Healthy Country

managing the land for healthy waterways

FarmFLOW

growth through good practice

Using poultry litter to grow green couch turf

The issues

As the cost of chemical fertilisers increases producers are looking for alternative, affordable sources of nutrients to drive plant production. Poultry litter has a long history in farming operations, used as a soil conditioner and nutrient source, and is becoming increasingly popular as a cheap alternative within the Pumicestone horticulture sector. Local poultry operators in the Pumicestone catchment produce over 50 000 tonne of litter per year which is available for purchase from specific suppliers.

Gaining an understanding of the fate of nutrients in poultry litter when applied to coastal sandy soils is important both to improve production and to avoid water quality problems downstream. Basing fertiliser and litter application on a better understanding of specific crop needs and in-situ nutrient availability has the potential to reduce fertiliser costs and improve the environmental performance of the production system.

This fact sheet provides the results of a trial conducted on a Pumicestone turf farm. The aim of the trial was to gain an enhanced level of knowledge of poultry litter use in green couch (*Cynodon dactylon*) grown on coastal sandy soil.

> **Recommendation for turf growers**
>
> Double batch poultry litter is partially composted before application and appears to provide superior environmental and production benefits compared to single batch poultry litter.

Nutrient sampling at the trial site

Trial aims

The pilot trial compared the differences between single and double batch poultry litter, specifically looking at the nitrogen, phosphorus and carbon content of these two products. Further we investigated how the two types of litter dispersed N and P through the soil profile over a twelve week growing period. Double batch litter is litter (straw and husk) which has been used as bedding for two batches of meat chickens.

Rates applied per hectare were: single and double batch litter 8 m^3, soil litter mixes 2 m^3 litter 6 m^3 soil. The collaborating producer chooses to apply poultry litter at these rates.

The aim was to determine which litter product performed best in terms of the economic and environmental objectives of good farm management.

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Healthy Country partners:

What did we do?

Leachate (soil water below the root zone) was collected using soil solution samplers at 15 cm and 30 cm depths to measure the differences in nitrogen and phosphorus content in water moving through the soil profile from the litters and litter/soil mix treatments. In unrestricted conditions, grass roots can easily reach a depth of 20–30 cm in irrigated sandy loams. A total of 288 samples were collected from the weekly sampling regime.

The four treatments were:

1. single batch (SB) litter
2. double batch (DB) litter
3. double batch litter / soil mix at a ratio of 1:3
4. single batch litter / soil mix at a ratio of 1:3 (refer Table 1).

In addition soil analyses were conducted for all treatments and trial site. These tests are only indicative of nutrient losses as N and P in various forms will also be linked to gaseous losses, runoff losses and environmental factors (i.e. rainfall, elevated water table), which were not recorded.

The collaborating producer applies poultry litter at the rate of 8 m^3 per hectare. When the top soil depth is reducing in height, the producer mixes 2 m^3 poultry litter with 6 m^3 of topsoil and spreads this mix as a top dressing.

An application rate of 8 m^3 of poultry litter is equal to 3.2–4.0 tonne using NSW DPI figures of 2.5 m^3 per tonne. Single batch litter costs $20 m^3 and double batch litter is $22 m^3. Litter was spread on 17 March 2009, and soil moisture sampling commenced on 24 March 2009. All soil, litter and leachate samples were analysed at the NATA accredited DERM laboratories at Indooroopilly, Queensland.

What did we find?

Soil and poultry litter nutrient levels

Soil from the trial site was sampled and analysed prior to spreading the litter and litter soil mix treatments. The results showed a residual nitrogen level of 0.3%, nitrate (NOx) 22 mg/kg, ammonium (NH_4) 46 mg/kg and residual phosphorus of 0.3%. The soil carbon level was 2.2%.

Initial analysis of random grab samples for each litter type revealed there was more nitrogen available in the double batch (DB) (3.2% N, 1380 mg/kg NH_4) sample than the single batch (SB) sample (2.4% N, 762 mg/kg NH_4). Similarly the DB sample contained more phosphorus (2.8%) than the SB litter (1.3%).

Following eight weeks of growth the nitrogen and phosphorus levels had reduced considerably across all treatments (Table 1). After 12 weeks growth, nitrogen and phosphorus were depleted from the top 15 cm of soil.

Soil carbon

At the time of purchase the SB and DB litters had carbon levels of 38% and 34% respectively. After eight weeks the large differences in soil carbon between the treatments was non-existent, as observed by the depletion in levels for the SB (37.9%–0.29%) and DB poultry litters (34%–0.24%). This depletion of soil carbon was observed for both poultry litter soil mixes also over the first eight weeks. Interestingly the poultry litter soil mix carbon levels were maintained between weeks 8–12 comparative to the SB and DB litters where carbon levels continued to decline (Table 1).

Table 1. Nitrogen, phosphorus and carbon levels for soil and poultry litter samples. Initial poultry litter samples and trial site soil sample taken prior to trial setup. Remaining samples collected from the top 0–15 cm at weeks 8 and 12.

Date	Treatment	NO_x mg/kg	NH_4 mg/kg	TN%	TP%	TC%	pH
17 Feb 2009	Pre-trial soil sample	22	46	0.27	0.265	2.19	5.9
17 Mar 2009	SB	5	762	2.35	1.28	37.9	7.3
	DB	5	1380	3.23	2.77	34	7.1
	DB soil mix	<2	121	0.17	0.081	1.68	6.4
	SB soil mix	10	317	0.37	0.314	3.31	6.6
12 May 2009	SB litter	2	17	<0.03	<0.020	0.29	6.4
	DB litter	17	9	<0.03	<0.020	0.24	6.1
	DB soil mix	7	16	<0.03	<0.020	0.35	5.9
	SB soil mix	<2	18	<0.03	<0.020	0.25	6.3
11 June 2009	SB litter	-	-	<0.03	<0.020	0.13	6.4
	DB litter	-	-	<0.03	<0.020	0.12	6.3
	DB soil mix	-	-	<0.03	<0.020	0.41	6.0
	SB soil mix	-	-	<0.03	<0.020	0.25	6.2

Nitrogen and phosphorus soil solution (leachate)

Two weeks after the treatments were applied to the soil a spike in mean nitrogen concentration for SB and DB litters peaked at 19 mg/L. Four weeks after application, the SB litter (28 mg/L) and DB soil mix (15 mg/L) recorded their peak mean nitrogen concentration (Figure 1). The nutrient peaks could be attributed to environmental factors (heat and moisture) that influence microbial activity to drive nutrient cycling. Similarly the phosphorus in the soil solution for the SB litter had the highest mean concentrations at week 4 of 35 mg/L (Figure 2). A 170 mm rainfall event during the previous week would have driven the peaks (Figure 3). Literature suggests that most of the P applied from litter applications is lost in the first runoff event.

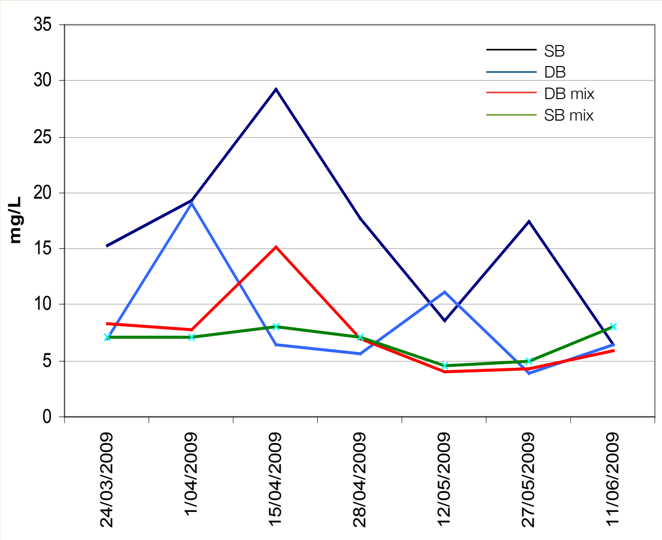

Figure 1. Mean nitrogen levels obtained from six soil solution samples collected at each period. Three soil solution sampling tubes were used at 15 cm and 30 cm depths. Samples were collected weekly (288 samples) with 168 samples analysed.

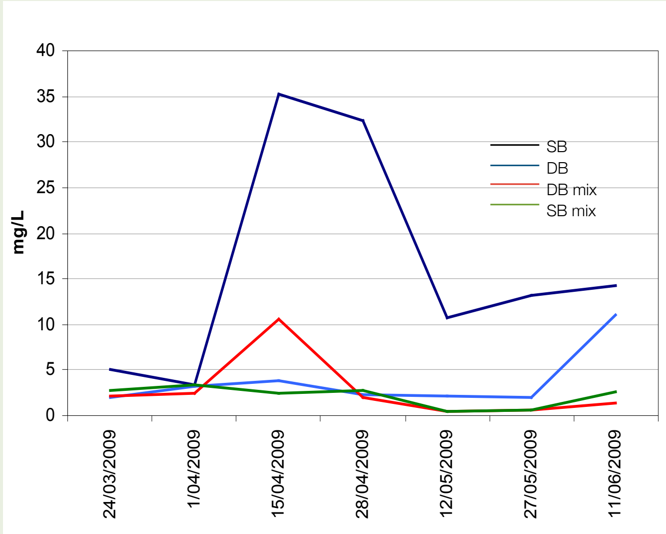

Figure 2. Mean phosphorus levels obtained from three soil solution sampling tubes at 15 cm and 30 cm depths. Six soil solution samples were collected weekly for each treatment.

Looking for nutrient consistency in the data sets, the DB litter had a more even release of phosphorus 3–11 mg/L, when compared to the SB litter 4–35 mg/L. When comparing the consistency of nitrogen release DB litter ranged from 4–18 mg/L with SB 7–29 mg/L. The SB soil mix had the most consistent release and availability of all the treatments for both nitrogen (5–8 mg/L) and phosphorus (1.0–3.5 mg/L). These results would suggest that nutrient release from the DB litter is more reliable than SB litter.

Collaborators Steve and Dave assist the soil nutrient monitoring team during sampling

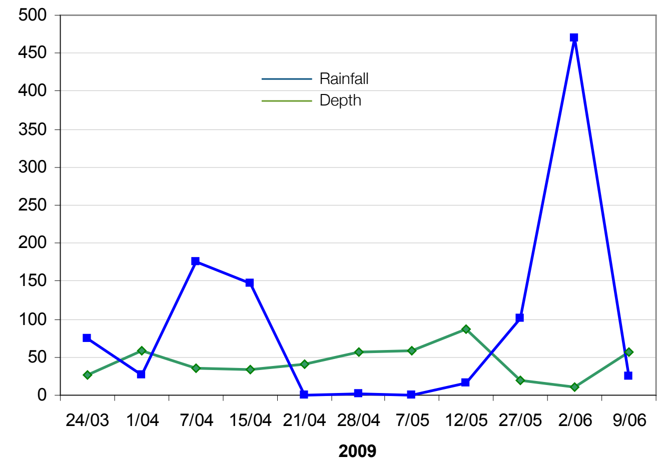

Figure 3. Weekly rainfall (mm) and water table depth from soil surface (cm) as measured during sample collection. The soil solution tubes were inserted at 15 cm and 30 cm depths to collect soil moisture for analysis. The water table depths indicate ground water interference during the sampling period occurred on 27/05 and 2/06.

Recommendations

Which poultry litter type is better for coastal soil turf production?

A summary of the soil data would suggest the SB litter has a greater capacity to provide the required nitrogen necessary to grow green couch, while delivering less than half the phosphorus (P) to the environment when compared with the DB litter. In fact, the DB litter contains nine times the plant P requirements, while the SB provides four times the P requirements for green couch.

However, when we consider the soil solution data we see the exact opposite. While there are more nutrients in DB litter than SB litter, the stability combined with more consistent release of N and P when incorporated into the soil remains the key beneficiary to select DB over single batch (SB). The results show that SB litter has the potential to release large pulses of N and P under identical conditions.

An important consideration is that DB litter is not as readily available as SB litter as 70% of poultry producers change litter after each batch. DB litter is partially composted before application and appears to provide superior environmental and production benefits than SB litter and will become a highly sought after product. This is consistent with research on composted litters in the United States of America where fresh litter had higher mineralisation rates than composted litters. Partially composted litters like double batch (DB) poultry litter are a more predictable and more reliable source of nutrient mineralisation than fresh (SB) litter. To supply the imminent demand for DB litter it is suggested the poultry industry revisit current bedding practices.

Recent research through RIRDC and the University of Western Australia suggest that fertiliser requirements where poultry litter is the main source should be based on P levels in the soil matched with the P retention index (PRI) and plant P removal rates to determine P requirements. This is a distinct shift away from the current use of organic amendments (e.g. poultry litter) that is based on soil and plant nitrogen requirements.

Results from this trial indicate the possibility that mixing litter and soil assist for a more even release of nitrogen and phosphorus. Further trials on the soil / litter mixing combinations will qualify this suggestion.

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Further information

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