Poultry litter is not all the same

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Abstract: *Poultry litter is becoming more widely used as a fertiliser on pastures and crops as supply increases due to growth in chicken meat (broiler) production. Testing of nutrient and trace element content in poultry litter sourced from the Hunter Valley, Central Coast and Tamworth regions of NSW in 1997 and again in 2010 shows that nutrient content of litter has changed, with a major reduction in the percentage phosphorous now found in broiler litter. Test results also confirm that there are differences in nutrient content between broiler litter, turkey litter and layer manure. Differences in nutrient content can be attributed to the mix of bedding material and manure, and the diet of the birds. These differences mean that it is important for potential users to have reliable, current nutrient analysis when calculating application rates, and when calculating the relative cost or value of poultry litter compared to fertilisers or other nutrient sources. Results from pasture trials at Tocal Agricultural Centre show that poultry litter is an effective fertiliser, which can be used alone or in combination with other fertilisers to achieve high levels of pasture production. Poultry litter can also be very cost effective depending on its relative cost compared with other fertilisers.*

Key words: trace elements, by-product, application rates, variation

Introduction

Poultry litter is a by-product of broiler chicken, turkey and egg production and can be a waste disposal issue for the poultry industry. However, it can also be a valuable source of fertiliser for agricultural industries including dairy, beef, cropping and horticultural industries (Bolan *et al.*2010). Broiler chicken production for poultry meat products is the main source of poultry litter in NSW.

The nutrient content of poultry litter is known to vary widely depending on the type of poultry, bedding material used, stocking density, length of growing period, feed formulation, and duration and conditions for storage of litter. When using poultry litter as fertiliser, knowledge of the nutrient content is essential to calculate appropriate application rates and enable a comparison with other fertiliser options. While it would be ideal to test each load of litter before application this is impractical for most users due to time and cost of comprehensive sampling and testing, and time delays while waiting for results. The practical, cost effective option is to use average analysis of litter in estimating application rates and then use soil tests to monitor changes in soil fertility.

Monitoring of soils with a history of poultry litter application has shown that an increase in soil phosphorus (P) can be expected (Adams and Metherell 2000). Where there are regular and on-going applications of poultry litter the testing for soil P levels should be the priority test. Increasing levels of soil P has been observed in pasture trials at Tocal Agricultural Centre. These trials show that poultry litter is an effective fertiliser which can be used alone or in combination with other fertilisers to achieve high levels of pasture production.

In NSW the nutrient analysis of 22 poultry litter samples collected in 1997 from the Hunter Valley and Central Coast gave an average: nitrogen (N)=4.9%, P=1.8% and potassium (K)=1.4%. These average nutrient levels have been the source been commonly referred to in a number of publications including *Poultry Litter: A great resource or environmental hazard* (Griffiths 1998) and *Best Practice Guidelines for using poultry litter on pastures* (Griffiths 2000). However, management systems in broiler sheds have changed since 1997 from the open ventilation method to tunnel ventilation. Other changes in management since 1997 include an increase in stocking rates, the type of material used for bedding and changes in diet.

This paper reports on results from a survey conducted in 2010 following widespread introduction of tunnel ventilated broiler sheds in the Hunter Valley and Central Coast of NSW.

Methods

Representative samples were taken from poultry sheds in 1997 and 2010, in the key NSW poultry production regions of Hunter Valley, Central Coast and Tamworth. Samples were taken from a range of fresh and aged litter piles in 1997. In 2010 samples were taken from sheds immediately prior to cleaning or from storage heaps within 7 days of cleaning. Samples were taken from 22 broiler sheds in 1997 and 22 broiler sheds, 8 turkey sheds and 8 layer sheds (38 samples) in 2010. Samples were frozen until dispatch to laboratory for analysis and were received in good condition.

Samples were analysed by the NATA accredited Australian Government Analytical Laboratories in 1997 and by NSW DPI Diagnostic and Analytical Services in 2010 using the methods listed in Table 1.

Table 1. The analytical methods used to analyse poultry litter samples collected.

Analytical Method	Method number
pH and EC	In-house method
Acid Soluble Digestion	AOAC Method 965.09C(a)
Acid Soluble Elements by ICP-AES	USEPA 6010
Percent Moisture	SPAC 4
Total Nitrogen and Total Carbon by Dumas Combustion	AOAC 993.13
Water Soluble Phosphorus	USEPA 6010
Citrate Soluble Phosphorus	AOAC 960.01
Citrate Insoluble Phosphorus	AOAC 963.03 B
Water Soluble Ammonium, Nitrate and Nitrite	AOAC 960.02

Results and discussion

The major nutrient analyses of representative litter samples taken from poultry sheds in 1997 and 2010 are shown in Table 2. It is notable that N levels found in the 2010 survey are more consistent than results from the previous 1997 survey. This is likely because the 2010 survey comprised only samples taken when sheds were cleaned out, whereas the conditions varied for 1997 samples. The 1997 samples included fresh and aged storage heaps, which in most cases had low N levels, with the exception of one that recorded very high N levels. This sample was included in the results.

The 2010 survey also recorded lower average P in broiler litter compared with 1997 which is most likely due to changes in feed formulation (J Blunden pers.comm.).

The results of the analyses of the litter samples for trace elements and heavy metals from the 1997 and 2010 surveys are presented in Table 3. The relatively high concentration of copper (Cu) and zinc (Zn) in both the 1997 and 2010 surveys is of interest. Cu and Zn in poultry litter would be valuable where these trace elements were deficient in soil but could pose a long term risk if poultry litter was repeatedly applied in excess of plant requirements.

Low levels of arsenic were recorded in 1997 samples. The heavy metals, arsenic, cadmium, lead and selenium were below the level of detection in the samples collected for the 2010 survey.

There was a wide variation in nutrient content of the poultry litter samples analysed (Table 2). On average the layer manure had the highest fertiliser value which is expected due to absence of bedding material. Turkey litter had next highest fertiliser value which may

Table 2. The range and average (Av) of results from litter samples collected in the 1997 and 2010 surveys and analysed for: dry matter, electrical conductivity (EC), pH, nitrogen (N), phosphorus (P), total carbon, potassium, magnesium, calcium, sodium and sulphur.

Source of litter	Broiler litter 1997		Broiler litter 2010		Turkey litter 2010		Layer manure 2010	
Number of samples	22		22		8		8	
	Range	Av	Range	Av	Range	Av	Range	Av
Dry Matter %	(36–83)	69	(57–80)	76	(56–83)	68	(39–81)	59
EC (Ds/m)	(2.0–9.75)	6.8	(4.8–12.0)	9.0	(74.4 –14.0)	9.5	(5.1–12.0)	7.5
pH (1:5 water)	(6.0–8.8)	8.1	(6.3–8.8)	7.8	(7.3–8.6)	8.0	(6.7–8.5)	7.8
Ammonia N (mg/kg)	(1280–13730)	9903	(1800–5700)	3264	(2800–7500)	3925	(1300–5500)	2675
Nitrate N (mg/kg)	(0–1634)	318	(1–680)	111	(1.3–690)	299	(0.25–390)	50.5
Nitrite N (mg/kg)	(0–440)	85	(2–290)	47	(1.5–440)	104	(1.6–12.0)	4.9
Total Nitrogen (%)	(1.96–13.4)	4.9	(2.5–5.6)	3.74	(2.4–5.4)	3.8	(3.1–7.6)	5.8
Phosphorus (P)								
Water Soluble P (%)	(0.15–0.39)	0.23	(0.25–0.86)	0.49	(0.50–1.10)	0.78	(0.21–1.10)	0.52
Citrate Soluble P (%)	Not available	(0.13–1.22)	0.53	(0.47–1.10)	0.78	(0.77–2.70)	1.53	
Citrate Insoluble (%)	Not available	(0.04–1.18)	0.10	(0.05–0.33)	0.16	(0.10–0.23)	0.14	
Available P (%)	Not available	(0..9–1.75)	1.03	(1.2–2.2)	1.6	(0.98–3.80)	2.05	
Total P (%)	(1.2–2.6)	1.77	(0.46–1.90)	1.13	(1.3–2.3)	1.7	(1.1–4.0)	2.2
Total Carbon (%)	(28–41)	36	(33–44)	41	(36–42)	39	(25–37)	33
Potassium (%)	(1.1–2.0)	1.44	(0.85 –2.3)	1.43	(1.5–3.0)	1.9	(0.91–2.7)	1.68
Magnesium %(%)	(0.35–0.81)	0.54	(0.31–0.64)	0.43	(0.32–0.94)	0.46	(0.32–1.0)	0.49
Calcium (%)	(1.7–3.7)	2.5	(1.1–2.7)	1.75	(1.8–3.5)	2.7	(3.2–14.0)	9.2
Sodium (%)	(0.24–0.43)	0.31	(0.2–0.49)	0.36	(0.25–0.53)	0.33	(0.24–0.51)	0.36
Sulphur (%)	(0.47–0.74)	0.60	(0.29–0.73)	0.47	0.38 –0.55)	0.49	(0.29–0.66)	0.45

Table 3. The average levels (mg/kg) of trace elements and heavy metals measured in litter samples collected in the 1997 and 2010 surveys.

Element measured	Source of litter			
	Broiler litter 1997 (n=22)	Broiler litter 2010 (n=22)	Turkey litter 2010 (n=8)	Layer manure 2010 (n=8)
Aluminium (Al)		700	1068	1794
Arsenic (As)	4.53	<5	<5	<5
Boron (B)		21.36	28	16
Cadmium (Cd)	<0.5	<0.2	<0.2	<0.2
Cobalt (Co)		1.42	1.27	2.12
Chromium (Cr)		4.19	12.8	2.37
Copper (Cu)	76.5	108.2	50	45
Iodine (I)	<0.5			
Iron (Fe)		637	1445	1683
Manganese (Mn)		378	393	453
Molybdenum (Mo)		2.41	2.83	2.6
Nickel (Ni)		5.5	6.5	3.5
Lead (Pb)		<2	<2	<2
Selenium (Se)		<4	<4	<4
Zinc (Zn)	353	361	340	350

be explained by the longer growing period for turkeys, while the broiler litter generally had the lowest fertiliser value.

Conclusion

The availability and amount of poultry litter is increasing as the demand by consumers for poultry products increases. The results from the samples of the different sources of poultry litter in 1997 and again in 2010 indicate that all types of poultry litter and manure have value as a fertiliser resource, although there are differences in value between the different sources. Turkey litter and layer manure have a higher average fertiliser value than broiler litter and this needs to be accounted for in calculating application rates and in comparing the cost and value with alternative manure or fertiliser products. Of importance, is the much lower P content of broiler litter in 2010 compared to 1997. This has major implications to the value of broiler litter compared to other fertiliser options.

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