

Guidelines For Successful On Farm Trials

Precision agriculture technology, and in particular the yield monitor provides many of the tools required for conducting on farm trials. However, if we are to make appropriate conclusions from these trials that will result in improved management decisions then it is important that the trial is designed and analysed appropriately to produce significant results. A poorly implemented trial can be at best a waste of time and effort and at worst may lead to incorrect management decisions being implemented on farm. However, a well designed and run trial can provide significant insight into improving the management of your own land.

Below are some guidelines to appropriately implementing on farm trials.

1. Trial Design

The following example shows how fertiliser rate trials can be designed in paddocks. Similar designs can be used for other treatments such as different gypsum or seeding rates.

1.1. Few rather than more treatments

In on-farm experiments, where treatments must fit in with a commercial operation we recommend restricting the number of treatments to one or two and at most three. The remainder of the paddock can be the normal paddock treatment. A simple trial that produces a clear outcome is better than a very complex and time consuming trial that confounds the issue.

When deciding on a treatment it is important to decide on the question, for example

- What effect does increased nitrogen have on grain yield?
- When will the crop yield more if nitrogen is increased (season)?
- Where will the crop yield more if nitrogen is increased (region)?

1.2. Go for large treatment differences

The objective of a trial is to learn something about how the crop responds to inputs. To ensure this happens, treatments must be large enough to bring about a change in crop yield or quality.

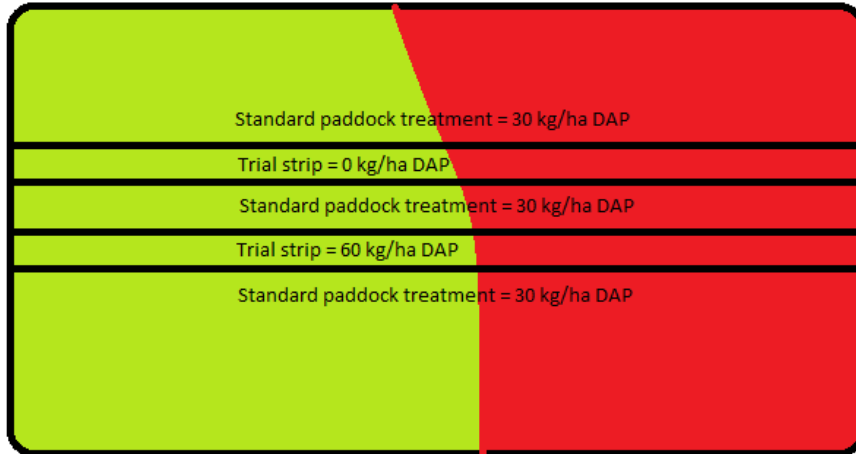
Examples of treatments that will have an impact if there is a deficiency or constraint might include:

- Increasing nitrogen (N) by 20 kg N/ha (i.e. about 50 kg/ha of urea)
- Increasing phosphorous (P) by at least 4 kg P/ha (i.e. 20 kg/ha DAP)
- Applying gypsum at a rate of at least 2 t/ha; or
- Applying lime at a rate of at least 2 t/ha.

Only change one input at a time between each treatment. For example don't change the rates of fertiliser and seed at the same time. Also, where the response to P is being assessed avoid using a fertiliser blend where the N rate will also change significantly, as this will confound the result. For example use MAP or DAP rather than 32:10 or 27:12.

1.3. Orientate the trial and treatments ‘up and back’

The trial should be orientated to cross the high zone and the lower or average yielding zones in the paddock, as indicated in the example below.



- The treatment should occupy at least two seeder bar widths, and preferably 3 header comb widths. This will ensure that when harvested at least 2 full comb widths can be extracted from the yield map for each treatment strip for analysis. Header passes where the comb is harvesting from 2 treatments at once can be deleted, as it is mixing the treatments.
- The location of the treatment must be recorded using a GPS so it can be overlaid on a yield map. This can be done at seeding by logging an as applied map, or if the treatments are marked with a dropper the GPS coordinates can be collected at a later date. A good example of marking a trial is below, where a dropper with a chemical drum with treatment notes recorded can be invaluable when others are assessing the trial.
- The treatment should be located next to the standard paddock management. This minimises the amount of the paddock that is ‘experimental’ and ensures the costs associated with running a trial are kept to a minimum.



This is an appropriate trial design for comparing fertiliser rates, where in between each treatment strip there is a reference strip of the normal paddock treatment. This acts as a check plot for comparisons. To improve the robustness of the trial design further the treatment strips could be replicated in another area of the paddock.

2. Additional information for on farm trials

In addition to applying the trial treatments and harvesting the final yield results, additional information may also help to explain why or why not a yield response occurs. This additional information may include visual observations, soil tests, plant nutrient analysis, N-rich strips, grain nutrient analysis, plant counts and weed counts.

2.1. Soil Sampling for Phosphorous, Salinity and pH within zones

- Target soil samples within zones that have been defined for your paddock, these zones may be based on the compilation of yield maps, EM38, biomass imagery or some other relevant layer. Alternatively, base the sampling on your own knowledge of the paddock and your feel for the difference in production across the paddock. We can still zone the paddock after it is sampled and locate the sample sites in the relevant zones afterwards.
- Take samples from points located with a GPS.
- Sample between 2-4 sites in each zone, depending on the size of the paddock and the relative size of each zone.
- Take 10-15 samples at each point to a depth of 10cm. Sample in an area up to 30m across. Use a consistent method for sampling the row and inter-row, for example if the crop row is 5cm with 25cm row spacings, then take 1 in 5 cores from on the previous crop row.
- For each zone samples can be either bulked or analysed individually. Bulking samples for each zone reduces the cost of soil testing. However, analysing each sample separately gives an indication of how much variability is within the defined zones and may indicate whether the zones are accurate or not.
- Mix thoroughly and sub sample 100-150g (bit less than a cup full) for each sample to be analysed. If soil is moist allow to dry in open bag. We use plastic zip lock bags.
- Use a code system to label samples using grower initials and a number.
Eg ST1, ST2, ... Record location of each sample.
- For trials assessing P response have the phosphorous buffering index analysed in addition to Colwell P. Save an additional 100g of soil and this can be sent to the University of Adelaide for a DGT analysis.

2.2. Soil sampling for available Nitrogen (nitrate and ammonia) and sulphate Sulphur

- Follow a similar protocol as for phosphorous above. Take cores to a depth of 60cm.
- Take 2 cores at each location rather than 10-15, within a couple metres of each other to get a representative sample for that point.
- For each zone samples can be either bulked or analysed individually. Bulking samples for each zone reduces the cost of soil testing. However, analysing each sample separately gives an indication of how much variability is within the defined zones and may indicate whether the zones are accurate or not.
- Mix the entire core thoroughly and sub sample 120-150g soil. Alternatively the cores can be segmented into depth layers, e.g. 0-30cm and 30-60cm to give a better indication of where the N is in the profile. Testing for sodicity, salinity and pH within these segments may also indicate the presence of sub soil constraints that may affect the availability of N at lower depths.

2.3. Plant nutrient analysis

Leaf tissue tests are a useful tool for gauging plant responses to applied nutrients by checking to see what the plant has taken up. In particular, this may be useful for P, S, K and micronutrient trials.

- For each sample collect 30-50 leaves of the youngest fully emerged leaf (YEB = youngest emerged blade). For younger plants and small leaves more leaves will be required to make an appropriate sample size. 10g of dry material is appropriate.
- Collect the samples using clean plastic gloves to avoid contamination from your hands.
- Place leaves in an envelope and dry in a clean oven at 40-80°C (Do not go over 100°C) for 24 hours to prevent going mouldy in transit to the lab.
- Collect samples from each treatment and within each zone for comparison. Record these details on the envelope.
- Record the date of collection and an accurate growth stage. The critical concentration of some nutrients changes significantly with growth stage.
- Leaf nutrient analysis is not a good measure for N. For N trials it would be best to take biomass cuts for dry matter measurements and then subsample the dry matter and send off for a N analysis.

2.4. N-rich strips

N-rich strips are reference strips setup in the crop, where a high rate of N is applied to the reference strip, beyond what the crop is expected to require. The growth of the crop in the N-rich strip and the crop adjacent that represents the paddock managed crop is monitored and compared during the season. The difference in growth between the two areas of crop can be used as a measure of the crops responsiveness to N. Sometimes the difference between the N-rich strip and the adjacent crop is visual to the eye; however the use of a crop sensor such as a Greenseeker can help to measure the differences between the two. The size of the response in the N rich strip can be used as a guide when making decisions about post emergent N rates. For example, if there is no difference between the crop and the N-rich strip then it indicates the crop requires little or no N, however if the difference is quite large it may indicate the crop requires a high rate of N. Research is continuing into linking the in season N response measured from the N-rich strip and the N rate required to reach yield potential.

Tips for putting N-rich strips in place

- Apply the N-rich strip at seeding or soon after.
- Use a high rate of N, the rate itself is not that important. The idea is to make sure N does not limit crop growth in that strip. Rates of 100-200 kg N/ha should be appropriate in most areas.
- Locate strips within each of the major production zones within the paddock.
- The strips can be large strips applied across the paddock and all the soil types using the seeding equipment for example, or smaller strips applied by hand. For small strips (i.e. 10x2m) it is best to run the strips across the direction the crop is sown. This minimises the likelihood that a blocked hose or wheel track will affect the growth of the crop within the strip.
- In a 10x2m strip 400g of urea is equivalent to 200kg/ha of urea.
- Accurately locate the strips so that you can find them within the growing crop, the crop growing in the N-rich strip may not be as obvious as you think.
- Monitor the strip during the season and where possible gather readings with a crop sensor such as the Greenseeker or Crop Circle.

2.5. Plant and weed counts

It may be useful to do crop plant and weed counts in trials that are assessing variable rate seeding.

For crop plant counts

- Count crop plant emergence 4-6 weeks after sowing at 8-10 locations within each treatment and within each zone to determine the actual population attained from the seed rates applied.
- Count crop head number prior to harvest at 8-10 locations within each treatment and within each zone.
- Use a 1m length stick, place between two crop rows and count the plants or heads in the two rows.
- Record the row widths to calculate plant density.

For weed counts

- For trials assessing the competition affects of crop density on weeds, count weed head number prior to harvest, this provides an indication of competition effects on potential weed seed production.
- Use a 0.1m² quadrat or bigger.
- Count head number at 15-20 locations within each treatment and within each weed patch. Weed density can be highly variable within a patch, therefore locate counts adjacent to one another between treatments and the more counts and replicates the better.

3. Acknowledgements

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