



# CALCULATING RETURN ON INVESTMENT FOR ON FARM TRIALS

DIY PRECISION AGRICULTURE

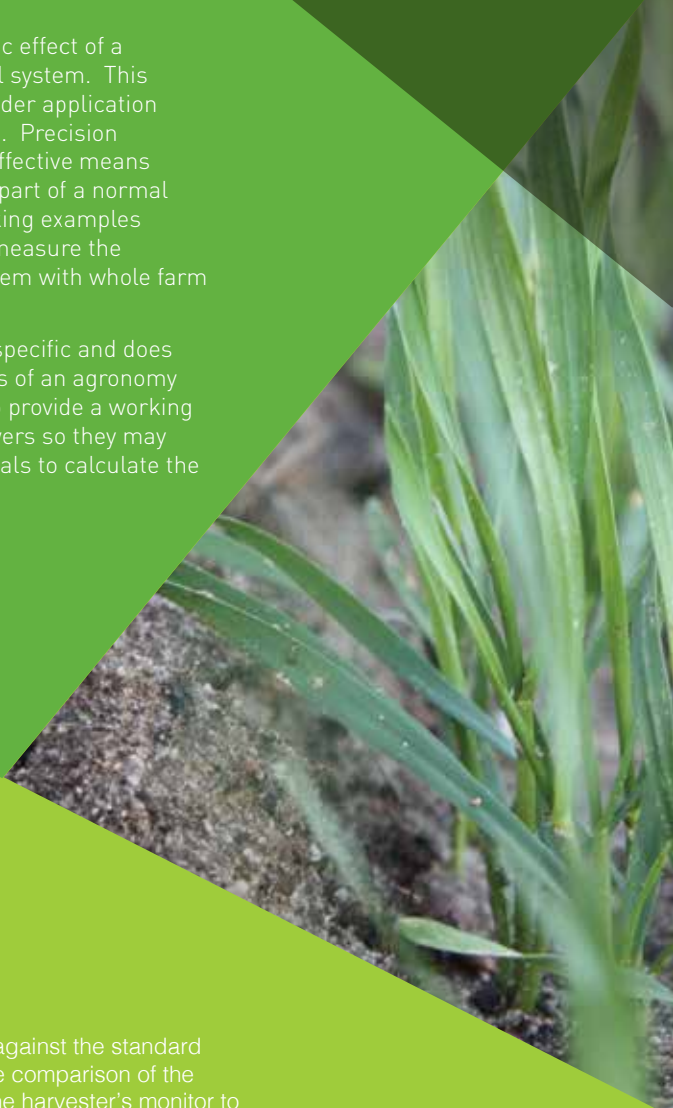
An on farm trial tests the yield or economic effect of a management treatment on an agricultural system. This information can then form the basis for wider application of the treatment in other parts of the farm. Precision Agriculture (PA) tools offer a simple and effective means to implement and measure such trials as part of a normal farming operation. This booklet uses working examples of how PA tools have enabled growers to measure the economic returns of treatments to help them with whole farm decisions.

The data expressed in this booklet is site specific and does not necessarily represent the effectiveness of an agronomy treatment for your farm. The purpose is to provide a working example of the methodology to other growers so they may competently conduct their own on farm trials to calculate the potential return on an investment.

## WHY DO ON FARM TRIALS?

Trials test ideas. Trials enable comparison against the standard paddock practice and allow for an objective comparison of the ideas being tested. Using yield data from the harvester's monitor to analyse these trials puts a value to the practice change and allows you to understand how profitable the change is to your business.

Sometimes trials won't provide you with a return on investment in the first year, and this is an important result. Growers spend money on inputs either as an insurance or to provide them with a direct return. If an input is used as an insurance, it may be worthwhile including a zero strip to gain an understanding of how important this insurance is. If the input is aimed at improving returns it is critical to know how long the investment will take to payoff, the bigger the investment the longer it will take to pay off and that poses the question; could your money be better spent elsewhere?



# ARE HIGHER YIELDS BETTER?

If more yield returns you more money after the treatment cost is deducted, then yes! However, some treatment costs may take several years to give a return. So even though you have increased crop yield, it may take some years to recoup the total treatment cost. Each farm business will have different approaches to high cost treatments. You may be fixing something for the future such as clayey or preventing an issue, such as sub soil acidity with liming. This increases the importance of doing trials, so that you understand the long term financial impact an input will have on your business's profitability.

# HOW DO I CALCULATE RETURN ON INVESTMENT?

Below is a simple calculator based on three main sections – treatment cost, yield (averaged from yield data) and the average grain price to then produce the gross revenue and return on investment.

Treatment	1	Nil	Explanation
Treatment cost/ha	\$76.00	\$0.00	How much the treatment costed
Yield (t/ha)	4.23	3.90	Average yield of treatment
Grain price \$/tonne	\$260.00	\$260.00	Grain price on farm
Yield X grain price \$/tonne	\$1,100.00	\$1,014.00	Grain price on farm multiplied by tons produced
Additional income for treatment/ha	\$86	0	Treatment 1 - nil treatment
ROI – year 1 (Additional income - treatment cost) treatment cost	13%		The percentage of extra income gained from the treatment after recouping the treatment cost.
Payback period	<1 year		The number of seasons to recoup the additional investment of a treatment



# THE Paddock GUIDE TO PA TRIALS

Implementing on farm trials at large scale was once a costly exercise requiring high time investment. However, with the integration of GPS technology into machinery and the ability to collect data on the go, trials can now be implemented as a part of the normal farming operation. For a valid trial, proper set up is crucial to ensure meaningful results for the grower.

## Trial Design

Trials ideally should be simple with fewer treatments of larger size. Trial design needs to be long enough to account for any lag between the header harvesting the crop to the yield data being recorded. Lag time can be up to 30m and so we recommend trial area lengths of at least 100m, giving you a good amount of data to analyse on the yield map, and wide enough to fit three header widths. Three header runs per treatment provides you with a higher confidence in that value reflecting the treatment effect. Replication of treatments or repeating the trial in a second location will give you greater confidence in the results. Incorporate nil or control strips to understand site variation.

## Site selection

When locating your trial, pick an even representation of your paddock, with the trial treatments falling clearly within your selected soil zones. You can use a variety of PA data types for site selection including soil mud maps, EM or gamma radiometric soil surveys, biomass imagery, or yield maps. By overlaying these maps into Google Earth or your PA software you can adjust your trial location so it clearly fits a designated area.



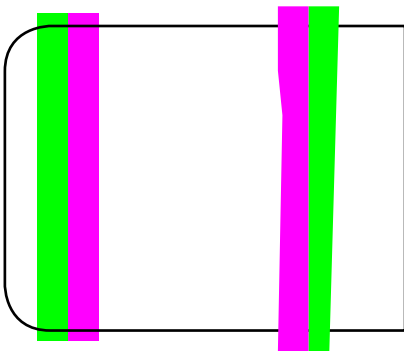


# TRIAL DESIGNS

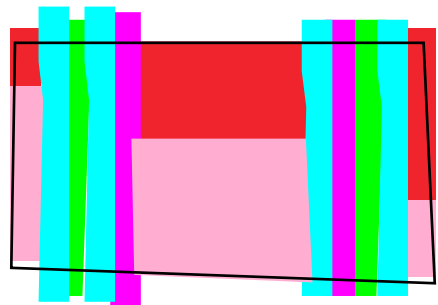
## Classic Strip Trial:

Strip trials generally run the length of the paddock, over two or more soil zones. One common strip trial is using double or nothing rates (green = 120kg application) (purple = 0kg application) as a comparison to the paddock standard (paddock = 60kg application). If the paddock is in variable rate, you will need to add additional control strips (blue = 60kg control strips).

**Blanket Rate**

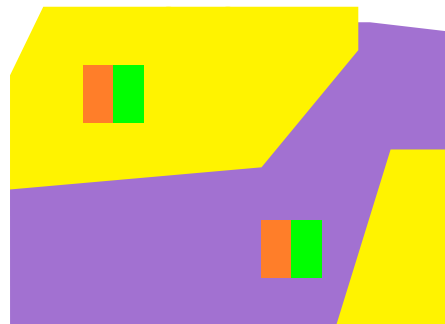


**Variable Rate**



## Trial Window Design:

The window design compares two treatments to the surrounding area; ideal for expensive inputs or trials which require high time investment. Treatments should ideally be 100m in length and at least three header widths wide, running in the same direction as the paddock will be harvested.

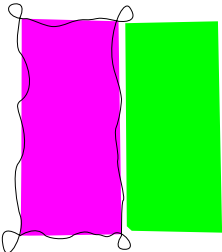


## GPS locating trials:

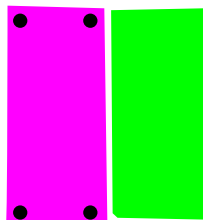
- Always GPS locate your trial. You can use an App on your iPad/Tablet (My Measure, Measure Map and GIS Kit are some examples). Your iPad GPS and Handheld GPS will have an accuracy of <5m, the GPS accuracy on your phone will be <10m.
- Datums are the model to which the 3D earth can be translated to 2D, therefore datums define your GPS coordinates. Using the same datum gives continuity to the created data ensuring it lines up as close as possible. The following two datums we commonly use:
  - WGS 84 (World Geodetic System 1984) is worldwide
  - GDA 1994 is custom for Australia
- Make sure your GPS is using either WGS84 or GDA1994 and map datum units are in Decimal Degrees as this is the most common unit for PA machinery.

## Marking out the Trial:

Unless you're marking out your trial using an RTK GPS signal (2cm accuracy) there will be error. Depending on your GPS it can be anywhere from 4m-10m. To reduce the error, we suggest recording your trial using a line rather than a point; this way you will leave a breadcrumb trail which at least shows you the movement in your GPS reading allowing for some correction in error.



Marking out with a line = higher accuracy



Only marking out the corners = less accurate

## Harvesting your trial:

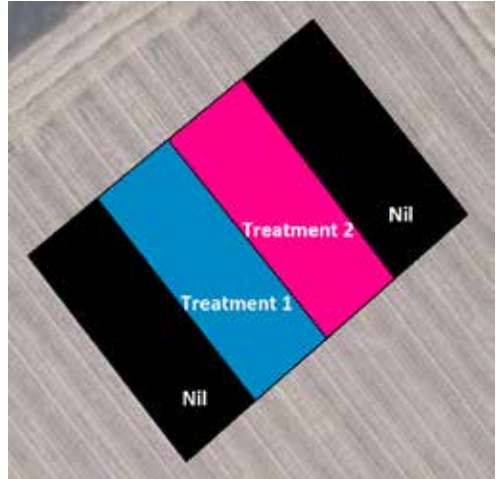
When harvesting your trial, make sure your trial runs in the same direction as you plan to harvest, use a single header, keep the header moving at a constant speed and if possible harvest all treatments in the same direction.

## Analysing results using yield data:

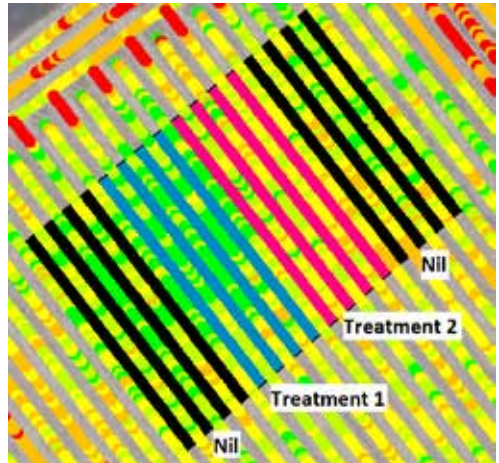
Working with raw point form yield data allows you to see overlap, stoppages, turn arounds and harvest direction. By visually inspecting the data in point form you can eliminate unreal yield data from the analysis.

## How to extract yield data:

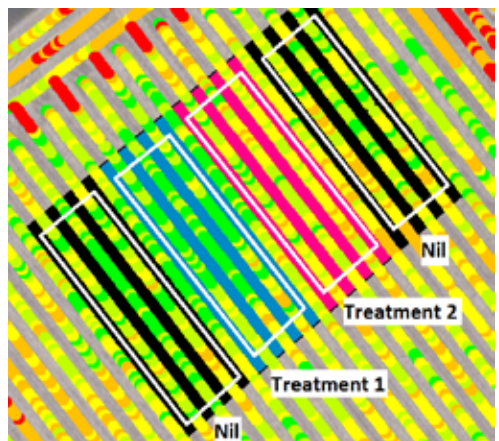
### 1. Use GPS locations to define trial layout



### 2. Overlay yield data in point form

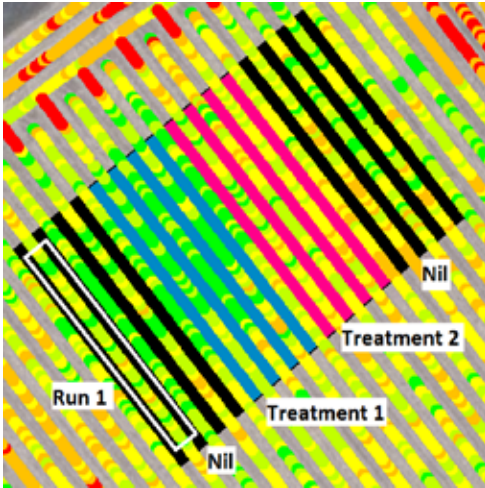


### 3. Only use run lines which fall entirely within the treatment





**4. Extract yield data points run by run from within treatments and zones, average and summarise data**



Run ID	Gypsum Treatment	Average yield for whole run	Variation side by side (same treatment)
Run 1	0 t/ha	2.32	0.16
Run 2	0 t/ha	2.16	
Run 3	5 t/ha	2.52	-0.23
Run 4	5 t/ha	2.75	
Run 5	2.5 t/ha	2.45	-0.21
Run 6	2.5 t/ha	2.66	
Run 7	0 t/ha	1.84	-0.14
Run 8	0 t/ha	1.98	

From the example results we know that there is up to 0.23 t/ha of variation within a treatment. Variation between treatment results will need to differ by greater than 0.23 t/ha to show a meaningful result.

Treatment	Average yield (both run lines)
0 t/ha	2.24
5 t/ha	2.63
2.5 t/ha	2.56
0 t/ha	1.91

The example gypsum trial results show significant differences between 2.5 t/ha and 0 t/ha as well as 5 t/ha and 0 t/ha, however there was not a significant difference between 2.5 t/ha and 5 t/ha as there is only 0.07 t/ha difference.

# TRIAL ANALYSIS

## Understanding the variation:

There will be variation from run to run within the same treatment. Differences between treatments needs to be greater than the variation factor to show convincing results of a treatment effect.

## Does this trial show a good return on investment?

Treatment	2.5 t/ha	5 t/ha	Nil	
Treatment cost	\$25	\$50	\$0	Gypsum costed at \$10/tonne/ha applied
Yield	2.56	2.63	2.24	Average yield of treatment
Grain price \$/tonne	\$260.00	\$260.00	\$260.00	Wheat grain price on farm
Yield X grain price \$/tonne	\$665.60	\$683.80	\$582.40	Grain price on farm multiplied by tons produced
Additional income for treatment/ha	\$83.20	\$101.40	\$0.00	
ROI (Additional income - treatment cost) treatment cost	232.80%	102.80%		The percentage of extra income gained from the treatment after recouping the treatment cost.
Payback period	<1 year	<1 year		The number of seasons to recoup the additional investment of a treatment

## CASE STUDY

# BEN CRIPPS VARIABLE RATE PHOSPHORUS



## OPERATION AT A GLANCE

**Area:** 4300ha in Binna (40km North East of Northampton)

**Annual rainfall:** 300mm

**Soil types:** A mix of gravels, clay loams and yellow sand plain

**2014 Seasonal Details:** 215mm of growing season rainfall with a hot, dry finish

**Crop Variety:** Mace wheat

Ben Cripps with his family runs a continuous cropping program, 40km north east of Northampton in Binna. Ben runs Case IH machinery with Pro 700 monitors and uses Spatial Management Software (SMS) to analyse and store yield data as well as create prescription maps.

## BACKGROUND TO TRIAL:

Ben purchased a new farm in 2014 that changed their seasonal cash flow, particularly for variable costs such as chemical and fertiliser.

Ben's local knowledge intuitively told him the new farm required more fertiliser, but was not sure exactly how much to invest. Conducting a trial allowed him to test how responsive the new farm was to additional phosphorus application in context of their budget constraints.

Using multiple years of yield data and surveying the paddock Ben created a variable rate phosphorus map to place inputs where he thought they were needed.

To test whether the variable rate program was actually matching the soil type requirements, a trial was placed across the two main soil types, red loam and sandy gravel.

## DESIGN OF TRIAL:

The trial design was composed of three rates; 0kg, 30kg and 60kg across two soil zones allowing Ben to see the effect of investment in phosphorus fertiliser. Ben also replicated the trial twice which gave greater confidence in the results.

The trial was implemented as part of a variable rate application map and results were analysed using yield data collected by standard harvest operation.

As a result, the paddock operation of seeding and harvest were not disrupted by the trial's presence.



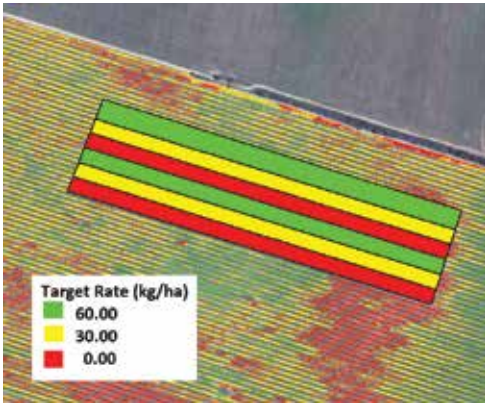


Figure 1. Phosphorus (MAP) trial layout over 2014 wheat yield data.

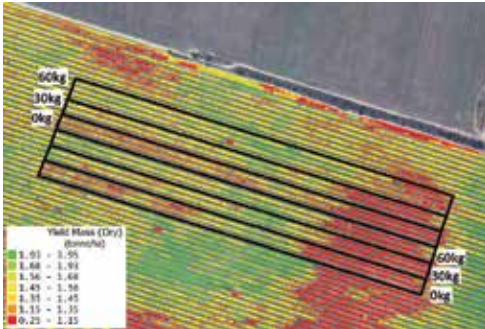


Figure 2. Phosphorus (MAP) trial layout overlaid on 2014 wheat yield data.

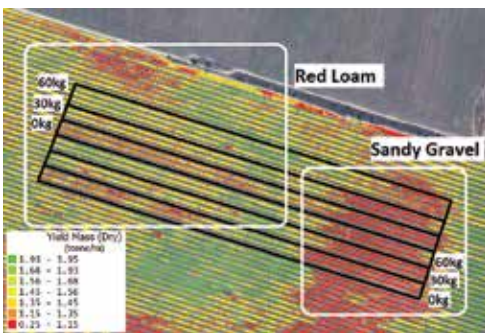


Figure 3. Phosphorus (MAP) trial layout overlaid on 2014 wheat yield data with soil zones outlined.

## YIELD RESULTS:

The crop yield response to applied phosphorus (MAP) is summarised in the following data set.

Individual treatment results from the yield maps were as follows.

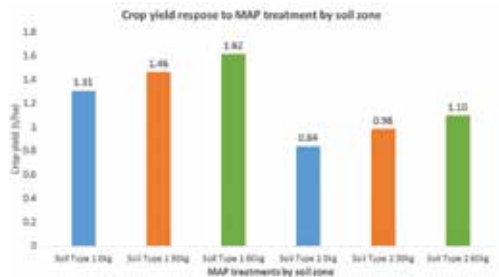
### Red loam

		0kg	30kg	60kg
Rep 1	Run 1	1.256	1.501	1.6
	Run 2	1.361	1.435	1.574
Rep 1 average		1.3085	1.468	1.587
Rep 2	Run 3	1.299	1.476	1.599
	Run 4	1.311	1.442	1.691
Rep 2 average		1.305	1.459	1.645
Whole trial average		1.31	1.46	1.62

### Sandy gravel

		0kg	30kg	60kg
Rep 1	Run 1	0.785	0.986	1.02
	Run 2	0.826	0.961	1.003
Rep 1 average		0.8055	0.974	1.012
Rep 2	Run 3	0.841	0.984	1.211
	Run 4	0.899	0.994	1.153
Rep 2 average		0.87	0.989	1.182
Rep 1 & 2 average		0.84	0.98	1.09

Figure 4. Crop yield response to MAP treatment by



soil zone.



## RETURN ON INVESTMENT:

Using the measured response to additional phosphorus the return on investment of each treatment could be assessed over each soil type.

**Table 1. Return on phosphorus investment with phosphorus fertiliser (MAP) costing \$495/t.**

### Red loam

Treatment	30kg	60kg	Nil
Treatment cost	\$15	\$30	\$0
Yield	1.46	1.62	1.31
Grain price \$/tonne	\$300	\$300	\$300
Yield X grain price \$/tonne	\$438	\$486	\$393
Additional income for treatment/ha	\$45	\$93	\$0
ROI (Additional income - treatment cost)/ treatment cost	200.00%	210.00%	
Payback period	<1 year	<1 year	

### Sandy gravel

Treatment	30kg	60kg	Nil
Treatment cost	\$15	\$30	\$0
Yield	0.98	1.09	0.84
Grain Price \$/tonne	\$300	\$300	\$300
Yield X grain price \$/tonne	\$294	\$327	\$252
Additional income for treatment/ha	\$42	\$75	\$0
ROI (Additional income - treatment cost)/ treatment cost	180.00%	150.00%	
Payback period	<1 year	<1 year	

## WAS IT WORTH IT?

All return on investment calculations for phosphorus fertiliser were greater than 100%, showing they paid for themselves in the year of application. This is important for a variable cost, such as fertiliser application, and indicates an overall high responsiveness of this new farm to phosphorus.

On red loam the return on investment was 200% demonstrating at least a doubling of invested funds when compared to a zero application. The fact that there is only a 10% difference between 30kg and 60kg rates indicates that the responsiveness is declining around 60kg/ha application. From this information Ben is aiming to apply 30-40kg/ha in this soil type.

On the sandy gravel the return on investment results were still positive, but not as strong as the red loam. This is more than likely due to the lower water holding capacity of the sandy gravels. For this soil type the 30kg application shows a 30% greater return on investment.

While both soil types appear to have similar optimal rates of MAP, this trial showed that investing money in this farm for phosphorus provides Ben with a very good result and he should prioritise budget allocation to phosphorus for the new farm. This is important information in context of the overall cash flow requirements facing Ben's business with the increase of cropping hectares.

## CASE STUDY

# BRENDON & KELLY O'NEILL REVISITING GYPSUM

## OPERATION AT A GLANCE

Area: 3,180ha in Ongerup

Annual rainfall: 380mm

Soil types: Grey clays and shallow duplex

Trial paddock details: 2014 Bonito canola, 2015 Hindmarsh barley



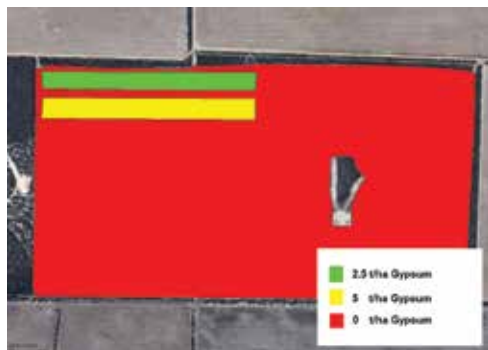
## BACKGROUND TO TRIAL:

Brendon and Kelly O'Neill farm north of Ongerup on a range of soil types including grey clays which are often termed 'mort clays' after the dominant native vegetation prior to clearing. These grey clays often form the sub soil layer to many local duplex soils, with the shallow top soil being a coarse sand or silt. Grey clays are renown for being hard setting when dry, and sticky and impervious to water when wet. This makes for difficult seeding and crop establishment. When dry seeding, poor soil contact limits germination, and following rain, the short term shallow surface water logging can seal over soils or cause seed burst.

Historic trials in the region had previously shown mixed results to gypsum. These trials however were prior to the implementation of no-till farming systems and in the presence of livestock. Now a number of years into a continuous cropping rotation, Brendon was curious to reassess if gypsum could improve the performance of the grey clay soils. As a means to investigate he decided to order 200 tonnes of gypsum to lay down trials in several locations.

## DESIGN OF TRIAL:

In 2014, Brendon trialled two rates of gypsum, 2.5 and 5 tonnes per hectare to a paddock called Scotty's. Two strips were laid out, one of each rate, and strips measured roughly 65m wide by 800m long, displayed in figure 1 below. Scotty's was then sown to Bonito canola in 2014 and Hindmarsh barley in 2015. Both years received above average rainfall.



**Figure 1. Gypsum trial laid out on Scotty's paddock with two rates, 2.5t/ha and 5t/ha.**

## YIELD RESULTS:

Brendon didn't notice any visual difference throughout the 2014 season, however after harvest in 2014 he read the header data cards into his PA software, Spatial Management System (SMS), and this showed a very noticeable difference between the trial strips and the paddock, displayed in figure 2.

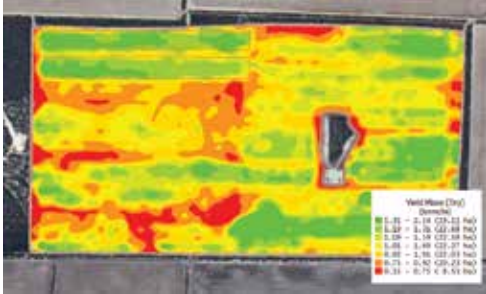


Figure 2. 2014 Bonito canola crop yield map with trial overlaid.

The 2014 and 2015 yield data was analysed one run at a time within each treatment strip to understand the crop yield response to applied gypsum. This generated data for the individual crop yield responses from canola in 2014 and barley in 2015 as well as provided a two-year cumulative crop yield response to gypsum.

In 2014, the 2.5t treatment averaged 1.3t/ha, the 5t treatment averaged 1.3t/ha and the 0t treatment averaged 0.9t/ha of canola. This shows a 400kg increase in yield within the 2.5t and 5t treatments compared to the 0t treatment, however there was no increase in yield from the 2.5t treatment to the 5t treatment.

In 2015, the 2.5t treatment averaged 3.6t/ha, the 5t treatment averaged 3.6t/ha and the 0t treatment averaged 3t/ha of barley. This indicates a similar relationship to 2014 with a 600kg increase in yield within the 2.5t and 5t treatment compared to the 0t treatment, yet there was no increase in yield from the 2.5t to the 5t treatment.

Table 1. Treatment results for 2014 canola crop yield response to gypsum trial.

Gypsum	2.5 t/ha	5 t/ha	0 t/ha
Strip 1	1.32	1.26	0.82
Strip 2	1.37	1.25	0.91
Strip 3	1.34	1.35	0.86
Strip 4	1.31	1.31	0.85
Average	1.34	1.29	0.86

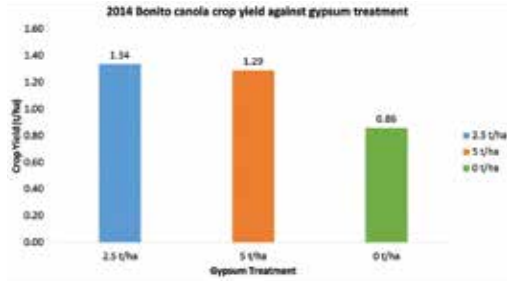


Figure 4. 2014 Bonito canola crop yield against gypsum treatment.

Table 2. Treatment results for 2015 barley crop yield response to gypsum trial.

Gypsum	2.5 t/ha	5 t/ha	0 t/ha
Strip 1	3.64	3.50	3.05
Strip 2	3.65	3.56	2.98
Strip 3	3.51	3.79	3.13
Strip 4	3.76	3.57	2.91
Average	3.64	3.60	3.02

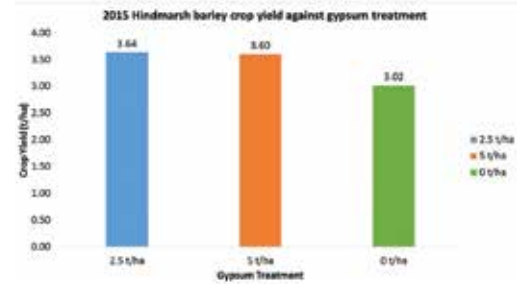


Figure 6. 2015 Hindmarsh barley crop yield against gypsum treatment.

## RETURN ON INVESTMENT:

Using the measured response to additional gypsum, the return on investment of each treatment could be assessed. For one tonne of gypsum the product costed \$26, freight costed \$16 and spreading was calculated at \$11. This amounted to roughly \$53 for one tonne of gypsum spread by a contractor. The on farm grain price for canola and barley was standardised for 2014 and 2015 and calculated at \$520/t and \$220/t respectively.



The return on investment calculation showed that in 2014 for the cost of \$132.50/ha (2.5t of gypsum applied) there was \$249.50/ha made which after you take out the gypsum cost there is \$117/ha additional income. And the cumulative 2014 and 2015 difference between the 2.5t treatment and the 0t increased to \$254/hectare making an additional \$137/hectare in 2015.

## WAS IT WORTH IT?

The return on investment for the 2.5t gypsum treatment was 88.38% in the year of application. For a high cost treatment to produce a positive return on investment in the first year means the treatment has paid for itself and generated extra profit.

The 5t gypsum treatment did not show a positive return on investment in the first year with a -15.62% ROI. This demonstrates that this

treatment did not pay for itself in the first year.. It did however make a positive return on investment after two years. In 2015, the return on investment for 5t of gypsum was 33%, generating \$86 additional income after treatment cost.

On paper it looks as though the 2.5t treatment was a better investment than the 5t treatment, however it will be interesting to see the longevity of this trial and if there is still a response within the 2.5t and 5t treatments in 5 or 10 years' time.

Brendon says "not all paddocks have results which are this good" and "they are not sure what would happen in dry years as the last three years have been wet and prone to waterlogging". They are continuing to trial how responsive their soils are to gypsum, but instead of doing small strips they are putting strips of 0t/ha and 5t/ha amongst paddocks which are being spread at a blanket rate of 2.5t.

**Table 3. 2014 Canola Return on gypsum investment with gypsum costed at \$53/tonne delivered and contract spread using a farm gate canola grain price of \$520/t.**

Treatment	2.5 t/ha	5 t/ha	Nil
Treatment cost	\$132.50	\$265.00	\$0
Yield	1.34	1.29	0.86
Grain price \$/tonne	\$520	\$520	\$520
Gross revenue/ha	\$697	\$671	\$447
Additional income for treatment/ha	\$249.60	\$223.80	
ROI ( <u>Additional income - treatment cost</u> ) treatment cost	88.38%	-15.62%	

**Table 4. Cumulative return on gypsum investment for 2014 and 2015 with gypsum costed at \$53/tonne delivered and contract spread using a farm gate grain price of \$520 for canola (2014) and \$220 for barley (2015).**

Year	2014			2015		
	2.5	5	Nil	2.5	5	Nil
Treatment cost	\$132.50	\$265.00	\$0	\$0	\$0	\$0
Yield	1.34	1.29	0.86	3.64	3.6	3.02
Grain price \$/tonne	\$520	\$520	\$520	\$220	\$220	\$220
Yield X grain price \$/tonne	\$697	\$671	\$447	\$801	\$792	\$664
Sum of years'	\$1,497.60	\$1,462.80	\$1,111.60			
Sum of years' additional income	\$386	\$351.20				
ROI ( <u>Additional income - treatment cost</u> ) treatment cost	191.32%	33%				

## CASE STUDY

# IAN & LYNDON MICKEL DELVING TO SUPPRESS NON-WETTING ISSUES

## OPERATION AT A GLANCE

**Area:** 4000ha in Beaumont (and 2000ha in Condingup)

**Annual rainfall:** 380mm at Beaumont (485mm at Condingup)

**Soil types:** Both properties have a range of soil types from deep sand plain to a sandy gravel over clay, and loamy duplex sand running through to heavy red clays.

**Enterprise:** Ian and Veronica Mickel farm with their son Lyndon and his wife Nikki in Condingup and Beaumont, east of Esperance. The Mickel's have been collecting yield data on their Case IH machinery since 2003.



## BACKGROUND TO INVESTIGATION:

The Mickel's identified non-wetting as a key agronomy problem on their Beaumont property, as the patchy germination significantly reduced the productivity on their continuous cropping program. Depth to clay varies on the Beaumont farm, but is often between 200 – 500mm from the surface. This shallower depth to clay meant that delving clay up from the sub soil was an option for improving the non-wetting sandy top soil.

Ian and Veronica took a trip to South Australia in 2003 to investigate delving machinery and on return built their own delver comprised of two large 1.5m long tynes, spaced 2.5m apart, that work below the surface between 700mm and 900mm. Paddocks are generally worked over twice so that the space between delving is only 1.25m apart. Delving began prior to the 2005 season and their background yield data collection allowed for a historical analysis of the clay delving work a decade on.

## DESIGN:

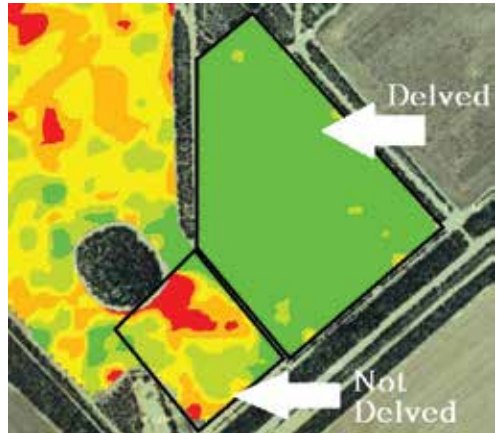
In the case of the Mickel's, the trial of a delved area versus a non-delved area came about as they ran out of time prior to seeding and this resulted in a section of paddock N1 not being delved.

While the trial design aspect of this example could be improved, the historic yield data has enabled the Mickel's to gain further understanding of response and monetary investment before they continued the delving program over the whole farm.

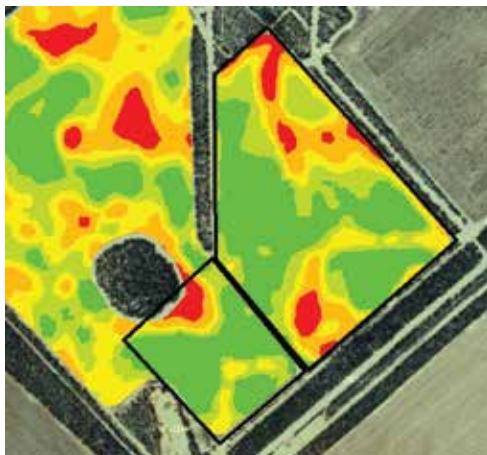
This case study is more of a side by side comparison to show differences over a number of seasons. To analyse the yield data SEPWA used a random block design to select comparison areas that were as unbiased as possible.

### YIELD RESULTS:

The following data sets present the crop yield before delving operation and four years post operation. Yield responses are assumed to be as a result of the delving operation.



2005 – Barley crop yield after delving



2004 – Before delving the side by side areas of the paddock were comparable in their yield performance.

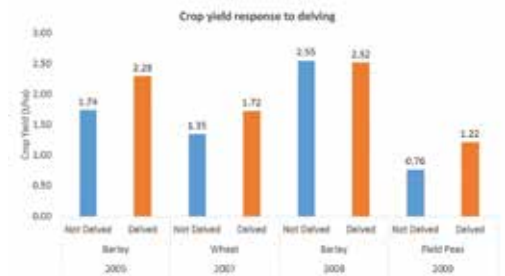


Figure 2. Crop yield (t/ha) responses to delving from 2005 to 2009.

### RETURN ON INVESTMENT:

Using the measured response to delving over four years the return on investment could

Table 1. Crop yield results on the two sections; delved and not delved of paddock N1 from 2004 to 2009.

	2004 – Wheat Before		2005 - Barley		2007 - Wheat		2008 - Barley		2009 - Peas	
	Not Delved	Delved	Not Delved	Delved	Not Delved	Delved	Not Delved	Delved	Not Delved	Delved
Random Block 1	2.05	1.91	1.66	2.37	1.28	1.90	2.56	2.18	0.88	1.32
Random Block 2	1.86	1.42	1.95	2.33	1.60	1.49	2.59	2.70	0.68	1.09
Random Block 3	1.86	1.88	1.61	2.18	1.16	1.78	2.49	2.66	0.74	1.23
Average of all Blocks	1.92	1.74	1.74	2.29	1.35	1.72	2.55	2.52	0.76	1.22
% of yield increase in Delved area		<1%		32%		21%		<1%		60%

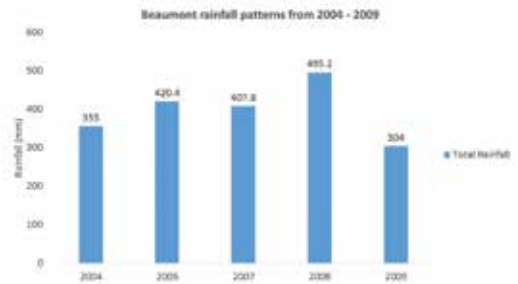
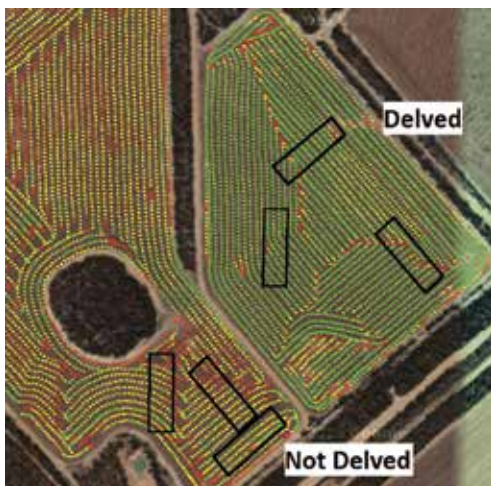
**Table 2. Return on investment analysis of delving using crop yields from 2005 to 2009.**

Year	2005		2007		2008		2009	
Treatment	1	Nil	1	Nil	1	Nil	1	Nil
Treatment cost	\$300	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Yield	2.29	1.74	1.72	1.37	2.52	2.54	1.22	0.76
Grain price \$/tonne	\$220	\$220	\$260	\$260	\$220	\$220	\$300	\$300
Yield X grain price \$/tonne	\$504	\$383	\$447	\$356	\$554	\$558	\$366	\$228
Additional income for treatment/ha	\$121		\$91		-\$4		\$138	
Sum of years' additional income	\$346							
ROI (Additional income - treatment cost) treatment cost	15.20%							
Payback period	4 years							

be assessed. The delving and incorporation treatment cost was put at a flat rate of \$300/ha. Standardised grain prices were used for barley, wheat and field peas of \$220/tonne, \$260/tonne and \$300/tonne respectively.



**Figure 1. 2005 barley yield data post delving.**



**Figure 3. Beaumont annual rainfall from 2004 to 2009.**

## WAS IT WORTH IT?

Results showed increased yields in 2005, 2007 and 2009, while in 2008, a high rainfall year, there was no difference between the delved and un-delved areas. This shows that in high rainfall years non-wetting is not a major problem, however in the average to low rainfall years' yields are reduced, indicating the impact non-wetting is having upon the farm. This seasonal variation further impacts on the time it takes to provide a return on investment.

The return on investment analysis estimated it took four growing seasons for the investment to pay for itself, with three low to medium rainfall seasons and one high rainfall season. In terms of ameliorating non-wetting, Ian Mickel says the delving has performed this task and they knew the operation would take a few years to pay for itself. By using historical yield data, the Mickel's now have a greater understanding of the properties response to delving and the financial implications associated with it.



## CASE STUDY

# MIC & MARNIE FELS CLANCARTY FARM

## OPERATION AT A GLANCE

Area: 10,500ha - Wittenoom Hills,  
Neridup & Three Springs

Trial area Neridup

Annual rainfall: 580mm

Soil types: Deep sands and  
shallow gravel duplex

Cropping: 100% Cropping



## BACKGROUND TO TRIAL:

Mic and Marnie Fels farm in multiple locations within the Esperance Port Zone as well as at Three Springs. The Wittenoom Hills farm has a duplex soil type, preventing nutrients from dropping out of the profile and out of plants reach. Conversely, the Neridup farm is predominately a deep sand, lacking the clay binding particles, meaning many of the inputs are leached out of the soil.

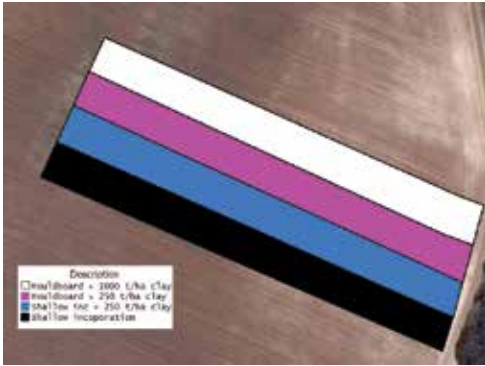
Mic wanted to experiment in creating the Wittenoom Hills duplex soil type on his deep sand Neridup farm using a mouldboard plough and claying.

## DESIGN OF TRIAL:

In 2013, to create the duplex soil type Mic trialled two different techniques using a mouldboard plough. The first technique was standard mouldboard ploughing which inverted the soil to a depth of 300-350mm, burying the topsoil and bringing up the subsoil layer. This was performed on two treatments, with 250t/ha and 1000t/ha of clay incorporated to each treatment respectively.

The second technique was a shallow incorporation. This was achieved by flipping the mouldboard plough and only disturbing the top 100mm. Two treatments of shallow incorporation were done and one had a rate of 250t/ha of clay added, the other with nil.

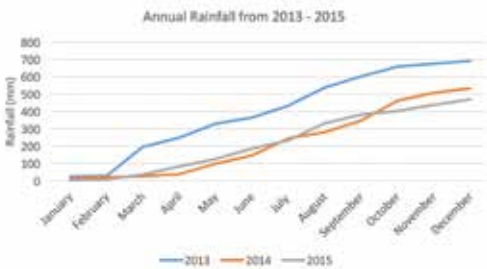
The paddock was then sown to Barley in 2013, 2014 and 2015, and either side of the trial was used as a control.



**Figure 1. Mouldboard and shallow incorporation with varying rates of clay trial layout.**

## YIELD RESULTS:

In 2013 the paddock received above average rainfall resulting in large areas of the farm experiencing waterlogging, while 2014 and 2015 were average rainfall years.

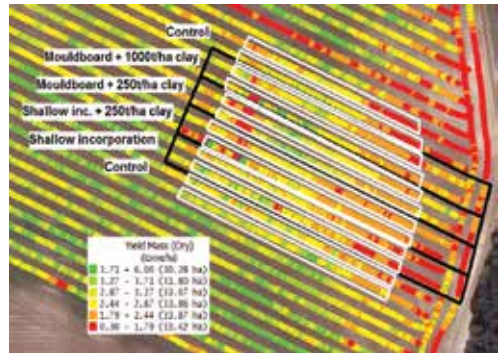


**Figure 2. Neridup cumulative rainfall graph from 2013 to 2015.**

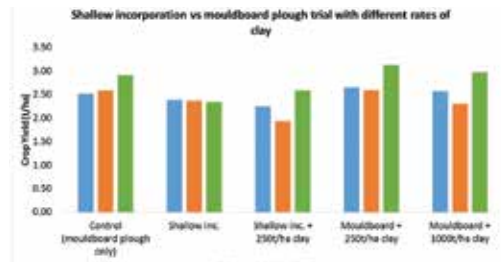
In 2013, 2014 and 2015 the mouldboard plough + 250t/ha of clay treatment yielded the highest of all treatments with barley crop yields of 2.65t/ha, 2.59t/ha and 3.13t/ha respectively. Although the mouldboard plough + 250t/ha of clay treatment consistently yielded the highest it was only by a margin as the mouldboard + 1000t/

ha of clay treatment yielded second highest in 2013 and 2015 with 2.57t/ha and 2.97t/ha. In 2014, the control was the second highest yielding treatment with 2.58t/ha. This displays a difference of 80kg, 10kg and 160kg between the highest and second highest yielding treatments in 2013, 2014 and 2015.

The lowest yielding treatment was the shallow incorporation + 250t/ha of clay treatment in 2013 and 2014 with 2.25t/ha and 1.94t/ha. While the standard shallow incorporation was the lowest yielding in 2015 with 2.34t/ha.



**Figure 3. 2013 barley yield data extracted out of the trial layout to measure the crop response.**



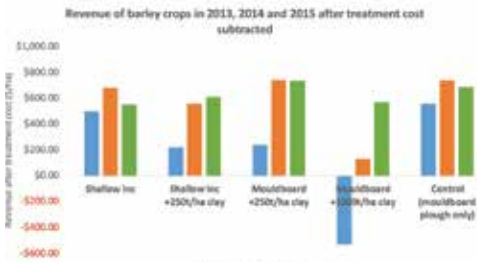
**Figure 4. 2013, 2014 and 2015 crop response to mouldboard and shallow incorporation trial with varying rates of clay. Control strips were either site of the trial.**

**Table 1. Yield responses to mouldboard plough and shallow incorporation treatments with varying rates of clay.**

	Control	Shallow inc.	Shallow inc. + 250t/ha clay	Mouldboard + 250t/ha clay	Mouldboard + 1000t/ha clay
2013	2.52	2.39	2.25	2.65	2.57
2014	2.58	2.37	1.94	2.59	2.31
2015	2.91	2.34	2.59	3.13	2.97

## RETURN ON INVESTMENT:

Treatment costs varied due to implements used and rates of clay. Mouldboard ploughing was costed at \$100/ha, shallow incorporation was \$30/ha and clay was \$1 per tonne. This put the treatment cost of shallow incorporation at \$30/ha, shallow incorporation + 250t/ha of clay at \$280/ha, mouldboard ploughing + 250t/ha of clay at \$350/ha and mouldboard ploughing + 1000t/ha of clay at \$1,100/ha. The high treatment cost significantly impacts on the viability of each treatment being implemented at paddock scale and this can be seen within figure 5 below.



**Figure 5. Revenue of barley crops in 2013, 2014 and 2015 after treatment cost had been taken out.**

Even though the mouldboard plough + 1000t/ha of clay treatment was the second highest treatment in 2013 and 2015 the high treatment cost of \$1,100/ha to implement meant this treatment made a loss in 2013. Treatments that had clay incorporated also took a significant discount in revenue within the first year to cover costs of implementation. However, the benefits of claying are long term and therefore the treatment



**Figure 6. Sum of years' (2013-2015) net revenue after treatment cost (\$/ha).**

costs need to be considered over a longer term as well.

The mouldboard plough + 250t/ha of clay treatment consistently produced higher yields than the control, however only by 220kg or less. Because of the high treatment cost and the small yield gain this treatment resulted in a negative return on investment after three years. Clay spreading is an expensive, but long term management option meaning it may show a positive return on investment over a longer period of time.

## WAS IT WORTH IT?

This trial was worthwhile as it demonstrated the mouldboard plough + 250t/ha of clay treatment consistently increased yields in the following 3 years, however this increase in yield was not sufficient to economically justify the treatment costs. This trial will form an ongoing benchmark to compare the cost versus benefit for long term soil renovation.

**Table 2. Return on investment for the mouldboard plough + 250t/ha of clay treatment.**

Year	2013		2014		2015	
	Mouldboard plough + 250t/ha of clay	Control (mouldboard plough only)	Mouldboard plough + 250t/ha of clay	Control (mouldboard plough only)	Mouldboard plough + 250t/ha of clay	Control (mouldboard plough only)
Treatment cost	\$350	\$100	\$0	\$0	\$0	\$0
Yield	2.65	2.52	2.59	2.58	3.13	2.91
Grain price \$/tonne	\$221	\$221	\$286	\$286	\$235	\$235
Yield X grain price \$/tonne	\$586	\$557	\$741	\$738	\$736	\$684
Additional income for treatment	\$29		\$3		\$52	
Sum of years' additional income	\$84					
ROI (Additional income - treatment cost)/treatment cost	-47.63%					
Payback period	>3 years					



## ACKNOWLEDGEMENTS:

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