Harvesting your trial

To use the yield data from your harvester to record the results of your trial, there are some simple tips to consider:

- **Use a single header to harvest a trial**. Variation in yield monitor calibration between harvesters is an obvious source of error in yield results. Side-by-side runs of different harvesters within a trial area should be avoided.
- **Harvest the entire trial in the same direction**, (if practical) because there can be large differences in yield caused by the harvester travel direction.

To get around this problem harvest up the paddock within the trial, then jump over several run lines to be outside the trial area on the return down the paddock. This way you only collect trial area data harvesting in a single direction.

- **Keep the harvester moving at a constant speed**. Harvest stoppages (for example waiting for a chaser bin) cause irregularities in the yield data recording which have the potential to distort trial results.

Guidelines for Yield data extraction

Once you have harvested the paddock and read your yield data into your PA software you can analyse the yield results.

The Agronomy Jigsaw project has found that working with raw harvest data (dot points) enables you to avoid selecting data which may have been affected by overlap, stoppages, harvest directions or turnarounds. Interpolated yield data displayed as a continuous contoured map tends to smooth over possible errors in data and could affect a trial result.

It is advised that you top and tail yield data on reading it into your PA software. This removes yield data outside the realistic biological limits of the crop. For example filtering and removing data < 0.3 t/ha and > 7 t/ha for a cereal crop across the whole paddock before commencing analysis.

The basic steps in your PA software for extracting yield data for analysis are:

- Define the trial layout and treatments from the prescription map or GPS marker points.
- Overlay your yield data in point form.
- Define yield data run lines which fall clearly within treatment areas (and zones if present).
- Identify your different soil zones (if present).
- Extract yield data points from within the treatment x zones areas, average and summarise these in a table for graphing.

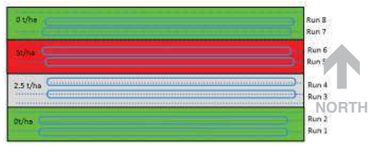
Yield data points to avoid -Some yield data points could be affected by harvesting irregularities, avoid data points that are:

- Within 30 m of a turnaround/headland.
- Within 10 m of passing over a treatment boundary.
- Too close together or more widely spaced (indicates speed irregularities).
- Near obstacles or affected by harvester overlap.

Basic trial analysis (Note: demonstration data only!)

Consider a basic trial of: 0, 2.5 and 5 t/ha applications of Gypsum.

Overlay yield data and pick out run lines which fall completely with a treatment area:



Check for how much variation present in the yield data.

To do this, check the whole run lines average yield of side by side runs within the same treatment to see how much natural variation you have in your data collection.

Run ID	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	

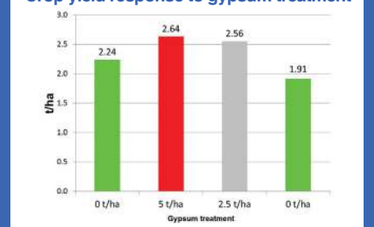
From this demonstration data, side by side runs vary up to 0.23 t/ha. There will need to be at least this amount of yield variation between treatments to be reasonably confident of a "real" difference being a result of the trial treatments.

Next compare whole treatment averages.

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 whole trial treatment averages between Gypsum treatments.

Crop yield response to gypsum treatment

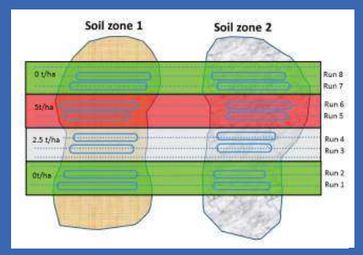


From this data it appears the 5t/h and 2.5 t/ha applications increased crop yield over the whole trial area. Although higher, the 5 t/ha treatment is not significantly greater than the 2.5 ton treatment as the trial appears to be trending to lower yields at the north end (shown by a lower yield in the 0t/ha) as well as not being more than 0.23t/ha difference.

Trial analysis with zones

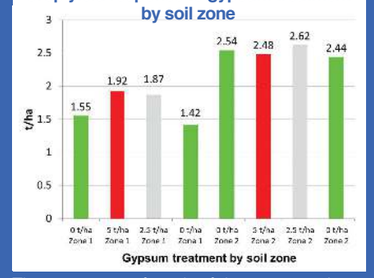
Continuing from the basic trail analysis, repeat the yield data extraction process, this time only extracting yield data from within our identified soil zones.

The basic gypsum trial - data extraction by soil zones.



Treatment	Run Line selection area	Average yield
0 t/ha Zone 1	Runs 7 & 8 in Zone 1	1.55
5 t/ha Zone 1	Runs 5 & 6 in Zone 1	1.92
2.5 t/ha Zone 1	Runs 3 & 4 in Zone 1	1.87
0 t/ha Zone 1	Runs 1 & 2 in Zone 1	1.42
0 t/ha Zone 2	Runs 7 & 8 in Zone 2	2.54
5 t/ha Zone 2	Runs 5 & 6 in Zone 2	2.48
2.5 t/ha Zone 2	Runs 3 & 4 in Zone 2	2.62
0 t/ha Zone 2	Runs 1 & 2 in Zone 2	2.44

Crop yield response to gypsum treatment by soil zone



The averages of each of these extraction areas (data points within the blue areas) can then be summarsied in a table and graphed.

From this demonstration data you can note:

Zone 1 clearly yielded less than zone 2, however it appears any gypsum response to yield is confined to soil zone 1 and is not present is zone 2.

This information could then be used to define a variable rate gypsum application over the whole paddock and similar soil zones on the farm.

Note: This is demonstration data only – real trial results are not always so clear!

More in-depth and accurate analysis is possible under guidance from a biometrician.

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The paddock guide to **PA trials**

This is a basic guide for farmers and consultants wanting to set up on-farm trials using precision agriculture (PA) equipment. It contains condensed information on the design, implementation, harvesting and analysis of PA style trials.

A simple well designed trial can help you determine the best step forward in solving an agronomy problem in your farming system. Correctly used, PA farming tools such as guidance, variable rate and yield mapping can greatly assist the implementing of on farm trails.

This guide captures the Agronomy Jigsaw project's findings from implemented farm PA trials on the south coast region of Western Australia. The Agronomy Jigsaw would like to acknowledge the work of Precision Agronomics Australia (PAA), who implemented a number of these trials, as well as the previous research done in this area by CSIRO.

For a series of You Tubes on this topic, simply scan this code with your smart phone or tablet to link directly to:
http://www.youtube.com/user/agronomyjigsaw

THIS PADDOCK GUIDE WAS PRODUCED FROM THE AGRONOMY JIGSAW, A COLLABORATION BETWEEN:

Department of Agriculture and Food · GRDC Grains Research & Development Corporation · Precision Agronomics Australia · SEPWA South East Premium Wheat Growers Association

The Aim of a Trial: **to assess the effect on crop yield of a particular treatment.**

We want to find out:

- Did your treatment effect crop yield?
- Does the effect on crop yield vary between different soil zones in your paddock?

Trial Design – keep it simple and replicate!

Some key rules for any on farm trial design:

- Keep it simple! Fewer treatments are generally better. From an analysis approach one or two treatments present a relatively simple analysis in which yield differences can be easily detected. A simple trial design prevents the trial becoming too big and more prone to the results being affected by paddock variation.
- Build in control strips (a constant or nil treatment) – this is a must for comparing variation across the trial.
- Repeat or replicate the trail. By conducting the trial treatments twice or more within the trial or simply repeating the trial in another part of the paddock, you can have greater confidence in your results.
- Make your treatments very different, so that the effect on crop yield should be easily detected. For example double or nothing treatments against the standard paddock rate.
- Trial strips need to be wide enough for at least two (ideally three) header runs for yield data collection. By ensuring 3 harvester widths for each treatment, there will always be at least two harvester run lines which fall completely within a treatment strip.

Locating your trial – site selection

- Pick an even representative site. Some historic yield maps or other PA data can greatly assist in the locating of your trial to ensure each treatment applied is represented in each of your targeted soil zones.
- Avoid areas which may affect yield results – for example fence lines, trees, headlands or other obstacles.

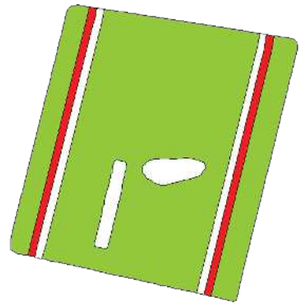
Trial designs

The Agronomy Jigsaw Project has encountered various trial designs in its study of PA-style trials.

Classic Strip Trial - with control strips

The classic strip trial is designed to run the length of a paddock and if possible pass over two or more soil zones. Ideally at least 2 treatment strips should be designated as control treatments.

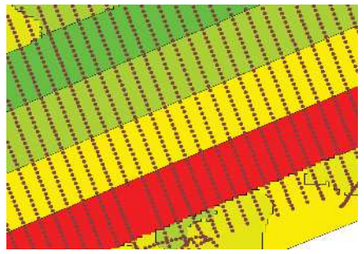
The below example is a double and nothing strip trial. A 120 kg/ha application being double (red strip) a 0kg/ha application (white strip) and the control 60kg/ha treatment being the remainder of the paddock (green area). Note the trial has been replicated in two places in the paddock for greater certainty of results.



If the remainder of the paddock is under variable rate application the control treatments will be needed to be built into the trial. Note here the additional green strips of 60kg/ha control applications in random order.

Classic Strip Trial – harvesting across the treatment strips

A variation of the standard strip trial is harvesting across the treatment strips. In this scenario treatment strips will need to be made wider to allow for a buffer between treatments in yield data points, yet there still needs to be sufficient data points falling within a treatment area.

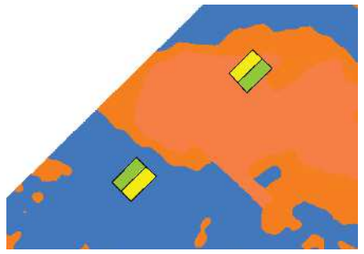


Note here the harvested yield data points running perpendicular to the treatment strips of red (10t/ha), yellow (0t/ha) light green 2.5t/ha and dark green (5t/ha).

The Trial Window design

The trial window design is the placement of several treatment windows (or blocks) in designated parts of the paddock to measure the treatment effect compared to the surrounding area. Treatment blocks should be around 100m long at the standard 3 header widths wide to make them sufficient size so that yield data can be extracted for comparisons.

This is ideal for costly or slow to implement treatments and enables flexible placement of the treatment windows so that it falls within a particular soil zone.



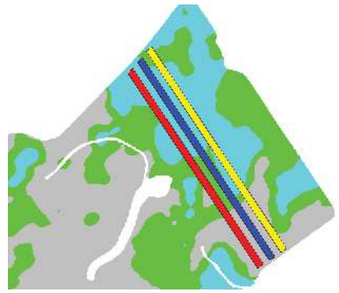
Note in this example a trial window design is replicated in another soil zone of the paddock. Green areas were deep ripped and the yellow areas were deep ripped with gypsum applied, the remainder of the paddock had a nil treatment.

Repeating or replicating any trial design greatly improves the certainty of results!

Soil zones in a paddock and the trial layout

Soil or production zones can be defined by any PA data source which clearly defines two or more parts of a paddock as being agronomically different. Data sources range from: EM or Gamma radiometric surveys; aerial photography; soil testing; mud maps; yield data and biomass imagery. The critical criteria is that the soil zones identified are sufficiently different in their agronomic characteristics and hence will more than likely also vary in response to your trial treatments.

The use of PA technology enables us to assess the variation in response of crop yield between soil zones and trial treatments. For this to be possible it is vital your trial passes over each soil zone in the paddock (or is repeated in multiple locations) to enable measurement of any treatment x zone effects on crop yield.



Note here the trial passes over Zone 1 (blue area) and Zone 2 (grey area). The trial has three treatments (red 5 ton/ha, blue 2.5 ton/ha and yellow 10ton/ha) with the remainder of the paddock and intermittent strips being control strips (nil application).

Marking out your trial with a GPS

If your trial is not part of a prescription map, you will need to record its location with a GPS device for overlay on the yield map data.

GPS Setup

You can use a hand held GPS or mobile device such as smart phone or tablet to capture the GPS coordinates and record your trial's location.

You need to check your map datum and the units of your device. The most universal map datum is WGS84 (World Geodetic System 1984), which works all locations on the planet. In Australia you can also use GDA 1994 which is within 1m of this.

We recommend you set your map datum units in decimal degrees with at least five (ideally six) decimal places. Most PA equipment works in decimal degrees and this eliminates the need for conversions.

Marking the trial

Go to your trial in the paddock and mark each corner of each treatment. Allow your GPS approximately one minute to refine the signal at each corner peg site.

Note down the Longitude and Latitude on a diagram of your trial. Note that in the southern hemisphere, latitude is negative as you are south of the equator.

Once you have your GPS coordinates, you can plug them into your PA software to overlay on the coming seasons yield data. You can also use Google Earth with the "Add Place mark" function to mark and label treatments should you not have PA software.

For more info on how to create Polygons or share your GPS points in Google earth see "Marking out your trial with a GPS" at: www.youtube.com/user/agronomyjigsaw