The use of pig manure – a study at Wollun, NSW

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Abstract: *A study of pig manure as a soil ameliorant was carried out on a granite soil on the northern Tablelands of NSW. Pig manure was applied at two rates over a period of three years. The study continued for a further six years. Soil test results showed no substantial changes in pH. Application rates directly affected soil phosphorus levels. There was a notable increase in pasture herbage mass and small positive effect on pasture quality.*

Key words: pig manure, acid soils, aluminium, phosphorus

Introduction

Increasingly, animal manures are being considered as alternative fertiliser products to add nutrients to pastures and crops. As a fertiliser, these manures can offer both macro and trace nutrients. Producers also value the reported additional benefits of supplying organic matter and improving soil biology. In some cases, manures and organic materials can be cost effective compared with manufactured fertilisers.

A replicated experiment investigating pig manure was established at Wollun on the northern Tablelands of New South Wales (NSW) in February 2001. Originally, the aim was to determine if pig manure was act as a liming agent to correct soil acidity. Some manures can be alkaline or neutral in nature, and may have a role in improving acid soils. Acid soils are one of the main forms of soil degradation, contributing to crop and pasture production limitations on the northern Tablelands (Edwards *et al.* 2009). This study complemented a lime movement study conducted at this site (Edwards 2004).

This paper reports the effect of topdressed manure at three rates (0, 5 and 10 t/ha) applied in each of the first three years of the experiment on soil pH, soluble aluminium at depth and phosphorus (P) on a fine granite soil over nine years. The paper also reports the effect of the pig manure on pasture production and quality.

Methods

The study was located at "Blaxland", 25 km north-west of Walcha on the northern Tablelands of NSW. The pasture was dominated by tall fescue (*Lolium arundinaceum* Schreb. syn *Festuca arundinacea* cv. Demeter) and yearlong green native perennial grases (*Austrodanthonia spp.* and *Microlaena stipoides)*. Subterranean (*Trifolium subterraneum*) and white clover (*Trifolium repens*) were present when rainfall was favourable. The site consisted of a soil with a pH of 4.75–4.95 (Ca) at 0–10 cm depth and 4.85–5.05 at 10–20 cm. Initially, mean aluminium levels of 4.7% of Cation Exchange Capacity (CEC) were common in the 0–10 cm depth, and 3.2% at 10–20 cm. Cation Exchange Capacity ranged from an average 3.9 meq/100 g (0–10 cm) to 2.7 meq/100 g (10–20 cm). The experiment consisted of three manure treatments (nil, 5 t/ha and 10 t/ha dry weight) with two replications. Treatments were arranged in a randomised complete block design.

Soil tests were taken prior to each application of manure. Manure was collected from piles that had been sitting for at least three months. A surface application of the manure was made in February 2001 and two subsequent applications were made in February 2002 and February 2003. Manure was applied at equivalent dry weight for each application and at the same time a sample was sent for analysis. Further soil samples were taken six months after application and repeated until August 2003. All soil samples were taken at two depths (0–10 cm and 10–20 cm). Further soil samples were taken in 2009. All soil samples were analysed for $pH_{(Ca)}$ and exchangeable cations. Phosphorus was measured at the 0–10 and 10–20 cm depth at six monthly intervals for the first three years.

The experimental area was defoliated with a rotary mower when plant height reached

10–25 cm. Total herbage mass (kg dry matter (DM) ha) was assessed 12 times over the period 2001–09. After pasture measurements were taken the site was mown to an even height and pasture material removed from the plots. A grab sample was taken from each treatment and bulked across the two replications on four occasions (July 2001, February 2002, April 2002 and May 2002) to determine pasture digestibility and crude protein.

Results

Pig manure

Following each application of pig manure a sub sample was sent for nutrient analysis (Table 1).

Table 1. Range of nutrients analysed for the applied pig manure.

Analysis	Range
Nitrogen (Kjeldahl)	1.6–2.1 %
Total phosphorus	1.6–1.7%
Sulfate sulfur	0.22–0.39%
Calcium	1.2–1.6%
Neutralising value	1.4–1.5%
pH (1:5 aqueous)	6.2–6.7

Table 2. Effect on three rates of manure on mean pH and aluminium percentage over three years (2001–04). Values followed by the same letter within columns are not significantly different (*P* <0.05).

Treatment	pH	Aluminium %
Nil	4.7 b	3.25 a
5 t/ha	4.7 b	2.74 a
10 t/ha	4.9 a	1.21 b

Soil pH

There was a significant manure treatment effect on pH and exchangeable aluminium at the 10 t/ha rate (Table 2). After the first three years, pH continued to be affected (Figure 1).

Soil nutrients

There continued to be an effect of the manure on P six years after the last application (Figure 2).

Pasture quantity and quality

There was an effect on the total amount of pasture grown in the two manure treatments compared with the nil treatment (Figure 3). The total amount of pasture in the manure plots was about 1.4–1.5 times that of the nil plots. Pasture quality samples were also taken at irregular intervals. A summary of pasture crude protein and digestibility values for 2001–03 is shown in Table 3.

Discussion

Pig manure contains a range of nutrients which can supply essential nutrients to pastures. At this site, the use of pig manure was initially aimed at investigating the potential as an alternative to lime on an acid soil. An increase in pasture production, pH and soil P occurred even at the lower rate of 5 t/ha.

While there was a marginal, but significant increase in pH and a similarly small reduction in aluminium on the 10 t/ha treatment, economic and management difficulties may limit a larger

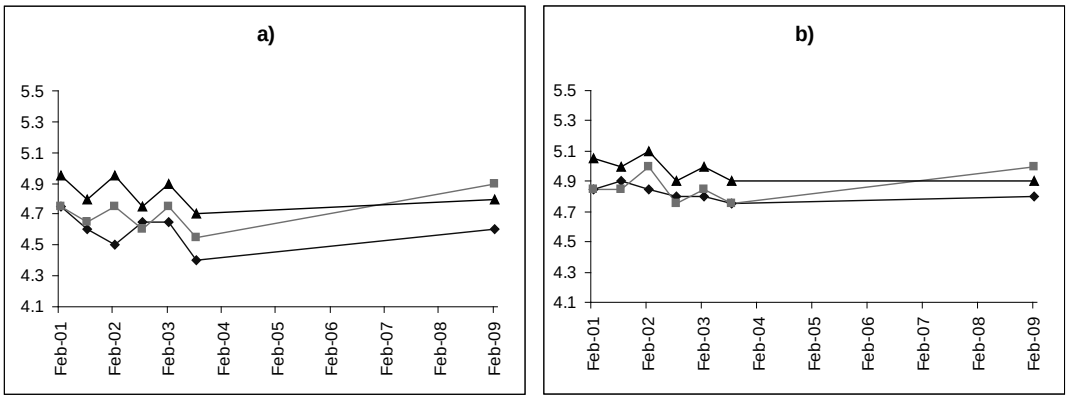

Figure 1. Effect of three rates; nil (◆), 5 t/ha (■), 10 t/ha (▲) of pig manure on pH from February 2001 to February 2009 at two depths a) 0-10 cm and b) 10-20 cm.

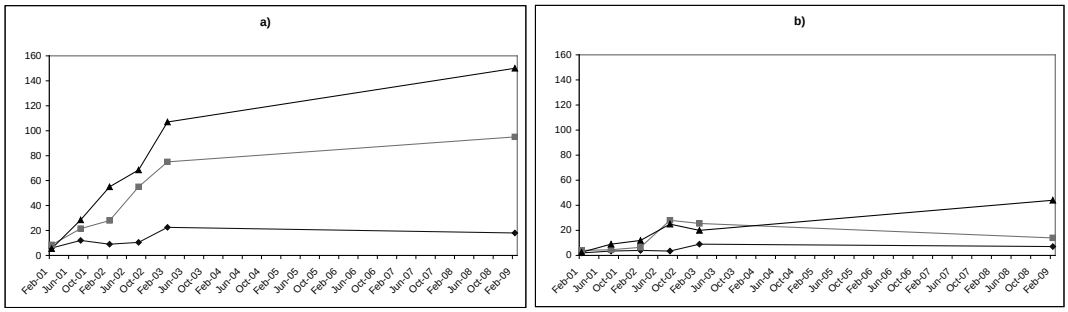

Figure 2. Effect of three rates; nil (◆), 5 t/ha (■), 10 t/ha (▲) of pig manure on P (Colwell) from February 2001 to February 2009 at two depths a) 0-10 cm and b) 10-20 cm.

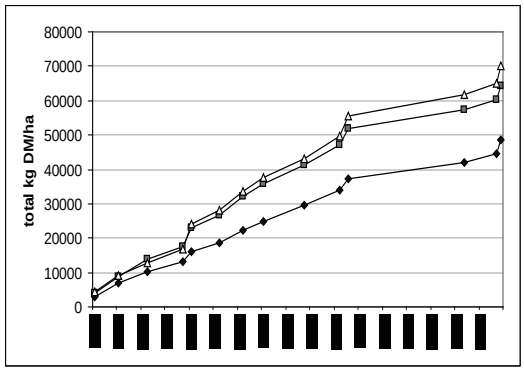

Figure 3. Total herbage mass (kg DM/ha) for the three rates; nil (◆), 5 t/ha (■), 10 t/ha (▲) of pig manure over the period August 2001 to September 2009.

Table 3. Effect of manure (nil, 5 and 10 t/ha) on crude protein and digestibility (%) at Wollun NSW. Values are averaged for four samples taken between 2001–03.

Treatment	Crude protein (% DM)	Digestibility (% DM)
0 t/ha	10.2	63.1
5 t/ha	11.6	67.9
10 t/ha	11.9	67.3

scale application. Phosphorus levels also showed a significant increase due to the addition of pig manure. Given the ongoing positive effect after nine years, an interesting question remains as to how long this effect will last.

Since this was not a comprehensive study on the effects on pig manure on pastures and soils, the results must be read with some caution. Further studies on the economics of pig manure should be undertaken.

The potential for nutrient loss, the amount of manure required to give significant pasture growth response and necessary environmental issues, such as Environmental Protection Act guidelines and animal health implications need to be examined. Certainly, further studies should be carried out to investigate the effects of manure on soil biology, soil carbon and potential use on different soil types and pasture mixtures.

Acknowledgments

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References

Edwards C, Duncan M, Harris C, Burgess A (2009) A lime movement experiment, Walcha NSW. In 'Proceedings of the 24th Annual conference of the Grassland Society of NSW'. (Eds D Brouwer, N Griffiths, I Blackwood). pp. 79–81. (NSW Grassland Society Inc.: Orange)

Edwards C (2004) The B.O.Z.O lime movement study at Wollun on the Northern Tablelands. In 'Proceedings of the 19th Annual conference of the Grassland Society of NSW'. (Eds S.Boschma, G Lodge). pp. 124–125. (NSW Grassland Society Inc.: Orange)