AUSTRALIAN Pork

Fact Sheet

FACT SHEET

March 2017

BENEFITS AND RISKS OF USING MANURES AS SOIL IMPROVERS

- This trial was conducted in Western Australia (WA) on sandy soils. Results may vary on different soil types
- There are a variety of manure types: some release nutrients more quickly (stockpiled, fresh) whilst others (composts, sludges) release them more slowly. Pelletized manure provide nutrients in a more compact and concentrated form, which means they are easier to handle, transport and apply (air-seeder)
- For most manures there is a minimal risk associated with their land application to semi-arid soils, however, care must be taken to avoid greenhouse gas (GHG) emissions and leaching
- The re-use of manures can improve crop performance through increased nutrient, carbon and moisture supply

Background

Piggery manure and its by-products (e.g. compost or pelletised manure) applied to land using sustainable practices can lead to enhanced crop performance, soil quality and soil biota (Figure 1) but if applied inappropriately they can potentially cause adverse environmental impacts such as, greenhouse gas emissions (GHG), leaching and pathogen survival. However, the true extent of their benefits and risks has not been fully quantified for reasons summarised in Figure 1.

Figure 1: Difficulties assessing benefits of manures

Image by Ian Waite

- Manure properties are highly variable
- Few scientific studies have been conducted in broadacre cropping
- The mechanisms involved in beneficial effects are not fully understood

Different manure types

A variety of manure types are produced under different housing systems. Solid manure and spent bedding material from animals housed in deep litter systems is either stockpiled or composted during storage. Alternatively, the manure could be pelletised or applied fresh to land without storage (shown in Figure 2).

Liquid manure produced from animals housed in conventional sheds is usually treated and stored in effluent ponds. By covering these ponds with impermeable plastic material and creating a covered anaerobic pond (CAP) digester, waste can be converted into biogas avoiding GHG and odour emissions (Figure 2).

Figure 2: Different types of manure by-products

Image by Ian Waite *Image by C-Wise*

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The choice of storage method will be dependent upon the scale of enterprise, installation cost and payback period, training requirement, transport and handling costs and new markets and opportunities (Table 1).

Table 1: Summarises the pros and cons of different types of manure by-products

Manure type	Pros	Cons
Fresh and stockpiled manure from deep litter housing or pond effluent and sludge from conventional sheds	• Low-cost, no additional processing or equipment requirements • Readily available nutrients • Adds structure and stability to sandy soils	• Transportation and handling costs • Equipment required to spead (broadcast) • Greater risk of leaching and greenhouse gas emissions • Pump required for sludge removal
Composted manure	• Stabilised product • Sanitised • Slow release nutrients • Adds structure and stability to sandy soils	• Transportation and handling costs • Equipment required to produce and spread • Expertise and experience required • Initial capital cost
Pelletised manure	• Reduced volume • Reduced transportation and handling costs • Applied with air-seeder	• Equipment required • Expertise and experience required • Initial capital cost

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What are the benefits?

Manure quality in terms of benefits and risks were assessed for different manure by-products in WA.

Manures quality was classified follows:

- Manures with properties falling in the **RED** zone are high risk and may need to be further treated prior to application
- Manures with properties falling in the **YELLOW** zone are moderate risk and need to be applied with caution
- Manures with properties falling in the **GREEN** zone are low risk and can be applied

Table 2: Summarises the benefits of the different manure by-products including dry matter (DM), Moisture content (MC) and total carbon (TC)

Manure type*	DM (%db)	MC (%)	TC (%db)	Nutrient supply	pH	Beneficial microbes	Yield (t ha^{-1})
Uncovered pond**	9.4	90.6	45.9	N, P, K, Mg, Ca	7.4	Low	N/A
Covered pond**	7.6	92.4	44.1	N, P, K, Mg, Ca	7.6	Low	N/A
Pond sludge	35.8	64.2	23.1	N, P, K, Mg, Ca, Zn, Mg, Fe	7.1	High	N/A
Separated solids	26.7	73.3	39.0	N, P, K, Mg, Ca, Mg	7.4	High	N/A
Fresh ecoshelter manure	44.7	55.3	38.9	N, P, K, Mg, Ca, Zn, Mg, Fe, Cu	8.4	Medium	N/A
Stockpiled manure (3 mths)	42.7	57.3	13.2	N, P, K, Mg, Ca, Zn, Mg, Fe, Cu	7.4	Medium	2.93 (0.38)
Stockpiled manure (12 mths)	29.0	71.0	36.8	N, P, K, Mg, Ca, Zn, Mg, Fe, Cu	6.4	Medium	3.35 (0.80)
Blending semi-compost	20.4	79.6	35.4	N, P, K, Mg, Ca, Mg, Fe, Cu	7.6	High	N/A
Windrow compost	61.3	38.7	30.3	N, P, K, Mg, Ca, Zn, Mg, Fe, Cu	6.0	High	N/A
Aerated floor compost	45.9	54.1	43.8	N, P, K, Mg, Ca, Zn, Mg, Fe, Cu	7.6	Medium	3.51 (0.96)
Pelletised compost	84.2	15.8	37.6	N, P, K, Mg, Ca, Zn, Mg, Fe, Cu	8.1	Medium	3.42 (0.87)

** For the WA experiment ** New ponds N/A = not available*

Majority of the manure by-products provide nutritive value (Table 2) and therefore could increase crop productivity when yield is constrained by macro or micro nutrient availability. In addition, manures with high organic matter content may help alleviate the poor soil structure leading to improved soil stability, nutrient retention and water holding capacity.

What are the risks?

Overall, the risk of contamination with heavy metals, pathogens or leachates is minimal for majority of the manures when applied to semi-arid soils of Western Australia (Table 3). Care must be taken when applying effluents, fresh or stockpiled manure to soils to avoid GHG emissions. To reduce this risk it recommended to avoid applying manure after rainfall events.

Table 3: Summarises the risks of the different manures where volatile solids (VS), Electrical conductivity (EC) or salinity, ammonium (NH_4^-) and phosphate (PO_4^-)

Manure type*	VS (%db)	EC (µS/cm)	NH_4^- (mg/L)	PO_4^- (%db)	Heavy metals (mg/L)	Pathogens	GHG potential
Uncovered pond effluent**	91.9	6.6	402.0	0.9	<0.05	Low	High
Covered pond effluent**	85.4	7.4	520.0	0.6	<0.05	Low	High
Pond sludge	31.2	1.8	102.5	1.4	<0.05	Low	Medium
Separated solids	85.9	3.6	213.0	1.9	<0.05	Medium	High
Fresh ecoshelter manure	82.3	10.4	676.3	0.5	<0.05	Medium	High
Stockpiled manure (3 mths)	78.2	1.2	486.0	0.5	<0.05	Low	Low
Stockpiled manure (12 mths)	72.3	8.1	306.0	0.5	<0.05	Medium	High
Blending semi-compost	78.3	4.6	704.0	0.7	<0.05	Low	Low
Windrow compost	36.3	2.0	112.2	0.2	<0.05	Low	Medium
Aerated floor compost	32.5	2.1	116.0	0.2	<0.05	Low	Medium
Pelletised compost	27.3	6.5	205.3	0.4	<0.05	Low	Low

** For the WA experiment ** New ponds N/A = not available*

Manures are most effective in broadacre agriculture when their application alleviates a yield constraint (e.g. high acidity) leading to improved crop growth and productivity. However, the mechanisms involved are not fully understood but several possibilities have been proposed (Table 4).

Table 4: Summarises the possible mechanisms of how manures, composts or pellets might alleviate different constraint on crop yield

Yield constraint	Possible mechanisms for manures, composts and pellets
Poor nutrient use efficiency	Supply significant amounts of nutrients Improve chemical and physical properties of soil Increase growth-promoting microorganisms
Low available water capacity	They are highly porous and therefore able to store water
Reduced water movement	Improved soil structure via increased soil aggregation and pore space
Compacted soils	Improved soil structure via increased soil aggregation and pore space
High soil sodicity	Improved soil structure via increased soil aggregation and pore space
High soil acidity	They have strong pH buffering capacity
Heat or drought stress	Improved soil resilience and biological activity

Summary

Manures have the potential to alleviate yield constraints by improving the soil's structure, buffering capacity and nutrient availability. It is essential to use manures that are tailored to crop nutrient requirements, machinery and operations to avoid undesirable effects. Adoption of manure application in broadacre cropping will increase profitability from improved productivity with decreased operational costs (fertiliser inputs, manure re-use).

Further reading

- Development of microbial indicators of soil quality to quantify the benefits and risks associated with applying piggery by-products to land. Final APL report 2010/1015.332 (Jenkins, 2014)
- Utilizing Spent litter as soil improvers. Final APL report 2010/1015.338 (Craddock, 2013)
- Genomic approaches for characterising and quantifying microbial communities to the benefit of the pig industry – an environmental perspective 2013 in Manipulating Pig Production XIV APSA Biennial Conference November 2013