

The Economics of Subsoil Manuring the numbers are out

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Content of today's paper

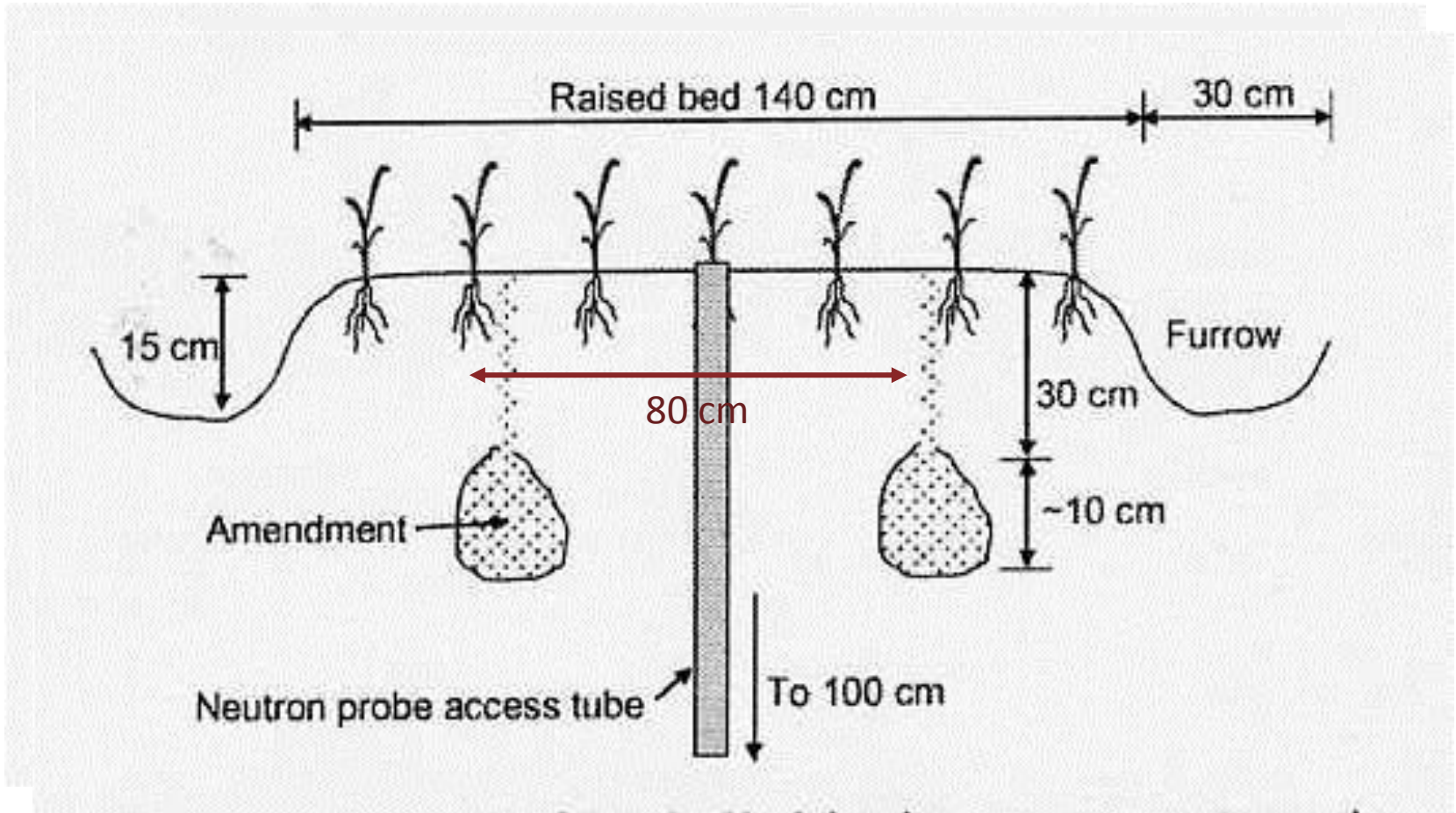
1. Background to subsoil manuring
2. Update on the 2012 results in GRDC project
3. Profitability of subsoil manuring
4. Comments on the use of subsoil water
5. Difficulties for adoption of subsoil manuring.

...the problem of dense clay subsoils



Low macro-porosity
High bulk density
Low infiltration
Frequently sodic ($\text{ESP}\% > 15\%$)

...subsoil manuring ... a solution ?



- The deep incorporation of high rates (up to 20t/ha) of manure into the clay subsoil

Key messages :

1. Subsoil manuring is VERY expensive...
2. Large, consistent increases in grain yield each year
3. Payback in 1-2 years
4. Subsoil manuring is HIGHLY profitable
5. Agronomy proven
....now we must refine amendment form, rate, source,
and machinery.

Crop yield responses....and the story in 2012 (dry spring)

Crop yields & increases in 2012 (dry spring)

	Control	SSM (20 t/ha)	Yield increase	
Penshurst canola	- 2.3	4.3	2.0 t/ha	+ 87%
Derrinallum wheat	- 6.3	10.4	4.1 t/ha	+ 65%
Stewarton wheat	- 4.9	9.4	4.5 t/ha	+ 92%
Dookie wheat	- 5.3	9.4	4.1 t/ha	+ 77%
Wickliffe faba beans	- 3.6	6.3	2.7 t/ha	+ 75%

Average wheat responses over 7 years

.... twelve (12) wheat crops from 2005-2012
(site x season combinations, 1 to 4 years after incorporation)

Average commercial crop - 5.8 t/ha

Average subsoil-manured crop - 9.3 t/ha

(at 20 t/ha)

+ 60 %

Is Subsoil Manuring Profitable ?

....the perception has been that it is exorbitantly expensive to try to modify the subsoil !

The economic analysis

..... approach taken

Manure amendments incorporated once in subsoil, April 2009

2009 – wheat
2010 – canola
2011 – wheat
2012 – canola

2009 – wheat
2010 – canola
2011 – wheat
2012 – wheat

Penshurst Derrinallum

Partial budgets set up for the 4-crop sequences at these 2 sites
Profitability determined by Extra Returns – Extra Costs

“This is what happened over 4 years of cropping at these two HRZ cropping farms, when subsoil manuring was undertaken in 2009, compared to what happened with normal cropping practices over the same time.”



EXTRA COSTS in 2009 (Penshurst)

POULTRY LITTER:

ACTUAL

Purchase of poultry litter (40 m³ @ \$8) = \$ 320/ha

Freight on poultry litter (@ \$0.083 / t /km) = \$ 435 /ha

Handling litter + labour = \$ 150 /ha

TOTAL Litter = \$ 905 /ha

EXTRA COSTS in 2009 (Penshurst)

INCORPORATION:

ESTIMATED

Tractor - 300 HP - working extra 500 hours/year on SSM;
subsoiling at 0.5 ha/year to achieve high incorporation rate.

owning (depreciation, interest, shedding)	= \$ 48 /ha
operating (total operating + labour)	= \$ 272 /ha

Custom-built subsoiling machine @ \$170,000

owning & operating	= \$ 120 /ha
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TOTAL Incorporation = \$ 440 /ha

**TOTAL cost of subsoil manuring
at Penshurst in 2009**

\$ 1345 /ha

Additional EXTRA COSTS (Penshurst)

COSTS of HARVESTING / HANDLING extra grain:

Harvesting @ \$15/t

Handling @ \$12/t

EXTRA RETURNS (Penshurst)

\$'s from extra grain:

Extra yield (t/ha) x price (\$/t) **ACTUAL**

Savings on fertiliser:

No fertiliser for 3 years for 20t/ha

No fertiliser for 2 years for 10 t/ha

Price (\$/kg) x Rate (kg/ha) **ACTUAL**

Penshurst results (FULL rate – 20 tonnes litter/ha)

	2009 Wheat	2010 Canola	2011 Wheat	2012 Canola
Extra Costs (\$/ha)	1398	27	67	39
Extra yield (t/ha)	2.8	1.2	4.5	2.0
Extra benefit (\$/ha)	830	789	1202	1100
NET benefit (\$/ha)	- 568	764	1135	1061

Penshurst (20 t/ha) 2009-2012

....investing \$1345 /ha in 2009 ?

NPV	\$1810 /ha
Annuity	\$ 546 /ha per annum
MIRR	76 %

Penshurst results (HALF rate – 10 tonnes litter/ha)

	2009 Wheat	2010 Canola	2011 Wheat	2012 Canola
Extra Costs (\$/ha)	717	21	57	22
Extra yield (t/ha)	2.0	0.6	3.6	0.6
Extra benefit (\$/ha)	678	398	814	330
NET benefit (\$/ha)	- 39	377	757	308

Penshurst (10 t/ha) 2009-2012

...investing \$717 /ha in 2009 ?

NPV	\$1140/ha
Annuity	\$ 336/ha per annum
MIRR	239%

Comments on the use of subsoil water

Crop yields & increases in 2012 (dry spring)

	Control	SSM	Yield increase	
Penshurst canola	- 2.3	4.3	2.0 t/ha	+ 87%
Derrinallum wheat	- 6.3	10.4	4.1 t/ha	+ 65%
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Loss of subsoil water (50-100 cm) in 2012. (between flowering and maturity)

	Control	SSM	
Penshurst canola	- 14.8	45.8	**
Derrinallum wheat	- 12.0	26.7	**
Stewarton wheat	- 0.6	40.6	**
Dookie wheat	- 47.8	81.6	**
Wickliffe faba beans	- 5.2	23.4	NS

Can we increase...

“soil bucket size” ?



...the “Golden Chalice” in soil management.....

Subsoil manuring and ... “ Bucket Size” ?

	Control plot	Subsoil-manured plot
PAWC (0-40 cm)	98 mm	102 mm
PAWC (40-100 cm)	60 mm	138 mm

PAWC is the plant available water capacity

**Increase in water holding capacity [40-100 cm]78 mm
with subsoil manuring**

Why are we able to use the extra subsoil water ?

.... because of changes in the physical properties
of the clay subsoil

..... 4 years after treatment

Control plot 30-40 cm



SSM plot 30-40 cm



Explains 50-fold increase in *hydraulic conductivity*
2 ½ -fold increase in *macroporosity*

(Gill *et al.* 2009)

Difficulties for subsoil manuring !

.....what advisers should discuss with interested cropping clients.

1. Machinery to incorporate the amendments ?

New GRDC research project to develop machinery
- needs to handle different amendments at speed

2. The high cost of the organic amendments

Penshurst in 2009:

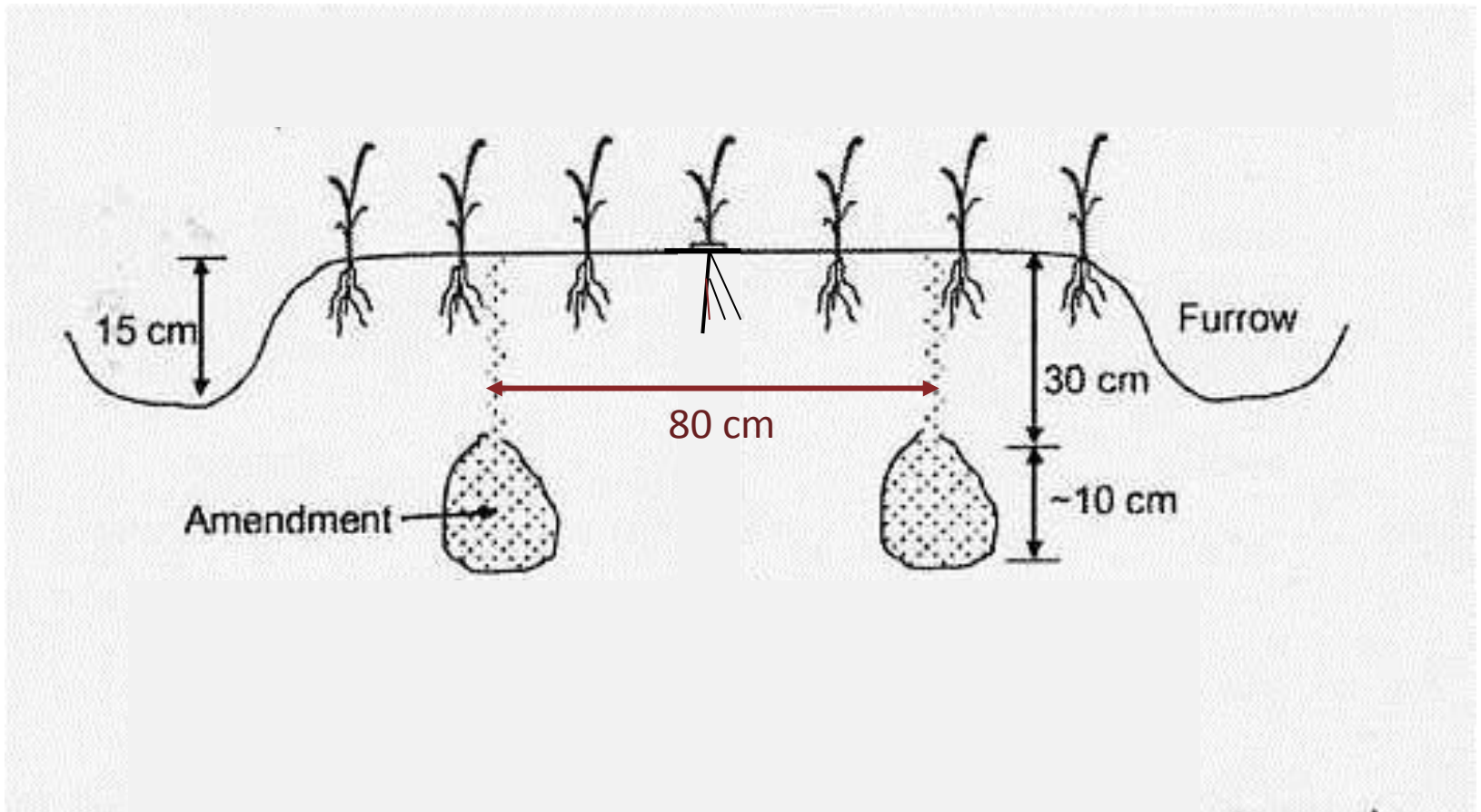
Purchase of 20 t poultry litter = \$320 /ha

Freight on 20 t poultry litter = \$435 /ha

Handling of 20 t poultry litter = \$150 /ha

....around 2/3 of total cost of practice.

Can we use crop residues (processed) as a subsoil amendment ?



Key messages :

1. Subsoil manuring is VERY expensive...
2. Large, consistent increases in grain yield each year largely attributed to increased use of subsoil water
3. Payback in 1-2 years
4. Subsoil manuring is HIGHLY profitable
5. Agronomy proven
....now we must refine amendment form, rate, source, and machinery to lower costs.



Thank you

Research team

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