.4	3.0	1

*DM dry matter

Planning can then be done to replace these nutrients.

Soil testing

Carry out soil testing on paddocks every two to three years to check for nutrient deficiencies or excesses.

Tests should include: pH, electrical conductivity (salinity), P, sulphur, calcium, magnesium, K, sodium, aluminium and N (optional).

Take the sample nine months after the last application of chicken litter.

Application technique

Important points for applying chicken litter effectively:

- use a calibrated broadcasting spreader
- spread evenly onto a recently grazed or harvested pasture (5 cm to 10 cm long stubble) to help hold the litter in place and reduce washing away
- a shrouded cover attached to the back of the broadcast spreader will help reduce dust and ensure a more even application of litter across the paddock
- application should coincide with the main growing season of the pasture to maximise nutrient utilisation
- the litter requires rain or irrigation to wash it into the soil
- spreading may be followed by cultivation where possible to reduce odours and losses of N into the air.

Do not apply chicken litter:

- to steep land
- to waterlogged soil
- within 50 m of waterways allowing overland flow to reduce run-off volume and re-capture particulate contaminants in run-off
- during heavy rainfall periods to minimise contaminants in run-off
- on windy days to minimise inappropriate dispersal
- on weekends to minimise the risk of dust or odours annoying neighbours.

Pasture management

Chicken litter can be used to fertilise all types of pasture and forage crops. The best results are obtained from mixed pastures comprising grasses and legumes.

Legumes

- Lucerne and clover respond well to chicken litter
- Lucerne and clover will use N supplied by chicken litter or fix their own N requirement from the atmosphere
- Rotation of legume paddocks with a grass pasture or forage crop will prevent excess N being wasted and the risk of polluting groundwater by leaching of excess N
- K-deficiency may limit growth depending on levels of K in chicken litter and soil

Kikuyu

- Chicken litter is valuable but will provide excess P compared to the amount of N and K required
- N is normally the nutrient which limits kikuyu growth when temperature and moisture are right
- Chicken litter will supply some N but unless a vigorous legume such as white clover is also used in the pasture, kikuyu will require extra N fertiliser e.g. urea or ammonium nitrate, to grow to its potential
- Additional K is not usually required unless a legume is grown with kikuyu

Grazing management

Pastures fertilised with chicken litter should produce large amounts of high-quality forage.

Paddocks should not be grazed for at least three weeks after spreading raw chicken litter to:

- minimise pathogen survival on the pasture
- allow pasture regrowth in response to fertilisation
- reduce palatability problems due to litter components.

To optimise benefits, pastures should be grazed at a height of 15 to 20 cm and before there is any yellowing or death of shaded lower leaves. Rotational grazing is often required for best growth and use of intensive pastures. Compared with continuous stocking, rotational grazing is useful in:

- promoting more uniform forage accumulation, which improves filtering and trapping of nutrients
- decreasing contamination of surface run-off because of better manure distribution.

Summary

- Effective use of chicken litter requires:
- a three-week spelling period to:
- allow for pasture regrowth
- minimise pathogen survival

- minimise palatability problems for cattle.
- controlled applications to:
- meet crop requirements for optimal growth
- avoid excessive nutrients or contaminants building up in the pastures.
- implementing appropriate management techniques to:
- minimise run-off and leaching.

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