

Cattle manure and composted gin trash: Benefits and costs

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There is a strong interest in using organic amendments such as cattle manure and composted gin trash in the Australian cotton industry because of perceived benefits to soil health and the environment. But detailed information on the relative benefits and costs involved is not readily available to cotton growers who farm on heavy clay soils.

In this article we present results of soil properties measured in two trials established by cotton growers. One trial was on a dryland site, near Brigalow, and the other was located near Goondiwindi and was irrigated. Results of a desktop study which investigated the costs associated with ap-

plying organic waste products as amendments at varying rates and distances from distribution centres are also presented.

Dryland site near Brigalow

Dryland cotton soils in the southern Darling Downs are frequently characterised by low potassium (K) availability, and high subsoil salinity and sodicity.

Exchangeable K concentration in the surface 0.10 metre of this field was less than 1.0 cmol/kg, and declined exponentially with increasing depth, average chloride concentration in the 0.6-1.2 metre depth was of the order of 550 mg/kg and Exchangeable Sodium Percentage (ESP) 22.

A trial was established during 2005 to evaluate the effects of some selected management practices and amendments on soil quality, and crop growth and yield.

Although the trial had six treatments, for reasons of clarity only results from three are reported in this article. The experimental treatments, imposed after zero-tillage were as follows:

- (1) Ripping alone to an average depth of 0.5 metre;
- (2) Deep application (0.5 metre) of phosphorus (P), zinc (Zn) and potassium (K); and,
- (3) Surface application and incorporation (no ripping) of cattle manure at a rate of 16 tonnes per hectare.

The amendments were applied during April 2005, and soil sampled during June of 2005, 2006 and 2007. Wheat was sown during winter 2005, cotton during 2006-07 summer and sorghum during 2007-08 summer.

Key changes in soil properties were that application of manure resulted in a higher exchangeable K and Soil Organic Carbon (SOC) concentration in the surface and a small decrease in ESP (relative to the control of ripping alone) at depth (Figure 1). Similar decreases in ESP also occurred with deep incorporation of P, K and Zn but to a lesser extent than manure.

Overall the changes which occurred with application of the amendments were small, and suggest that for discernible yield increases to occur, more frequent applications or higher rates may be required. The positive responses to manure also suggest that long-term cropping-related K depletion and SOC decline could be minimised by regular application of cattle manure. The suggested time interval could be of the order of five years.

Due to poor rainfall during 2005 the wheat crop failed but cotton and sorghum yielded well due to good in-crop rainfall in subsequent years. Crop yields were not affected by application of soil amendments. Mean yield of wheat grain (which was affected by drought) during 2005 was 1.8 tonnes per hectare, cotton lint during 2006-07 9.4 bales per hectare and sorghum grain during 2007-08 9.4 tonnes per hectare.

FIGURE 1: Effect of applying soil amendments during 2005 on average exchangeable K, soil organic C and ESP, Brigalow, 2005-07

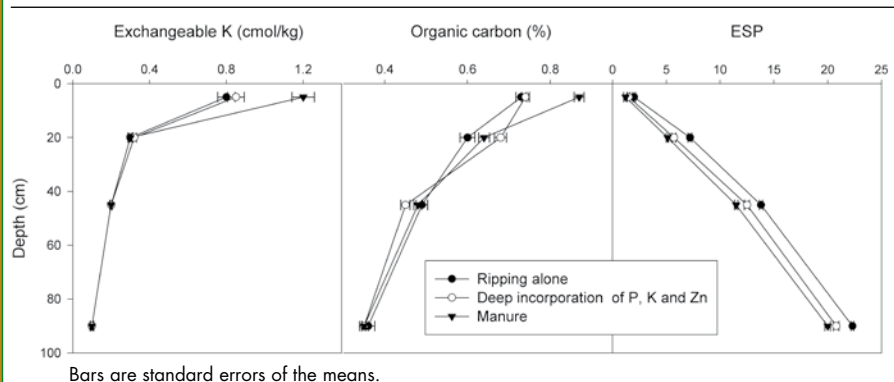
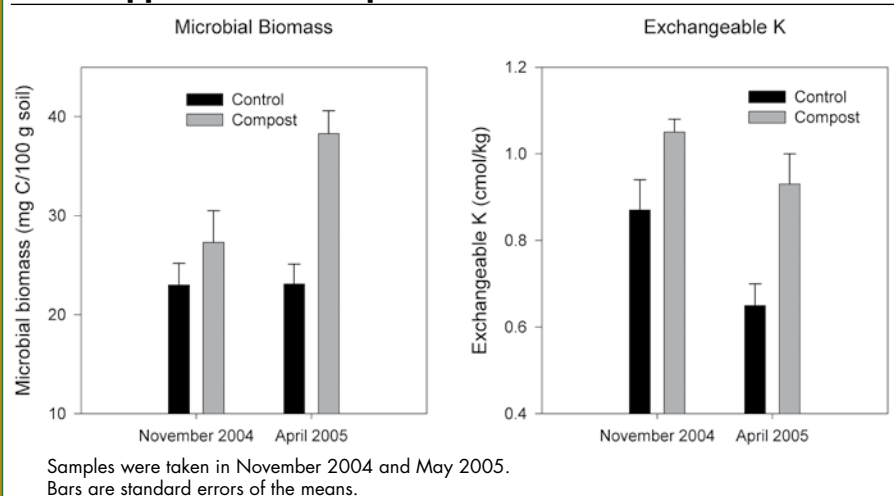


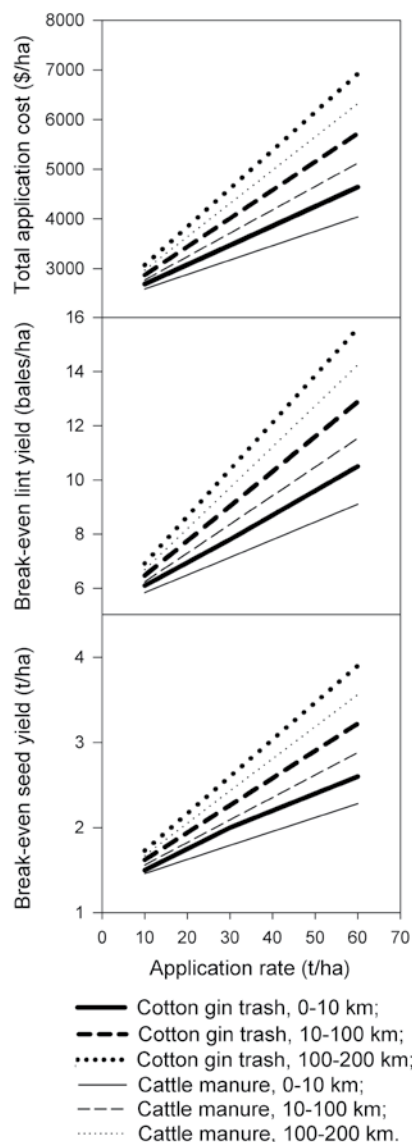
FIGURE 2: Changes in soil properties in the surface 0.10 metre due to application of compost at Goondiwindi



Irrigated site near Goondiwindi

Treatments were cotton gin trash compost (7.5 tonnes per hectare) applied a year (2003) before sampling during the 2004–05 growing season, and an untreated control. Soil was sampled from the 0–0.10 metre depth on two occasions (before sowing cotton and during picking), and analysed for selected microbiological and chemical properties. Application of compost increased the microbial biomass but only during the final harvest (Figure 2). Among the nutrients, exchangeable-K content was increased by application of

FIGURE 3: Total variable costs (including purchase, transport and application) for composted cotton gin trash and cattle manure and associated break-even values for cotton lint and seed yields



compost at both times – all other nutrients were not affected by the addition of amendments.

Costs of applying cotton gin trash and cattle manure

A desktop study was conducted to estimate the costs related to applying cotton gin trash and cattle manure as amendments to cotton fields. Factors considered in this analysis included distance from application site and rate of application.

Variable costs, excluding the costs related to purchase, application and transport of the amendments, were based on input and operating costs in trials conducted at the Australian Cotton Research Institute, near Narrabri, and were of the order of \$2300 per hectare (2007).

Estimated cost of cotton gin trash was \$25 per tonne and cattle manure (based on feedback from suppliers), \$15 per tonne. Transport was costed at approximately \$10 for a distance of 0 to 10 km from the distribution point, with an increase of \$1 occurring for each five km increment.

The break-even yield (lint and seed), the yield needed to compensate for the input costs incurred by applying the amendments in a production system, was also calculated in order to evaluate the feasibility of applying organic amendments at different rates. In other words, the break-even yield is the minimum yield which needs to be achieved. In these calculations it was assumed that the price of cotton lint was \$400 per bale and cotton seed \$175 per tonne.

From the results shown in Figure 3, it is clear that high application, transport and purchase costs make the use of organic amendments at higher rates prohibitively expensive, particularly at distances in excess of 100 km from a distribution centre. For instance, the break-even cotton lint yield exceeded 10 bales per hectare when either amendment was applied at 60 tonnes per hectare.

It is only when distances are of the order of less than 10 km and application rates are less than 30 tonnes per hectare, that costs can be maintained at manageable levels. Yet in many instances, the optimal application rates exceed this value and the distances involved are greater.

Under these constraints it would be more rational to apply the amendments at lower rates but spread it over several years. For example, where the optimal application rate for a particular field was of the order of 60 tonnes per hectare the amendment could be applied at a rate of 15 tonnes per hectare over four cotton crops rather than applying 60 tonnes per hectare to a single

cotton crop. This evaluation also shows that cattle manure is cheaper to apply than cotton gin trash.

IN SUMMARY

Both cotton gin trash compost and cattle manure improved potassium availability. As potassium stress during boll-filling is thought to be a possible cause of premature senescence in cotton, applying manure or composted gin trash as amendments may be able to reduce its frequency.

Manure increased soil organic carbon but compost improved microbial biomass in soil. Soil biological activity appears to be improved by application of organic waste products.

Application of cattle manure and cotton gin trash as amendments is feasible only when the distance from a distribution centre does not exceed 100 km for rates less than 30 tonnes per hectare and 10 km for rates greater than 30 tonnes per hectare. As yields were not improved by application of the amendments, the decision to apply organic waste materials as soil amendments must be carefully balanced against the potential financial returns.

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Acknowledgements: Funding for this research was provided by the Cotton CRC, Cotton Research & Development Corporation and the University of New England. Our thanks to David Turner and Wade Bidstrup for allowing us to sample from their trials and their constant encouragement and support.

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