Sustainable Recycled Organics Usage

ON-FARM FACTSHEET SERIES

Fact Sheet: M4.1 Updated: 14/2/2007

MANAGEMENT – Salt in recycled organic products

Recycled organic products contain salts, particularly sodium chloride, which needs to be managed to ensure sustainability of the land resource.

Salts are a natural part of the environment, and are added to the soil through soil formation, hydrologic processes and rainfall. While large amounts of salt can be added to agricultural land with irrigation water or effluent, relatively small amounts are added with solid recycled organics such as manure, unless very high application rates are used.

It should be noted that the salts contained in animal by-products are not all damaging. Solid by-products contain calcium, magnesium, potassium, nitrate, phosphate and sulphate salts. Many of these are beneficial plant nutrients.

Salinity is measured by the **electrical conductivity (EC)** of a soil water extract and is affected by the texture of the soil. Because of the additional salts found in solid by-products, the EC of some solid animal by-products can appear high despite having a relatively low risk of causing soil salinity or sodicity. In order to work out the risk of causing salinity, it is more useful to consider the actual amount of salt (particularly sodium and chloride) that is being applied with the by-product per hectare.

Importantly, effluent can have a far higher concentration of salts than manure. This fact sheet deals specifically with solid by-products (manure) and will not discuss effluent salt loads in detail. If applying effluent you need to carefully work out the salt loads being applied to reduce the risk of land degradation.

There are several factors which determine the risk of salinity and sodicity from applying animal by-products, including:

- The salt concentration in the by-product
- The application rate and total amount of salt applied
- Climatic conditions affecting salt movement
- Salinity and sodicity management

Is salinity a risk?

There are many natural salt affected areas in Australia, and growing amounts of salt affected areas that have been accelerated by management. Mostly this is in response to changes in water movement and vegetation management in the landscape.

The first step to working out the risk of salinity from using animal by-products is to know if your property is already affected. Table 1 below shows some EC levels that indicate soil salinity.

Table 1.Soil salinity criteria using $EC_{1:5}$ for four ranges of soil clay content

Plant Salt Tolerance Grouping	EC_{se} Range dS/m	Corresponding $EC_{1:5}$ Based on Soil Clay Content (dS/m)				Soil Salinity Rating
		10-20% clay	20-40% clay	40-60% clay	60-80% clay	
Sensitive crops	<0.95	<0.07	<0.09	<0.12	<0.15	Very low
Moderately sensitive crops	0.95-1.9	0.07-0.15	0.09-0.19	0.12-0.24	0.15-0.3	Low
Moderately tolerant crops	1.9-4.5	0.15-0.34	0.19-0.45	0.24-0.56	0.3-0.7	Medium
Tolerant crops	4.5-7.7	0.34-0.63	0.45-0.76	0.56-0.96	0.7-1.18	High
Very tolerant crops	7.7-12.2	0.63-0.93	0.76-1.21	0.96-1.53	1.18-1.87	Very high
Generally too saline for crops	>12.2	>0.93	>1.2	>1.53	>1.87	Extreme

Shaw et al. 1987

Generally, soils are too saline for crop growth where $EC_{1:5}$ is >1.53 dS/m (in soils with 40-60% clay). In soils with 10-20% clay, an $EC_{1:5}$ of >0.93 dS/m is considered too saline for crop growth (see Table 1). It may be a good option to sample soils in the area where by-products are to be applied. The EC measurement from a soil test can be used to work out the salinity level from Table 1 above. If there is a concern over salinity levels a good option is to carry out soil tests every year or two so that any changes in salinity will be picked up.

The other concern with applying manure comes from the sodium that is present in the manure. Sodium contributes to soil degradation, known as sodicity, by breaking down structure, causing dispersion and hard setting of clay soils. Sodicity is measured by the **exchangeable sodium percentage – ESP**) of

the soil. ESP is a measure of the sodium in the soil relative to other cations, including calcium, magnesium and potassium. Because of this, adding sodium to a soil can be offset by adding other cations (calcium and magnesium) which are found in gypsum.

In general, a soil is considered sodic if the ESP is above 6% in the surface soil. Above this level, soils are likely to start showing signs of structural decline such as hard setting and surface sealing. This can be managed by adding gypsum to lower the relative amount of sodium in the soil exchange.

Perhaps the best way to determine salinity or sodicity risks from solid by-products is to estimate the total salts applied per hectare with the by-product. This requires knowledge of the amount of salt and the application rate of the by-product. Some levels of sodium and chloride are shown in Table 2 below.

Table 2. Sodium and chloride concentrations in some animal by-products

	Feedlot Manure (stockpiled)	Meat chicken spent litter	Piggery spent bedding
Sodium (Na)	**0.6%**	**0.3%**	**0.3%**
Na / t manure	***4 kg***	***2 kg***	***2 kg***
Chloride (Cl)	**1.4%**	**-**	**0.8%**
Cl / t manure	***10 kg***		***6 kg***
EC (dS/m)	**12.4**	**6.8**	**6.5**

The above table shows a wide range of EC readings for these by-products, however the actual amount of salt applied to land is quite low (see example 1). Experience in Queensland has indicated that salinity and sodicity have rarely been shown to be a problem from manure usage and unless very sensitive crops are being grown, the risk of reducing yields or degrading soils from manure reuse is quite low[2].

Climate effects

Climate has a large effect on the risk of salinity or sodicity from manure usage. In general, higher rainfall areas are at a lower risk of salinity because salts added to the soil will be leached through the root zone. In lower rainfall zones (<500mm) salts are more likely to remain in the root zone unless irrigation water is applied.

Some other fact sheets in this series:
Typical composition – Layer hen manure
Typical composition – Feedlot manure
Management – Metals in recycled organics
Application – How much is manure worth?

Example 1:
Stockpiled feedlot manure – sodium and chloride;
Sodium (Na) = 0.6%, Chloride (Cl) = 1.4%
Dry matter = 70% (Moisture = 30%).
Calculate Na content on wet basis:

Na content × Dry matter % → = 0.6 x 0.7

= **0.4 % Na** as applied @ **30% moisture**
Using the same calculation gives **1 % Cl**

Calculate **kg** of **Na** & **Cl** applied **per tonne**
Na = 0.004 x 1000 = **4 kg**
Cl = 0.01 x 1000 = **10 kg**

At **10 t/ha** application rate this = **40 kg of sodium and 100 kg of chloride**

The example above shows that the added amount of sodium and chloride in manure is relatively low. In perspective, 100 kg of chloride per ha = 1 mg/kg change in the soil if all the chloride remains in the topsoil. If there are concerns about the impact of this on salinity then soil monitoring should be carried out before and after application to observe any changes.

Elevated sodium levels are managed by applying gypsum (at approximately 2.5t/ha). It is unlikely that this will be necessary because of manure application because of the calcium and organic matter that is also applied, but as always this should be monitored by soil testing.

References and further reading:

[1] Rengasamy, P & Bourne J 1997, 'Managing Sodic, Acidic and Saline Soils', Cooperative Research Centre for Soil and Land Management, Glen Osmond.

[2] Skerman, A 2000, Reference manual for the establishment and operation of beef cattle feedlots in Queensland, Information Series QI99070, Queensland Cattle Feedlot Advisory Committee (FLAC), Department of Primary Industries, Queensland.

Shaw, RJ, Hughes, KK, Thorburn PJ and Dowling AJ 1987, 'Principles of Landscape, Soil and Water Salinity – Processes and Management Options. Part A.' In "Landscape, Soil and Water Salinity". *Proceedings of the Brisbane Regional Salinity Workshop*, Brisbane, May 1987. Queensland Department of Primary Industries Conference and Workshop Series QC87003. Brisbane.

Department of Natural Resources (DNR) 1997, *Salinity management handbook*, Scientific Publishing, Resource Sciences Centre #222, Department of Natural Resources, Queensland.

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