# "Building Resilient Farming Systems, 2010"

## Part 1: Spader

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**Key Outcomes:**

- Spader generally produced a positive yield response (grain or biomass) on sandier soils that had previously been clay spread &/ delved
- The inclusion of organic matter prior to spading generally improved the level of response to spading
- Know your soils that you are spading; (not recommended on shallow red loam soils over clay where there is a sodic A2 horizon)

**Trial Objective:** To improve water use efficiencies of crops and pasture by reducing the soil constraints that impede root growth.
**Trial Duration:** 2009-2010
**Location & Farmer Co-operators:** 5 sites; Upper SE Region
Lowan Vale (Groocock), Sherwood (Jaeschke), Western Flat (Ramsey), Willalooka (Lock), Bordertown (Bordertown High School)
**Soil Type:** Various
**Type of Trial:**
**Trial Design:**

**Figure 1: Spader in action:**

### *Groocock – Lowan Vale*

The 2009 trial site, adjacent to the Old Landcare Project Site, has a very good fertilizer history and soil analysis from samples taken in August 2009 showed no difference between the different treatments with all the nutrients well in the adequate range.
Plant analysis confirmed this, with the only nutrient being in the marginal range being manganese. This paddock has had a history of delving over a long period of time. It has also had some deep injection of trace elements.
As the soil tests showed it has been transformed from a relatively infertile sand over clay soil into a very fertile sandy clay soil which has been further enhanced with the incorporation of clay to 35 cm with the spading machine.
There was no response to treatment in wheat grown at the 2009 harvest. This site had faba beans established on it in 2010.
Due to the non-responsiveness of the 2009 site, a second trial site on a less fertile paddock was established in 2010. This paddock had been delved and was sown to wheat.

***2010 Trial Site results:***

Table 1: 2009 Established Site; Faba Bean grain yield 2010 :

| Treatment | kg/ha | % site mean |
|---|---|---|
| Fertiliser spread on surface | 3029 | 90 |
| **Nil** | **3105** | **92** |
| Spader 2009 | 3263 | 96 |
| **Spader 2009 and Organic Matter** | 3504 | **104** |
| Spader 2009 and Fertiliser | 3510 | 104 |
| **Nil 2009 Spader 2010** | 3523 | **104** |
| Spader 2009 and 2010 | 3751 | 111 |

| | |
|---|---|
| Site mean (kg/ha) | 3384 |
| CV% | 5.16 |
| lsd(0.05) | 358.7 |

There was a significant response in bean yield to all the spading treatments except the single spaded treatment of 2009. Soil and plant analysis taken from this site does not explain why the response is occurring. It could be a physical response to a changed soil condition such as better aeration improving nodule activity but this is very speculative. The physical and biological changes in the soil that result from spading need closer investigation and were beyond the scope of this project.

Table 2: 2010 Established Site;
Wheat Vegetative Dry Matter (kg/ha):

| Treatment | kg/ha | % site mean |
|---|---|---|
| Fertiliser Spread | 1158 | 108.6 |
| **Nil** | **930** | **87.2** |
| Spader | 1051 | 98.6 |
| **Spader + Fertiliser** | **1009** | **94.6** |
| Spader + Organic Matter | 1184 | 111 |

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|---|---|
| Site mean DM(kg/ha) | 1067 |
| CV% | 12.42 |
| lsd(0.05) | 244.1 |

Dry Matter cuts were taken on 17/8/2010. No significant difference was observed between treatments

**Table 3: 2010 Established Site; 2010 Wheat Grain Yield**

| Treatment | kg/ha | % site mean |
|---|---|---|
| Nil | 3468 | 95 |
| **Spader + Organic Matter** | **3470** | **95** |
| Spader + Fertiliser | 3701 | 101 |
| **Spader** | **3770** | **103** |
| Fertiliser spread | 3860 | 106 |

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|---|---|
| Site mean (kg/ha) | 3654 |
| CV% | 4.96 |
| lsd(0.05) | 425.9 |

No significant difference was observed between treatments

## *Jaeschke – Sherwood*

**There was a response in vegetative yield on all the spaded treatments on this site in 2009. However, the spader + organic matter treatment that looked significantly better than other treatments during the growing season suffered with the heat of early November 2009 so that the vegetative growth was not reflected in grain yield.**

**Barley grown in 2010 was sown late into a heavy stubble and residual summer weeds that had accumulated over summer. Consequently the wheat did not reach its potential and the trial was patchy. This was reflected in the large coefficient of variation in the statistical analysis. However the Spader + organic matter treatment was significantly higher in vegetative yield and with the Spader + fertiliser was the best grain yielding treatment (but not statistically significant). There were no differences in the soil or plant analysis taken from the different treatments.**

**Table 4: Jaeschke Barley vegetative yield 19/10/10:**

| Treatment | Yield (kg/ha) | % site mean |
|---|---|---|
| Fertiliser spread | 2457 | 89 |
| **Spader** | **2503** | **91** |
| Spader deep | 2554 | 93 |
| **Spader + fertiliser** | **2715** | **99** |
| Nil | 2764 | 101 |
| **Fertiliser injection** | **2871** | **105** |
| Spader + organic matter | 3372 | 123 |

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|---|---|
| Site mean (kg/ha) | 2748 |
| CV% | 12.51 |
| lsd(0.05) | 602 |

Dry Matter cuts were taken on 19/10/10. The Spader + Organic Matter Treatment was significantly different.

**Table 5: Jaeschke Barley grain yield (kg/ha) 2010**

| Treatment | Yield (Kg/ha) | % site mean |
|---|---|---|
| Fertiliser spread on surface | 2030 | 92 |
| **Fertiliser injection** | **2105** | **95** |
| Nil | 2105 | 95 |
| **Spader Deep** | **2173** | **98** |
| Spader | 2184 | 98 |
| **Spader and Fertiliser** | **2349** | **106** |
| Spader and Organic Matter | 2585 | 117 |

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|---|---|
| Site mean | 2219 |
| CV% | 15.47 |
| lsd(0.05) | 598.7 |

No significant difference was observed between treatments

## *Ramsey – Western Flat*

**Following the 2009 harvest, soil analysis (0 -10 cm) suggested that the organic layer built up under long term pasture was dispersed throughout the profile. With the low fertility status of the site the grain yield on the spaded treatments, even with added fertilizer, was less than the undisturbed treatments. The exception was the spaded treatment with organic matter which grew significantly more vegetative growth during the season and followed through with extra grain.**

**In 2010 the site reverted to pasture with Balansa clover being spread with the superphosphate application. Pasture composition comprised volunteer barley, ryegrass, subclover, balansa and capeweed.**

**Interestingly there were significant responses in pasture growth to all the spaded treatments for the first 2 harvests during the growing season but not the final one in October. This is consistent with the results in lucerne at Willalooka and has often been the case in lime trials in the South East where pastures respond early in the growing season but this response grows out in the spring.**

**Table 6: Ramsey Dry Weight (kg/ha) July 2010**

| Treatment | DM (kg/ha) | % site mean |
|---|---|---|
| Nil | 562 | 64 |
| **Fertiliser spread** | **645** | **73** |
| Fertiliser injected | 651 | 74 |
| **Urea 2009** | **666** | **75** |
| Spader + fertiliser | 933 | 106 |
| **Spader** | 1217 | **138** |
| Spader + organic matter | 1514 | 171 |

| | |
|---|---|
| Site mean | 883.8 |
| CV% | 16.78 |
| lsd(0.05) | 288 |

There was no difference in the soil analysis between the treatments. In addition a suite of biological soil samples did not identify what was responsible for the growth response. In the plant samples there was an increase in the Total N concentrations in volunteer barley plants growing on the spaded treatments.

**Table 7: Ramsey Dry Weight (kg/ha) 30 August 2010**

| Treatment | DM (kg/ha) | % site mean |
|---|---|---|
| Nil | 387 | 61 |
| **Urea 2009** | **445** | **70** |
| Fertiliser Injection | 483 | 76 |
| **Fertiliser Spread** | **520** | **82** |
| Spader + Fertiliser | 738 | 117 |
| **Spader** | **912** | **144** |
| Spader + organic matter | 943 | 149 |

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|---|---|
| Site mean | 632.4 |
| CV% | 16.92 |
| lsd(0.05) | 186.3 |

**Table 8: Ramsey Pasture Dry Weight (kg/ha) 27th October 2010**

| Treatment | DM (kg/ha) | % site mean |
|---|---|---|
| Fertiliser Injection | 1921 | 88 |
| **Nil** | **2009** | **92** |
| Fertiliser Spread | 2015 | 93 |
| **Urea 2009** | **2075** | **95** |
| Spader + Organic matter | 2232 | 103 |
| **Spader + Fertiliser** | **2264** | **104** |
| Spader | 2719 | 125 |

| | |
|---|---|
| Site mean | 2176 |
| CV% | 20.64 |
| lsd(0.05) | 782 |

No significant difference in the final pasture cuts.

## *Lock – Willalooka*

In 2009 the trial results were presented as drymatter harvested because the barley was harvested with the rest of the paddock. The spader + fertilizer and spader + organic matter treatments indicated a vegetative response during the growing season with some contribution from the undersown lucerne.

The site was spread with around 250 tonne/ha of clay prior to spading, which may explain why there was not a reduction in yield with the spading treatment which may have been expected with the surface organic matter layer being buried and associated nutrition of the soil being diluted.

In 2010 the lucerne grew significantly better on the spaded treatments early in the season as shown by the August harvest. However there was no significant response at the later October harvest. There was no difference in soil or plant analysis between the treatments.

**Table 9: Lock Dry matter (kg/ha) 3/8/10**

| Treatment | DM(kg/ha) | % site mean |
|---|---|---|
| Fertiliser injection | 272 | 70 |
| **Fertiliser spread** | **285** | **73** |
| Nil | 267 | 68 |
| **Ripped** | **275** | **70** |
| Spader | 485 | 124 |
| **Spader + fertiliser** | **493** | **126** |
| Spader + organic matter | 658 | 169 |

| | |
|---|---|
| Site mean | 391 |
| CV% | 11.87 |
| lsd(0.05) | 81.9 |

**Table 10: Lock Dry matter (kg/ha) 29th October 2010**

| Treatment | DM(kg/ha) | % site mean |
|---|---|---|
| Ripped | 1578 | 92 |
| **Spader + fertiliser** | **1573** | **92** |
| Fertiliser injection | 1644 | 96 |
| **Nil** | **1693** | **99** |
| Spader | 1745 | 102 |
| **Fertiliser spread** | **1808** | **105** |
| Spader + organic matter | 1977 | 115 |

| | |
|---|---|
| Site mean | 1717 |
| CV% | 12.2 |
| lsd(0.05) | 369.5 |

No significant difference between treatments.

## *Bordertown High School - paddock 2*

The soil type at the High School farm is a red/brown loam over clay with an increasing level of sodium down the soil profile.

In 2009 at the seasonal break, the soil was only wet to around 10 cm when the site was spaded. This was not ideal and the spader broke a number of chains on the rear roller. Because of the breakdowns the seeding of oats was interrupted and there was patchy emergence and crop growth with no response to treatment.

The gypsum treatments should have both been responsive with the sodic nature of the underlying clay.

**Table 11: Faba Beans grain yield 2010**

| Treatment | Yield (kg/ha) | % site mean |
|---|---|---|
| Fertilizer spread on surface | 1395 | 79 |
| **Nil** | **1602** | **91** |
| Spader and gypsum | 1671 | 95 |
| **Spader** | **1756** | **100** |
| Gypsum spread on surface @ 5 T/ha | 1816 | 103 |
| **Spader and organic matter** | **1884** | **107** |
| Fertilizer injection | 1926 | 109 |
| **Spader and fertilizer** | **2040** | **117** |

No significant difference between treatments.

| | |
|---|---|
| Site mean | 1764 |
| CV% | 14.43 |
| lsd(0.05) | 441 |

## *Bordertown High School - paddock 8*

In 2009 similar difficulties were encountered with this site as for the other High School Site – paddock 2. Wheat was planted but was uneven in growth and there was no response to treatment. As can be seen in the photo below the sodic clay brought up from the A2 Soil horizon impeded drainage on the spaded treatments and the 5 ton of gypsum applied and spaded did not overcome this problem in the first year.

In 2010 there was no drymatter response in volunteer pasture to treatment at an October harvest.

**Table 12: Pasture Dry Matter (kg/ha) 26th October 2010**

| Treatment | DM(kg/ha) | % site mean |
|---|---|---|
| Spader + organic matter | 4160 | 87 |
| **Fertiliser spread** | **4426** | **92** |
| Nil | 4641 | 97 |
| **Fertiliser injection** | **4779** | **100** |
| Gypsum | 4965 | 103 |
| **Spader + gypsum** | **5096** | **106** |
| Spader | 5135 | 107 |
| **Spader + fertiliser** | **5198** | **108** |

No significant difference between treatments.

| | |
|---|---|
| Site mean | 4800 |
| CV% | 13.99 |
| lsd(0.05) | 1170 |

**In summary for the shallow red loam soils over clay, spading is not recommended.**

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## Part 2: Irrigation Area Sampling

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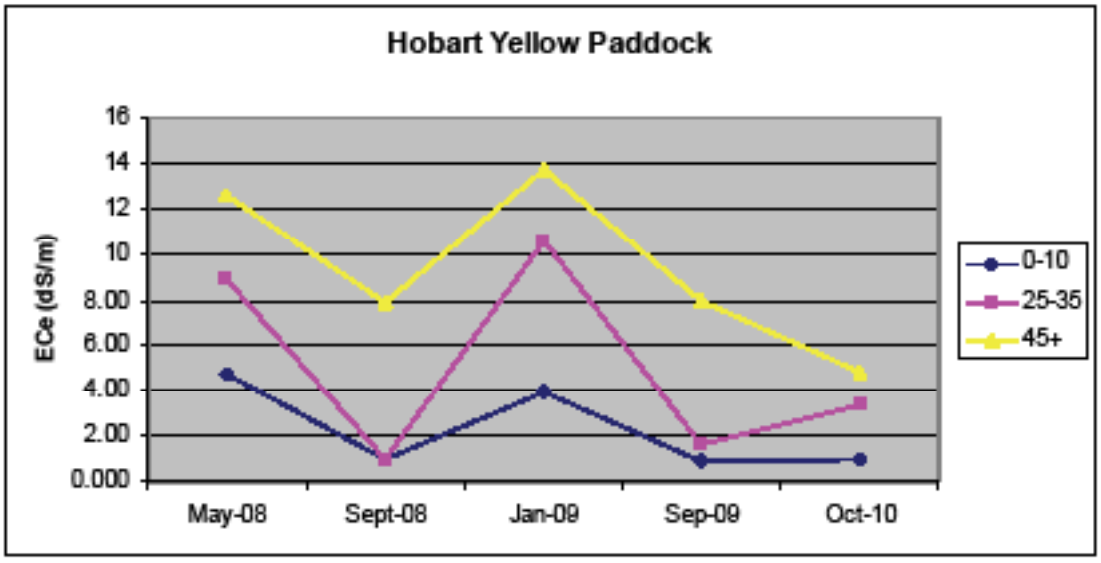
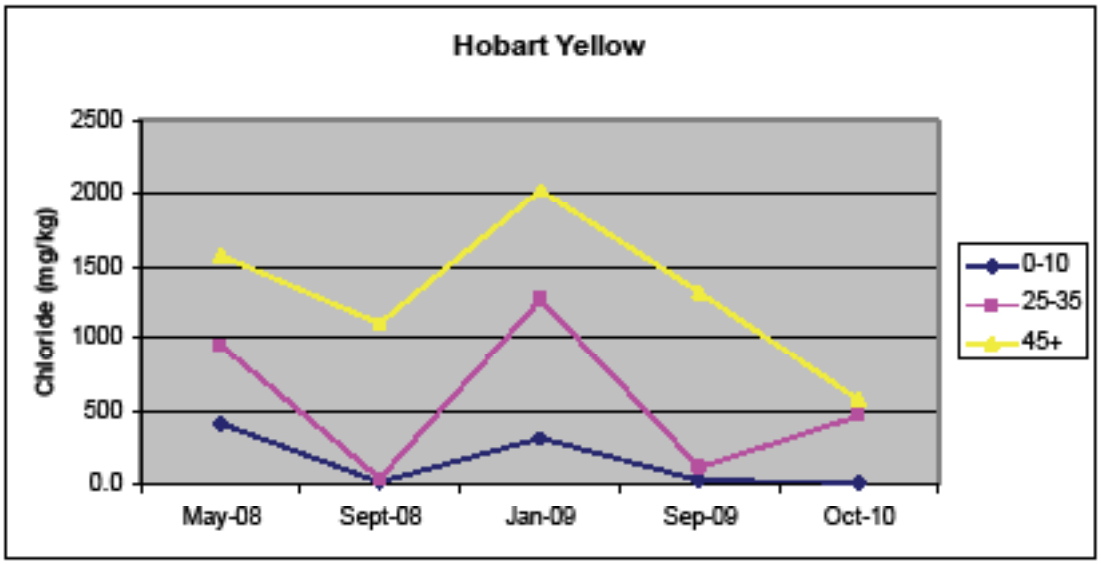
### *Irrigation Area Sampling*

The soil sampling program has continued at John Fry's in 2010. This was particularly valuable as it reinforces the 2009 season that was the first sampling undertaken in the program where near average winter rain helped flush accumulated salt down the profile under the irrigation systems. Not only did the surface salinities decrease but those deeper down the soil profile showed a downward trend.



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## Part 3: Soil Phosphorous on Wolseley Cracking Clays

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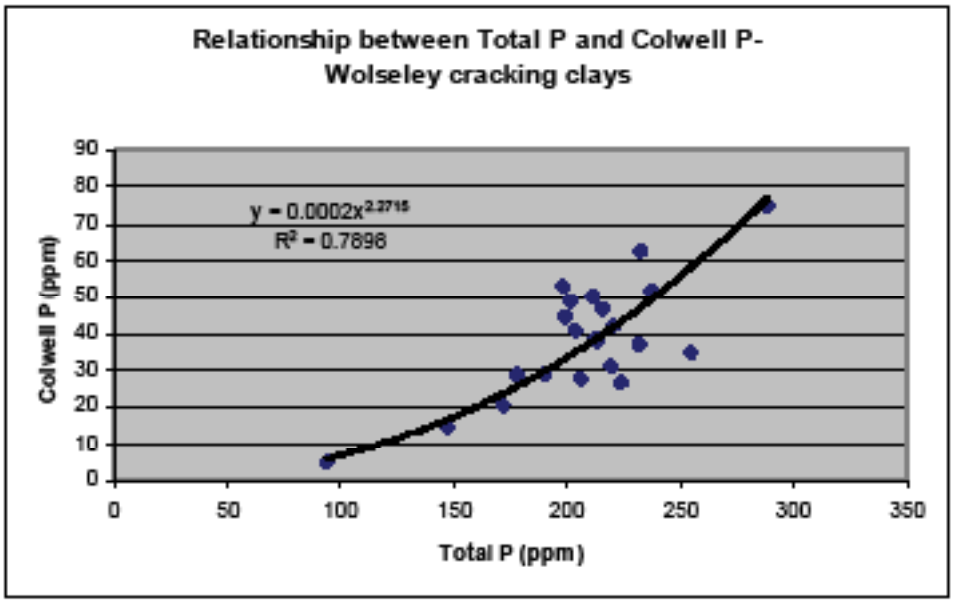
### *Data from Wolseley cracking clays*

With phosphorus fertilisers becoming more expensive and limited with time it is very important that we learn more about their behaviour and availability in our soils. In this project some initial work was done to determine what the fate of applied phosphorus fertiliser was and how this could help with future fertiliser decision making.

Using the standard soil test measure (Colwell P) a number of correlations were applied. The strongest was to Total P. After determining the relationship for particular soil types this has the potential for farmers to understand the dynamics of P in their soils and help budget fertiliser decision making.




- This is data from 22 sites over 11 properties.
- Significant correlations were made on these soils between the soil's phosphorus buffering capacity and the soil's content of "reactive" aluminium (extracted using ammonium oxalate), exchangeable calcium and free lime. Slight differences probably account for some of the "noise" in the middle of this graph.
- Get some baseline information on your soil type – "Reactive" Fe and Al, $CaCO_3$, Phosphorus Buffer Index. These all indicate the strength with which a soil will hold onto P.
- Start measuring your P balance with Total and Colwell P to generate robust information to manage P using a P budget approach.

# "Building Resilient Farming Systems, 2010"

# Part 4: APSIM and Crop Water Use in Wheat

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## *APSIM and Crop Water Use in Wheat*

This trial was established to see whether Soil Water Monitoring Devices data could be applied to assist decision making and yield forecasting in wheat production systems. Results from this trial were not conclusive, partly due to the seasonal conditions experienced during grain fill in both 2009 and 2010. However some important lessons were learnt

- Sensor placement

  Data needs to be collected from the entire root zone and a sensor should be placed beyond the likely root zone to monitor drainage as current calculations assume that all growing season rainfall contributes to yield.
- Assisting management decisions

  Data is likely to be more useful in marginal seasonal conditions when split applications of fertiliser require greater consideration.
- Soil water content at sowing

  In annual cropping systems devices should be installed directly after sowing to provide accurate results for initial water content and calibrated with samples for calculating gravimetric water content.

### Potential Benefits

- Assess the effect of soil and crop management practices on Rainfall Capture, Infiltration and Drainage
- Crop Forecasting and Modelling

***Publications and Extension***

3 publications have been produced with funding from the program:
Soil Water compendium – an identikit for determining the soils water properties. (Bailey 2009)
The Soil Book – Representative soils of the Upper SE (Rural Solutions SA 2009)
Assessing Wheat Crop Water Use – Using soil water monitoring devices in dryland agriculture. (Zerk 2010)