ENVIRO FACT SHEET

Composition and Value of Layer Manure

Manure from poultry layer systems can be a valuable plant nutrient resource for grazing and cropping systems. There are two main types of layer manure; manure from caged systems and litter from barn laid or free range systems. Generally, manure from caged systems has a higher nutrient content and less carbon than litter. However, both of these by-products usually have a higher nutrient content than other animal manures.

Layer manure supplies essential plant nutrients in a 'slow release' form, which can boost plant growth for a period of weeks after application. Sufficient manure for two or more seasons may be spread in one application as nutrients such as a phosphorus will be released over time.
Like other manure and litter by-products, layer manures are not a balanced nutrient source. They have a high ratio of phosphorus to nitrogen and for this reason they are best used primarily as a phosphorus source. It is important to carefully manage the reuse of manure, as over application and poor reuse practices can cause environmental harm. To read more about application rates, see the fact sheet in this series called *Layer Manure – Spreading Layer Manure*.

Composition

The composition of layer manure varies between different layer farms because of differences in diets fed and management systems (caged layers, barn laid or free range). Manure composition also depends on the length of time the manure has been stockpiled. Generally, the amount of carbon and nitrogen will decline as the stockpiling time is extended, while other conservative nutrients such as phosphorus are concentrated due to the loss of carbon and nitrogen.

Consequently, the nutrient profile of layer manure is variable, and the figures presented in *Table 1* are indicative only. A chemical analysis of the manure is needed to accurately determine the composition.

Table 1. Average composition of layer manure

Parameter	Units	Belt Average*	Spent Litter Average*	Composted manure, range and average.+
Moisture	%	58.9	20.8	20.5 – 43.6 (34.4)
pH – water		6.3	6.9	7.3 - 8.7 (8.3)
Electrical conductivity	dS/m	12.3	9.5	8.4 – 12.7 (11.5)
Organic carbon	%	37.8	32.3	20.2 – 35.6 (25.5)
Nitrogen	%	6.0	2.7	1.6 - 4.9 (3.5)
Ammonium nitrogen	mg/kg	6449	1941	485 – 7455 (3863)
Nitrate-N	mg/kg	<200	384	66.2 – 152.1 (136.3)
Phosphorus	%	2.3	1.6	1.6 - 1.8 (1.7)
Ortho-phosphorus	mg/kg	3224	2052	4526 – 4660 (4593)
Potassium	%	1.9	1.5	**

* Values derived from Wiedemann et al. (2008)
\+ Values derived from those reported in the *Egg Industry Environmental Guideline* (Edition II, McGahan et al., 2018)
** Not reported.

Environmental management

Layer manure is a valuable resource, but reuse needs to be managed in a sustainable way to overcome potential environmental threats, such as nutrient losses. For more information on determining the risk of nutrient losses refer to the *Egg Industry Environmental Guidelines* (Edition II, McGahan et al., 2018).

Metal and pathogen contaminants can be managed using a range of approaches. The first step is to determine the risk of metal contamination.

Table 2 shows the different elements that may be present at low concentrations in layer manure. Several of these elements are necessary for plant growth, but may become toxic to plants at high concentrations.

Table 2. Composition of layer manure – potential environmental contaminants (Wiedemann et al., 2008)

Contaminant	Layer Manure Concentration (mg/ kg), range and average.
Arsenic (As)	1–1 (1)
Copper (Cu)	31–82 (58)
Zinc (Zn)	280–540 (398)

Table 3 shows the recommended upper limits for several potential contaminants that may be found in layer manure. The maximum concentrations for arsenic, copper and zinc in layer manure are typically lower than the limits suggested by the Natural Resource Management Ministerial Council (NRMMC 2004).

Table 3. Limits for contaminants in compost, soil conditioners and mulches for agricultural land application (mg/kg) Sources: NRMMC (2004), NSW EPA (2000), VIC EPA (2004)

Contaminant	NMRCC	NSW EPA	VIC EPA
Arsenic (As)	60	20	60
Copper (Cu)	2500	2000	2000
Zinc (Zn)	2500	2500	2500

While the levels of contaminants in layer manure are generally well below the guideline upper limits, it is recommended that users of layer manure monitor soils to ensure elements do not build up to levels where toxicity becomes limiting to plant growth. If other metals are a concern, chemical analysis of the manure before use is advised.

Pathogens can also exist in layer manure and this may be a concern if applying manure directly to horticultural crops. Some pathogens potentially present in layer manure are *Campylobacter jejuni/coli, Clostridium perfringens, Clostridium botulinum, Enterococcus spp, Listeria monocytogenes, Salmonella spp*. Use of appropriate health and safety precautions will protect worker health. Refer to www.biosolids.com.au for more details on biosolids regulations in your state.

Calculating potential manure value

It is possible to roughly estimate of the value of layer manure by comparing the value of the macro nutrients (nitrogen, phosphorus and potassium) in the manure with the cost of commercial inorganic fertilisers (see *Table 4*). This provides a starting point for assessing the value of manure as a nutrient resource.

Table 4. Value of nutrients in layer manure (Belt system) compared to inorganic fertilisers

	Manure Analysis *(%dry basis)	kg / m3	Inorganic Fertiliser product ($/t ex GST)	Value of Layer Manure
Moisture content	58.9	501.6		
Nitrogen (N)	5.95	20.1	Urea (46% N) $420	$19.00
Phosphorus (P)	2.3	8.1	MAP (21% P) $660	$24.26
Potassium (K)	1.9	6.65	MOP (50% P) $595	$7.91
Calcium	11.3	39.55	Gypsum (23% Ca)	$8.60
Maximum value of N,P,K and Ca per m3				$59.79

$1m^3$ is assumed to contain 350kg of solids
*Values from Wiedemann et al. 2008

To do this, the kilograms of nutrient per cubic meter (the most common measurement) need to be calculated. These calculations are provided in the *Layer Manure – Spreading Layer Manure* fact sheet in this series. In addition to nitrogen, phosphorus and potassium (N, P, K), there are significant amounts of calcium, sulphur and trace elements in layer manure. Comparing the value of manure with lime as a source of calcium, layer manure may be valued at around $8.60/m3 if compared to agricultural lime at $50/t, though in practice the amount in manure is lower than typical application rates for lime.

The trace elements in layer manure include magnesium, manganese, iron, boron, copper and zinc. Where required, these trace elements are highly valuable and will increase the reuse value of layer manure.

How much is layer manure worth?

Typically, layer manure is sold for $10 – 15/m3 (1m3 = approx. 850kg with 59% moisture). This is considerably less than the value of the nitrogen, phosphorus and potassium in the manure. Also, manure has the added value of organic matter (approximately 30% of dry weight) which is beneficial to soil, improving soil structure and water holding capacity. However, there are also reasons why manure value will be lower than the maximum value of the nutrients, caused by difficulty in handling and application of manure compared to fertilisers.

Manure can be difficult to handle compared to conventional fertiliser, requiring specialised equipment and management. Manure also contains several nutrients that need to be balanced with plant requirements, which requires understanding of the attributes of the manure product as well as the fertiliser requirements of the crop being grown. Nutrients within the manure may not be in a form that is immediately available for plant growth, increasing the need for nutrient monitoring of soils and crops. These factors increase the management and handling requirements compared to conventional fertilisers.

Because of these factors, it may be reasonable to value manure at approximately 50% of the value of the N, P and K it contains. This would give a value of approximately $28/m3 at 2018 fertiliser values.

Getting maximum value from layer manure requires a good understanding of the product and the best ways to manage this product in a farming system. Several other fact sheets in this series have been produced to provide information on setting application rates and spreading. These fact sheets are designed to help producers to get the maximum value out of layer manure in farming systems.

References and Further Reading

Wiedemann, S., McGahan, E. and Burger, M. (2008) *Layer Hen Manure Analysis Report*. Australian Egg Corporation Limited.

McGahan, E., Wiedemann, S. G., & Gould, N. (2018) *Egg Industry Environmental Guidelines, Edition II*. Australia, Australian Eggs Limited.

NRMMC (2004) *Australian Guidelines for Sewerage Systems-Biosolids Management*, Australian Water Association, NSW, and the Natural Resource Management Ministerial Council.

NSW EPA (1997) *Environmental Guidelines for Use and Disposal of Biosolid Products*, Department of Environment and Conservation, Sydney and the New South Wales Environmental Protection Agency (NSW EPA).

VIC EPA (2004) *Guidelines for Environmental Management-*Biosolids Land Application. Southbank, VIC: Victorian Environmental Protection Agency (VIC EPA).