Recycled Waste Products as Fertilisers



Barossa Soils Forum 2013

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Australian Government
Rural Industries Research and Development Corporation
RIRDC New ideas for rural Australia

AUSTRALIAN Pork

What nutrients do we need in broadacre crops and pastures?

- **Phosphorus – Number 1!!!**
- Nitrogen – For yield and grain protein (but this is a moving target due to ammonia losses!)
- Potassium – In some soils and some crops (sandy soils, but not generally heavier clays and clay loams)
- Sulphur – especially for canola and on light sandy soils
- Zinc – trace amounts required occasionally in many areas
- Copper – Periodically in some soils (sandy mallee soils)

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Increasing Cost of P Fertilisers

- P- based fertilisers are expensive!
- P as DAP (20% P) is generally around $4.00 per kg of P

DAP (18:20) @ $800/t
1000kg x 0.2 = 200kg P
$800/200 = **$4.00/kg P**

- 2008 sparked immense interest in alternative P sources

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Recycled Organic Wastes - Which Products?

- Grape Marc
- Biosolids
- Chicken Litter
- Pig Eco-shelter Bedding

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Grape Marc

- By-product of wine production
- Low and largely unavailable P content
- P Content 0.1 – 0.3%
- N Content 1 – 3%
- S Content 1%
- Also contains some Zn, Cu and other trace elements
- Provides organic N addition to soil
- Limited to areas close to wineries

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Biosolids

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Biosolids or “Hu Poo”

- Available through SA Water at Bolivar
- 20,000 tonnes produced annually
- Free of charge – just have to freight and spread it
- 100 tonnes minimum order
- P Content – 1.2% quoted (typically 1.5 – 2.2%)
- N Content – 1.2%
- S Content – 0.6%
- Also contains 800g/T Zn, 600g/T Cu, and Mn
- Denser product – weighs between wheat and barley
  - freight is cheaper and spreading is easier than many other products

Biosolids

- Typical use rate – 5 tonnes per hectare (max. 8T/ha)
- Can spread with normal belt spreaders
- This supplies…..
  - 60kg/ha Phosphorus
  - 60kg/ha Nitrogen

  300kg of DAP equivalent
  - 30kg/ha Sulphur
  - 4kg/ha Zinc
  - 3kg/ha Copper

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Cost Effectiveness of Biosolids

- Freight - $20 per tonne (Bolivar to Barossa)
- Spreading - $10 per tonne
- Assuming 5T/ha application rate
- Costs: $30 X 5T = $150 per ha to supply 60kg/ha P
- Cost per kg P = $150/60 = $2.50 per kg

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Restrictions on Use

- EPA approval and soil testing is required
- Conducted and paid for by SA Water
- Contains heavy metals – Zinc, Copper, Cadmium, Lead and Mercury
- Max. application determined by EPA based on soil tests
- “Generic Approval” 8t/ha per year over a 10year period – 80t/ha!!

Biosolid No-No’s

- ✘ Land susceptible to runoff or erosion
- ✘ Rocky ground or poorly drained areas
- ✘ Acidic soils (< pH 5.5 water)
- ✘ Within 100m of watercourses or dwellings
- Must be incorporated within 1 month of spreading

What about use on Pastures?

- ***Must be incorporated within 1 month of spreading***

- This effectively limits biosolids applications to pastures undergoing renovation

- Light soils with harrowing? (Mt Compass)

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Chicken Litter

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Availability

- Currently over 90,000t of chicken litter produced per year in SA
- Likely to increase to over 150,000t if single batch litter systems are continued

Chicken Litter Nutrient Content

- Phosphorus content varies between 0.7 - 2% (dwt)
  - Moisture contents are around 20%
  - i.e. 2.5 t/ha supplies 14–40 kg/ha of Phosphorus
  - Equivalent P rate to 70 - 200kg/ha DAP
  - Very important to get the litter nutrient tested

- Nitrogen content varies from 3-5% (dwt)
  - A component of the N is volatile
  - Up to 50% of N lost if not incorporated or washed in by rainfall
  - Considered as a bonus
- Sulphur 0.6%
- Potassium 2%
- Zinc between 400-500g per tonne

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Valuing Phosphorus(P) in Chicken Litter

- DAP (18:20) @ $800/t
  - 1000kg x 0.2 = 200kg P
  - $800/200 = **$4.00/kg P**

- Raw Chicken Litter (1.2% P dwt)
- Cost $25/t or $10 per cubic metre delivered to paddock
- 20% moisture (or 80% DM)
- Spreading costs $15/t
  - 1000kg x 0.012 x 0.8 = 9.6kg P
  - $40/9.6 = **$4.17/kg P**

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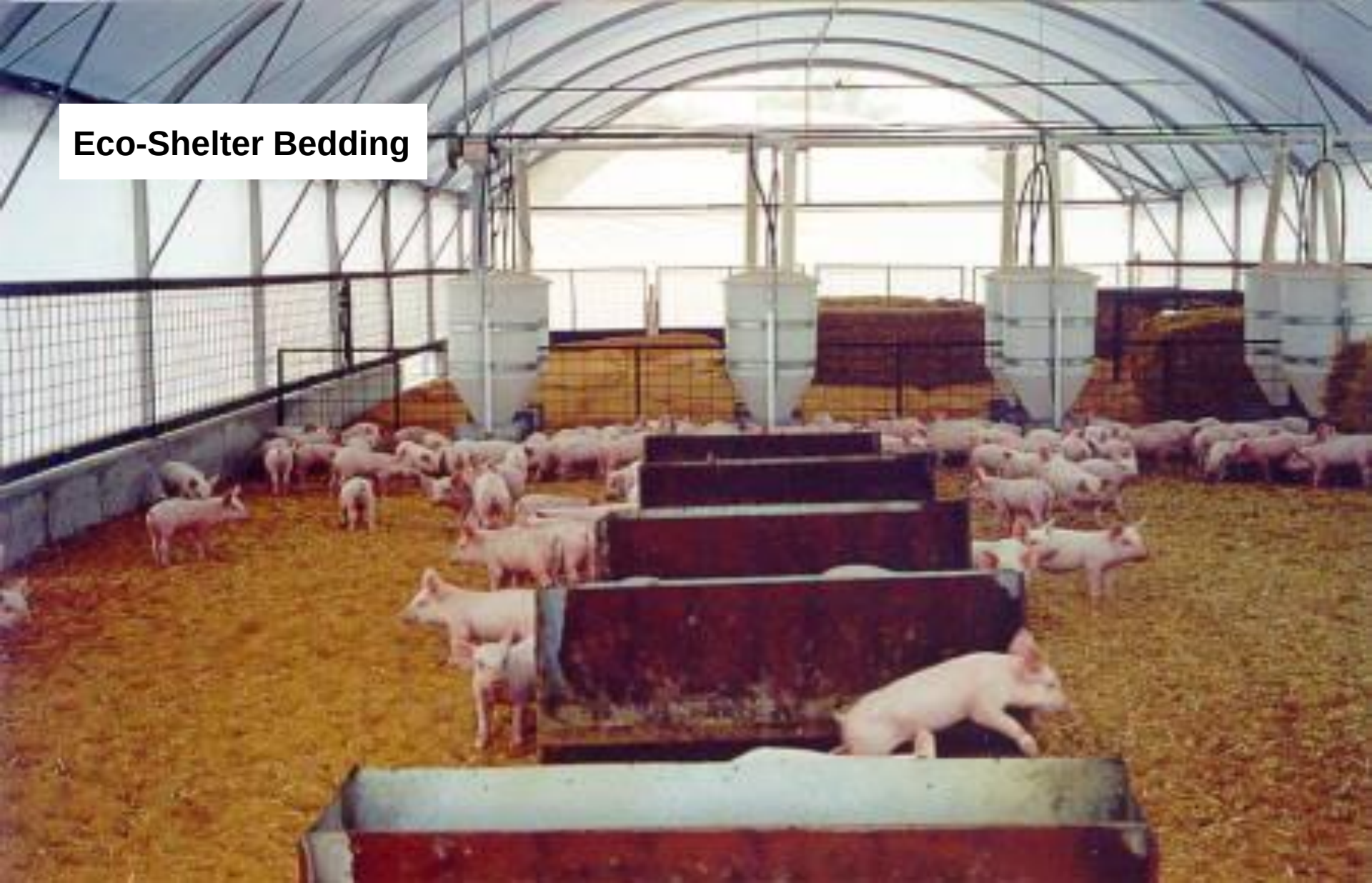
Eco-Shelter Bedding



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EcoShelter Bedding

- P Content 1.2% ave.
- N Content 2.9% ave.
- S Content 0.6% ave.
- Contains useful amounts of Zinc
- Variable Copper
- Difficult to spread
  - can be lumpy when high in moisture content
  - Light when dry
  - can blow around
  - Apply to stubble paddocks to anchor product
  - need high capacity spreader
- 20-50% N losses if not incorporated or washed in

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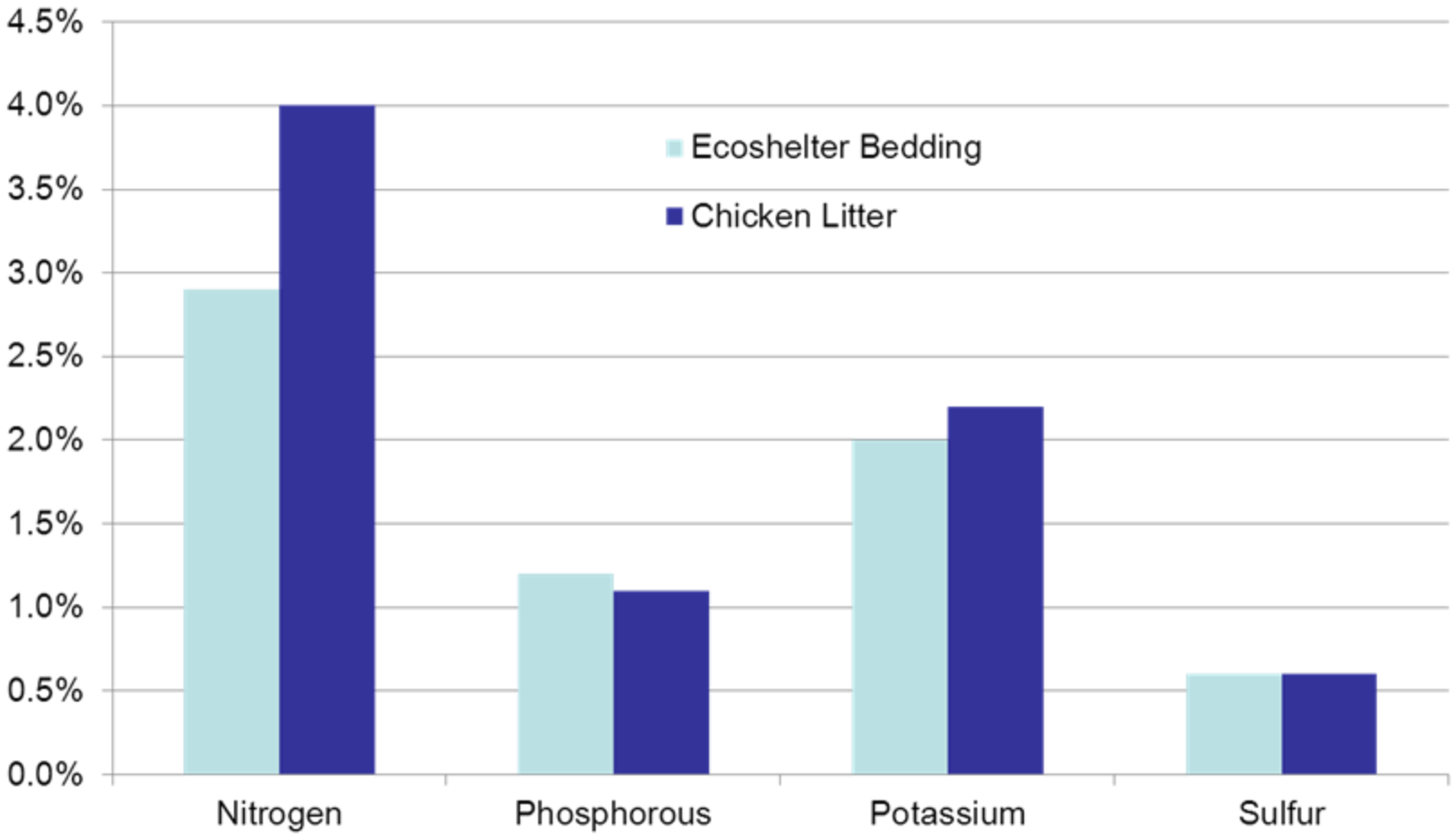
EcoShelter Bedding vs Chicken Litter - Macronutrients



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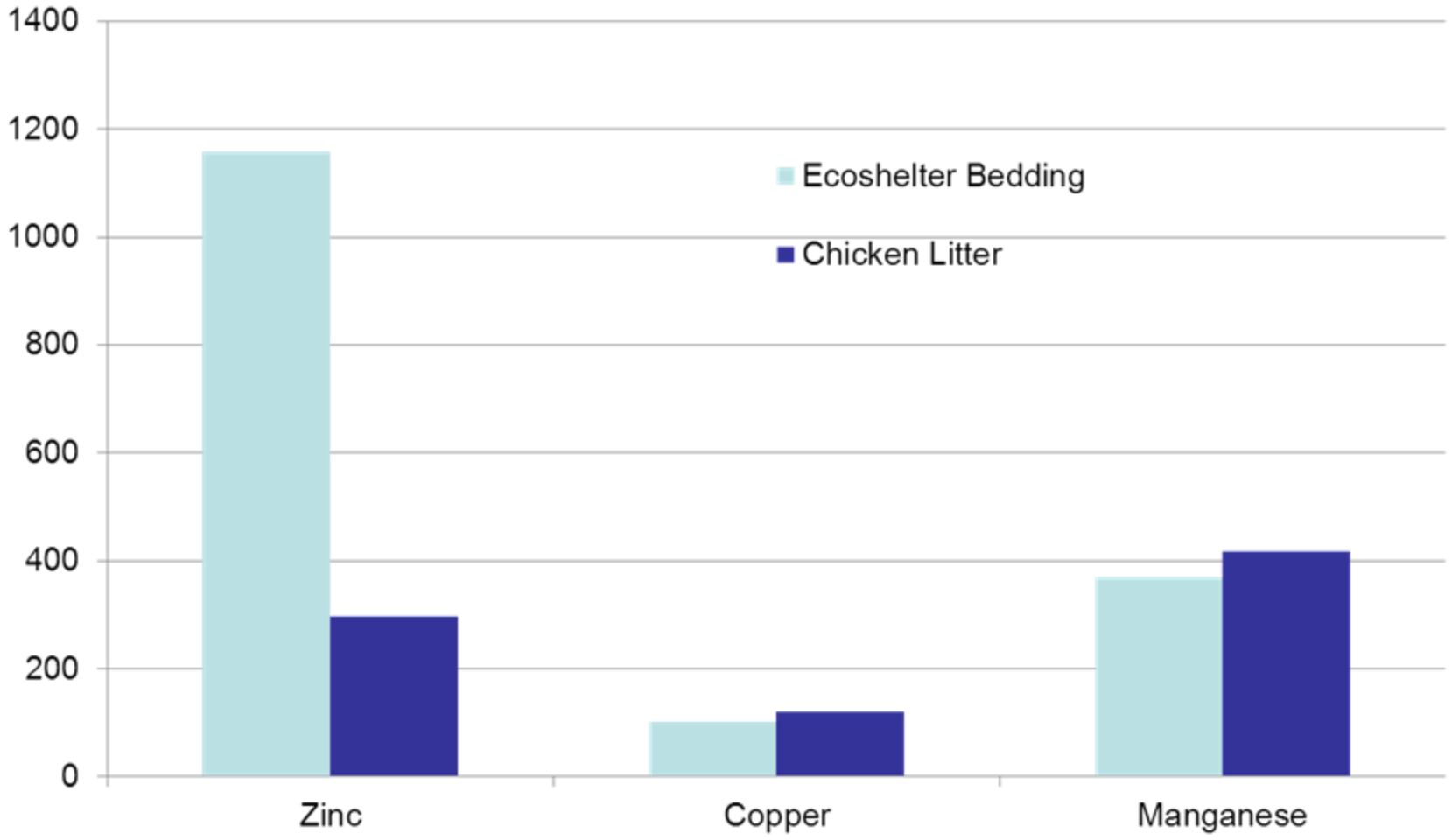
EcoShelter Bedding v Chicken Litter - Micronutrients



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Piggery EcoShelter Bedding Product Survey

- High moisture contents
- Due to the wet 2010-11 summer?

Moisture %

Average	48%
Range	*6.40% - 73.7%*

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Do we need to use some conventional fertiliser as well?

Vigour Score 7 **(Photo taken 3rd July, 7WAS)** Vigour Score 9

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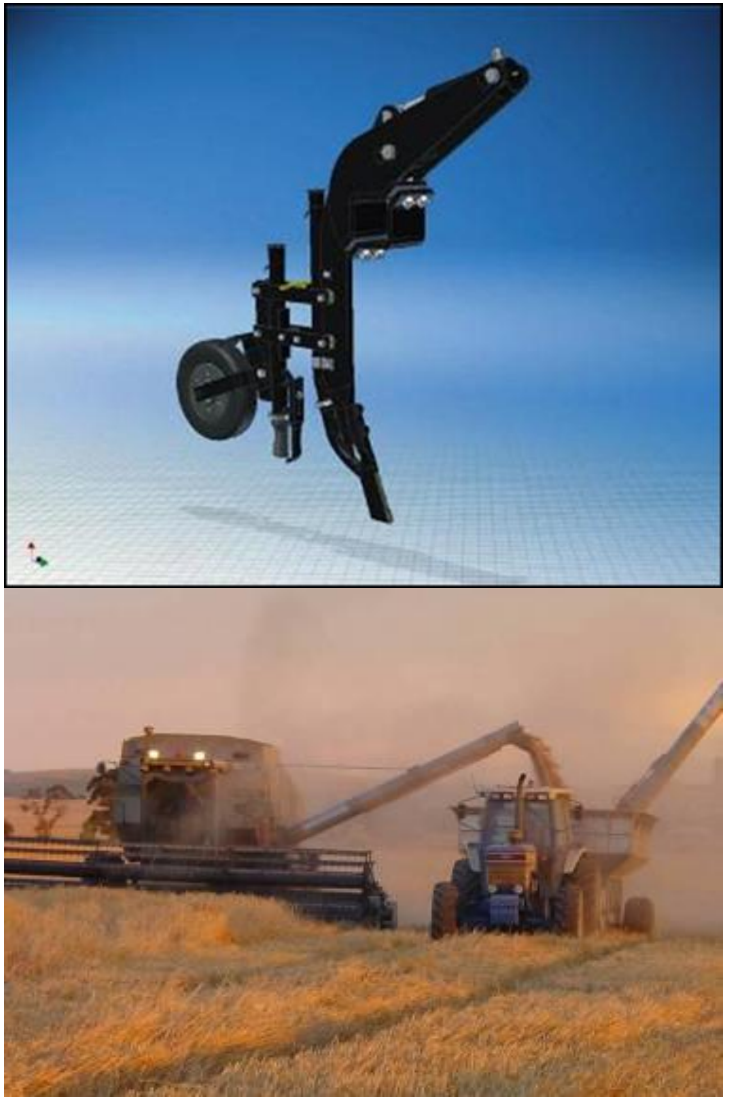
Why were yields and vigour slightly lower with chicken litter?

- Lower nutrient availability (phosphorus in particular)?
- Lower nutrient accessibility?– i.e. Placement of plant nutrients with fertiliser compared with chicken litter?

Observation:

- At most sites, yield reductions were overcome with the application of a “starter rate” of conventional fertiliser (50% of the “normal” rate) applied in the seed row



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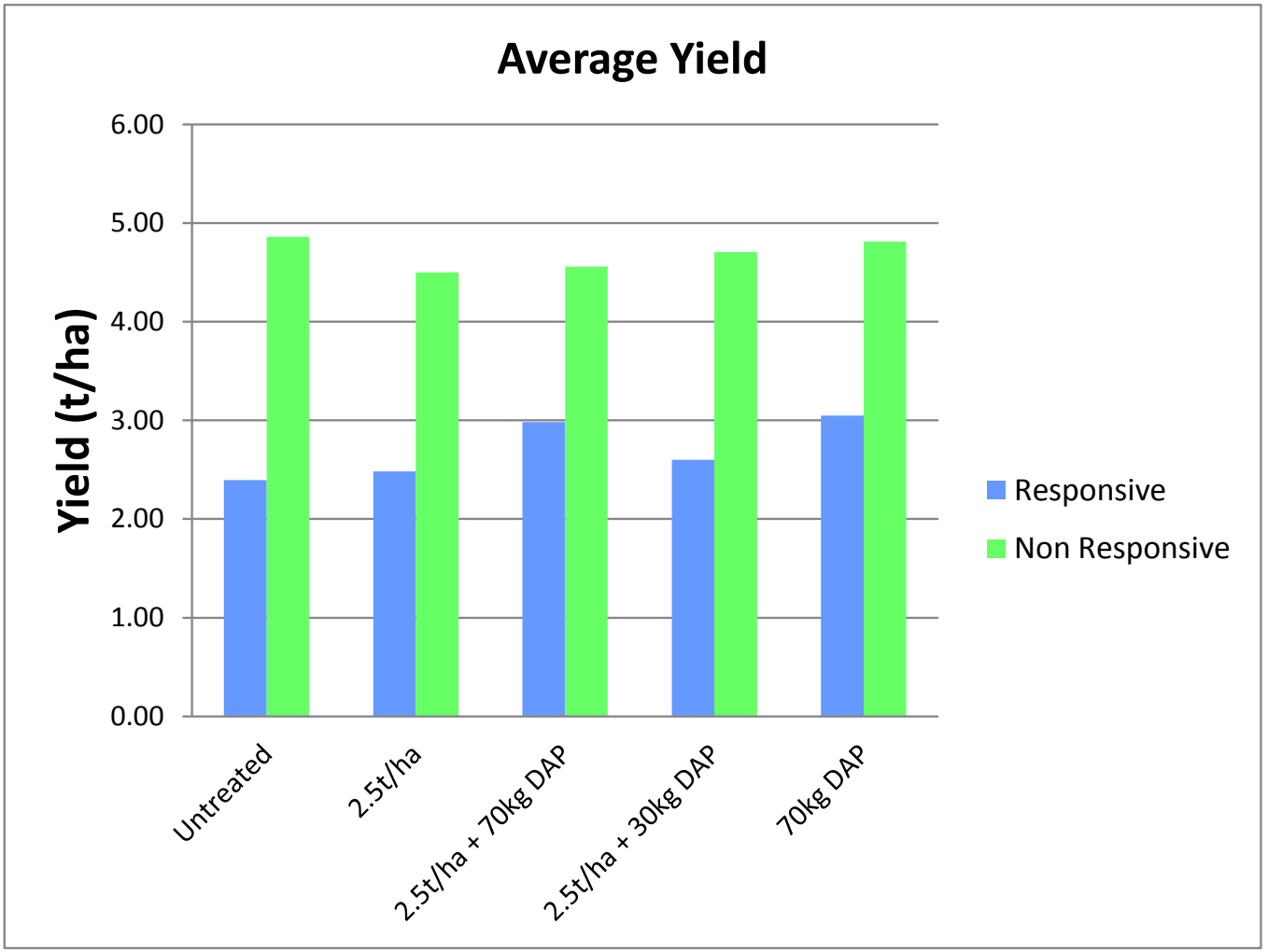
Chicken Litter and Starter Fertiliser - Freeling



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Incorporation

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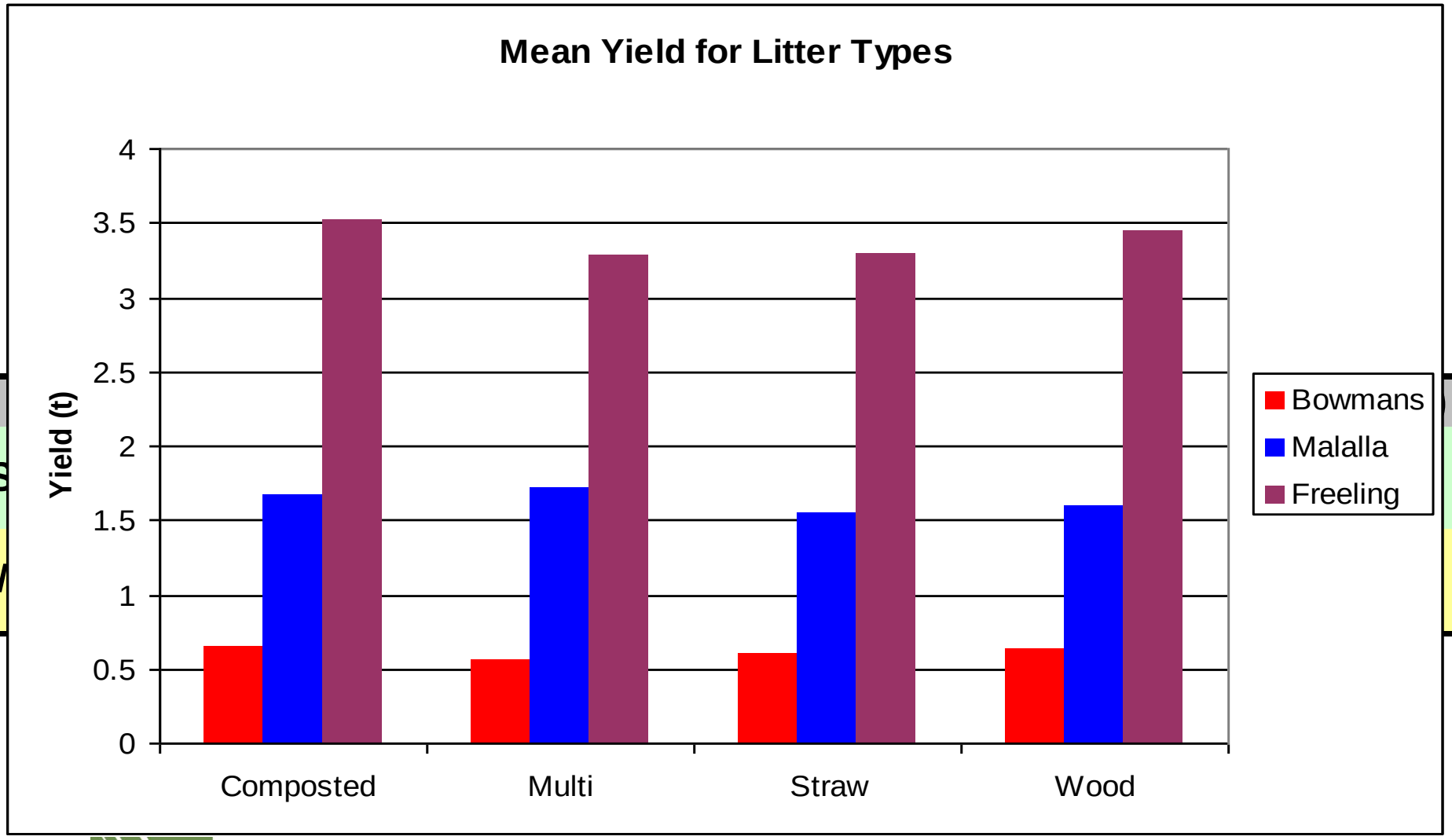
- Significant rainfall or incorporation soon after spreading raw manure products should improve N efficiency
- In practice this is difficult to achieve – treat N as a “bonus” when valuing product

Composted Chicken Litter vs Raw



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What about use on Pastures?

- ***It is illegal for stock to be allowed to consume these products***
- Contains spilt feeds (including meat meal)
- BSE risk but also botulism and salmonella
- Must not allow stock access to stockpiles
- Do not graze pastures within 3 weeks of application

Messages for Chicken litter and Ecoshelter Bedding Users

- These products contain a range of nutrients required by broadacre crops and pastures.
- You may need to apply "starter" fertiliser when sowing crops if you have low soil phosphorus levels – Soil Test
- "Heavy metals" appear to be low – but need to watch "nutrient accumulation" in soils with long term use
- Prevent consumption by livestock – Restrict access to stockpiles and don't graze for 3 weeks post application
- Nutrient content, moisture content, and cost are the key drivers of cost-effectiveness rather than the type of product
- Nutrient contents vary substantially between products and batches – get it tested!
- These products needs to be price competitive on a cost per kg of nutrient basis to be attractive – do the sums!

Recycled Organic Wastes as Soil Improvers?

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Recycled Organic Wastes as Soil Improvers?

Soil Improvement Trials – Erith 2010 -2012

No Chicken Litter

20 t/ha Chicken Litter

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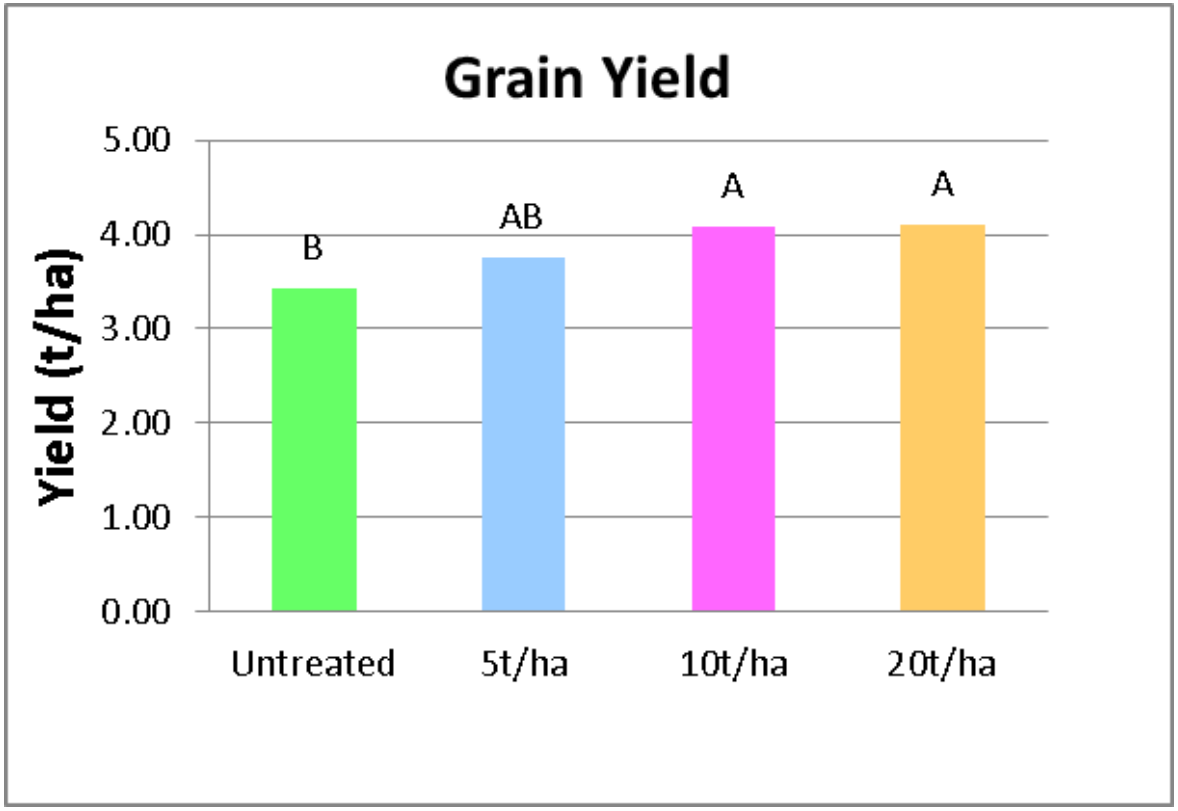
Wheat Grain Yield 2010 – Year 1

- there was 19.5% increase in yield with high rates of of chicken litter



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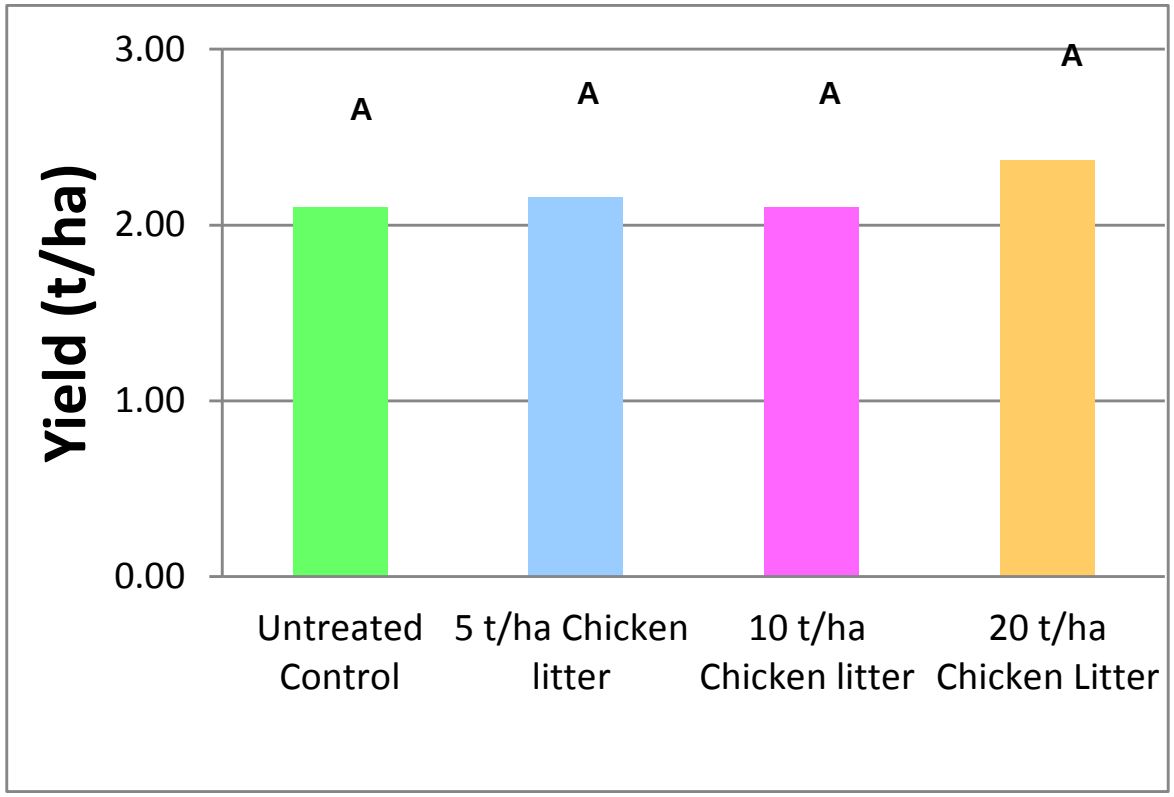
Barley Grain Yield 2011 – Year 2

- Vigour responses evident
- Yield response at 20t/ha but not statistically significant
- Rhizoctonia and mouse damage



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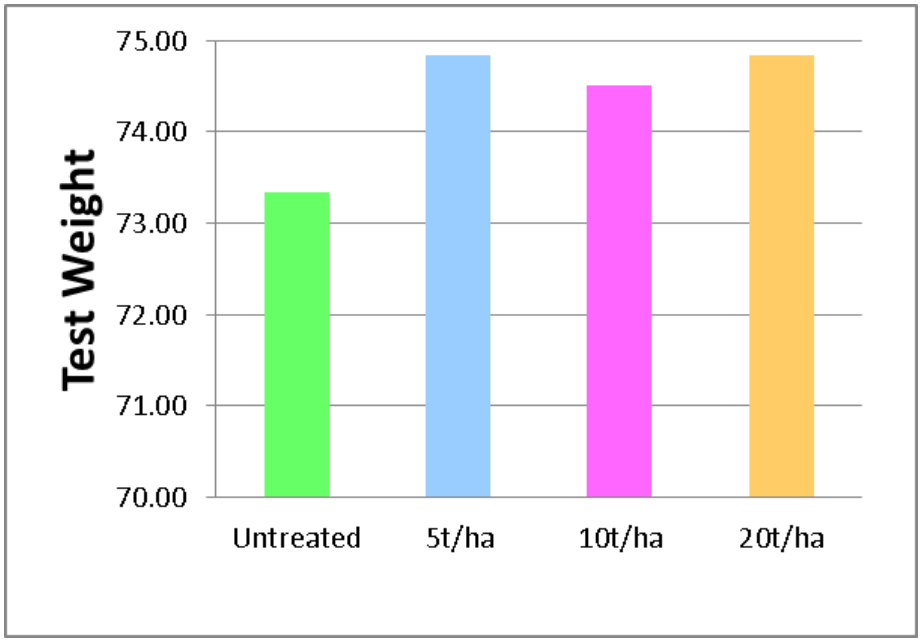
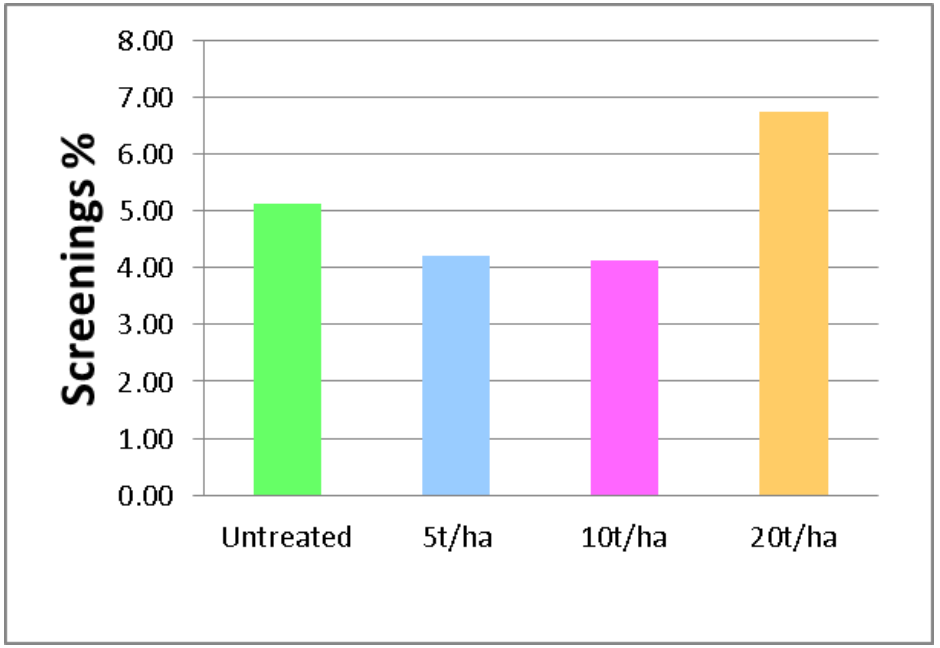
Grain Quality – Screenings and Test Weight

- there were no significant grain quality responses to high rates of of chicken litter





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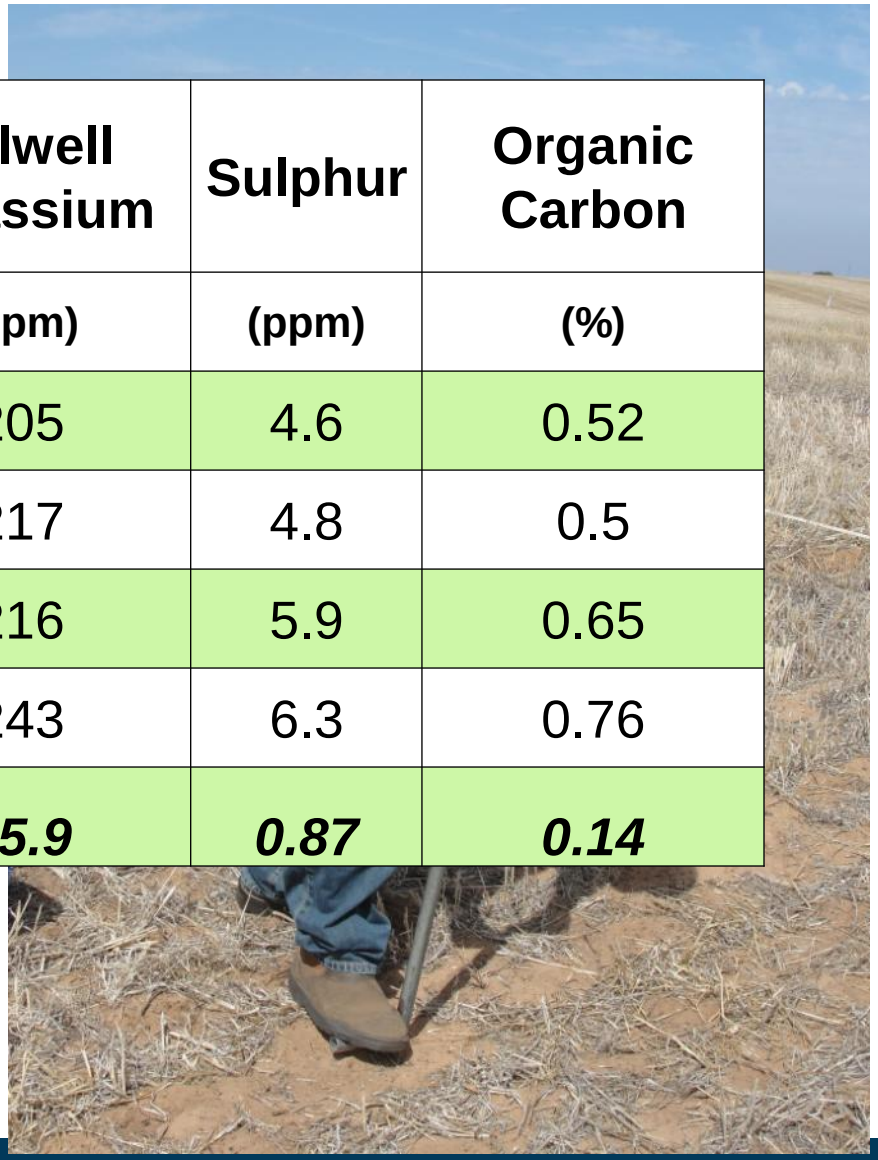
Plant Tissue Test Responses

	Copper	Manganese	Phosphorus	Potassium	Sulphur	Nitrogen	Zinc
	mg/kg	mg/kg	%	%	%	%	mg/kg
2011 Barley*							
Untreated	5.8	45.0	0.5	4.5	0.3	4.0	26.9
5t/ha	6.3	47.9	0.6	4.9	0.4	4.9	31.3
10t/ha	6.4	40.9	0.6	4.8	0.4	4.9	36.1
20t/ha	8.1	48.2	0.6	4.8	0.5	5.3	39.5

Soil Test Results – February 2012

Treatment	Colwell Phosphorus	Colwell Potassium	Sulphur	Organic Carbon
	(ppm)	(ppm)	(ppm)	(%)
Untreated	32.7	205	4.6	0.52
5t/ha	39.7	217	4.8	0.5
10t/ha	52	216	5.9	0.65
20t/ha	70.7	243	6.3	0.76
LSD 5%	***17.1***	***35.9***	***0.87***	***0.14***



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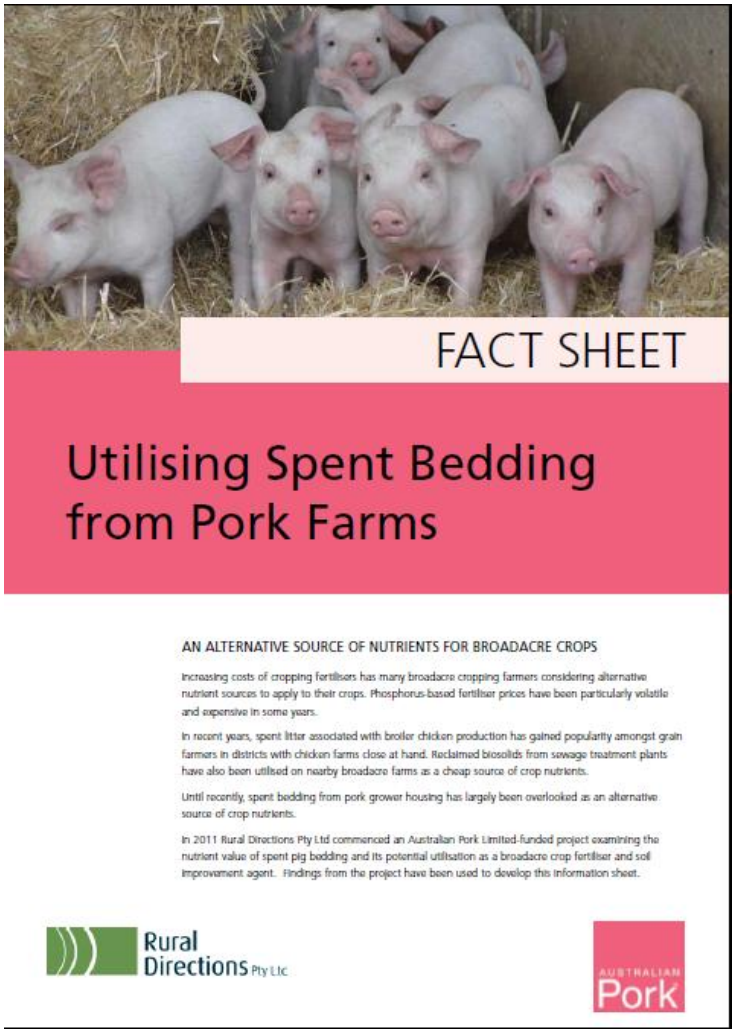
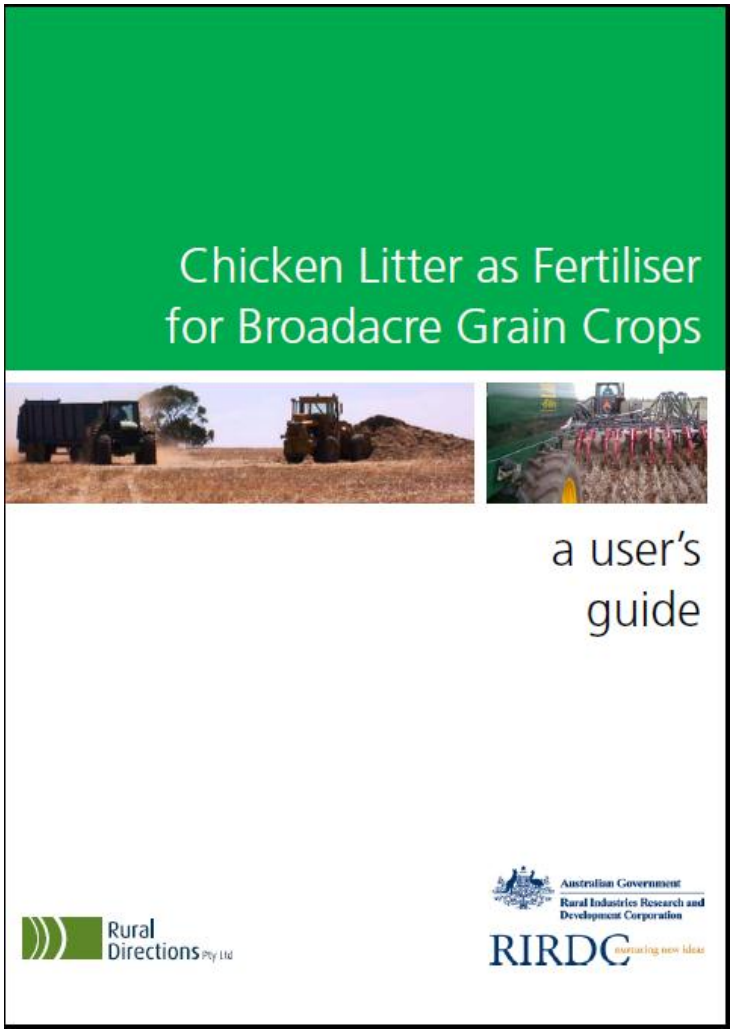
Helpful Resources http://www.ruraldirections.com/





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Poo Calc

A calculator for estimating the value of nutrients in chicken litter and other by-products

Inputs required:

1. The nutrient composition of the by-product, including moisture content and bulk density
2. The price per tonne of conventional fertiliser
3. The cost of the organic by-product, freight and spreading

Instructions:

1. Click on the ***Organic By-Product Calculator*** tab to begin
2. Enter data into the ***yellow*** cells only
3. Enter the analysis details of the By-Product into ***Table 1***
4. Enter the Price per tonne of conventional fertiliser (delivered to farm) into ***Table 2***
5. Enter the intended application rate of the by-product into the ***Additional Assumptions*** table
6. Enter the estimated percentage loss of nitrogen from the organic by-product into the ***Additional Assumptions*** table
7. Nominate the nutrients to be valued in ***Table 3*** by entering **1** in the nutrients to be valued, and **0** in nutrients not valued
8. Enter the purchase cost of the by-product, freight and spreading per cubic metre into ***Table 4***

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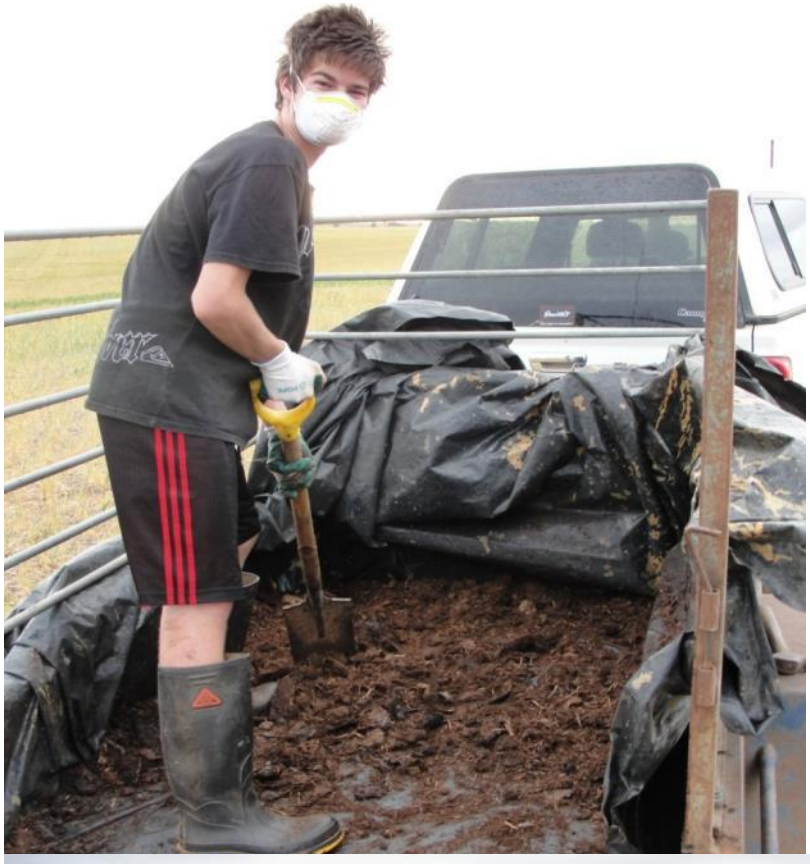
Agribusiness Consultants

Instructions | Organic By-Product Calculator

What's Next????



Monarto Agricultural Bureau Project

- Have recently been awarded a Landcare Community Grant

- Demonstration trials planned in 2014
  - Biosolids
  - Chicken Litter
  - EcoShelter Bedding

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