

Experimenting at scale: grape growers shape spatial approaches to trials

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Figure 1. Examples of vineyard staff applying treatments for botrytis bunch rot (a fruit disease) during two collaborative trials using their own equipment. The treatments were: (a) mechanical shaking using a harvester and (b) fungicide application.

Farmers in Australia, like farmers around the world, commonly conduct experiments or trials on their own farms to test new ideas, crop varieties, practices, and technologies. These trials can generate information to support farmers' management decisions about what has been tested.

Our survey of 43 grape growers and viticultural consultants across Australia found that most of them conduct trials every year. Their key motivations include improving grape or wine quality, reducing the cost of production, or improving management operations in the vineyard. Importantly, they trial to enhance confidence in operational decisions, such as changing a fertiliser, and to gain knowledge about how to better manage the vineyard.

As such, growers' trials help them meet production goals, and address challenges or constraints faced by the business, thus keeping the business moving forward.

Conducting on-farm trials, however, is yet to be realised as 'business as usual' for many of the growers, mainly due to

limited availability of time and labour. Spatial variability in land, such as varying soil properties, adds another challenge for on-farm trials by confounding the interpretation of trial results.

Spatial approaches to on-farm trials that use precision agriculture (PA) tools can address the issues associated with time, labour, and spatial variability. In a spatial approach, for example, trial data can be collected using yield monitors to improve efficiencies of data collection. Trial results can be presented to visualise how the effects of a given treatment vary across the trial area.

Spatial approaches can be applied to a whole farm (whole-field designs), or a crop row of field length (strip designs). The latter can likely reduce the effort and costs associated with using whole-field designs.

Case studies

To investigate how growers and their consultants view the use of spatial approaches for their own trials, we conducted four case studies where we

collaborated with four growers and two consultants in New South Wales, South Australia, and Tasmania.

A 'simple strip' trial approach was applied to growers' own trials (Figure 1) in vintages 2020 and 2021 to answer the questions that growers had for their farms.

This strip approach involves positioning a trial strip (i.e., a crop row or maybe two rows) in such a way that it crosses the range of variation within the paddock, or the block of a vineyard.

If you already have management zones established, doing this may be quite straightforward. An alternative is to make use of a potentially useful covariate which might affect treatment responses.

A covariate is a variable that covaries with a response variable of interest. For example, if you were doing a fertiliser trial in a dryland situation, you might expect yield responses to be greatest where soil moisture availability is at its best, because this sets yield potential.

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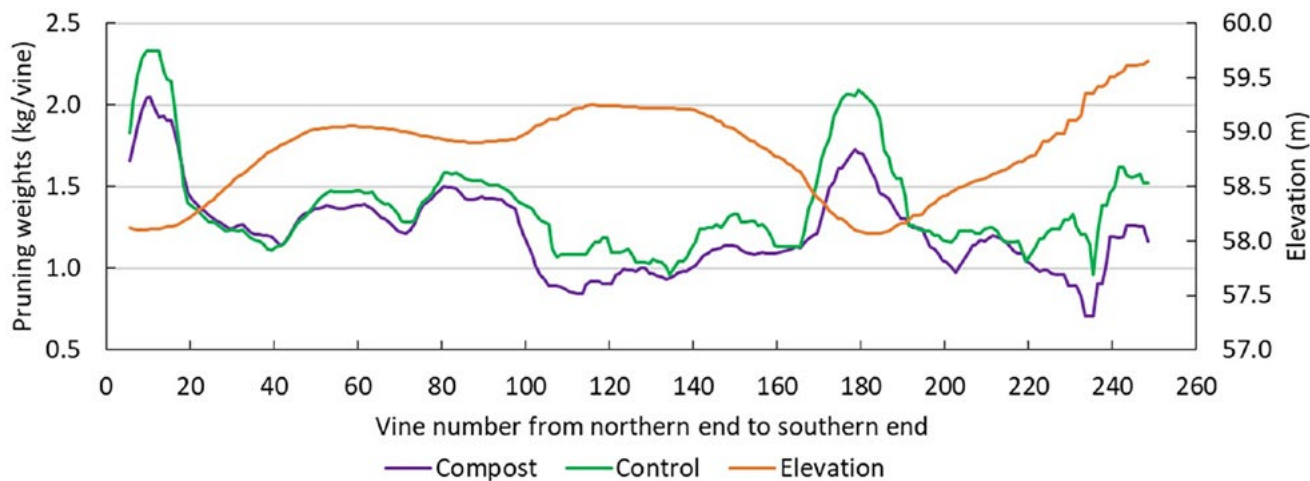


Figure 2 Shows spatial variation in pruning weight (kg/vine) for compost and control treatments, and in elevation, along the trial strip for the compost trial of a case study conducted in vintage 2020 in South Australia.

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So, in this kind of situation, soil clay content, or something that reflects this, such as soil electrical conductivity, may be a useful covariate.

When the range of variation in a covariate in the trial strip is close to that encountered over the whole paddock or vineyard block, the trial can likely produce results that inform how a treatment performs relative to another treatment in different locations of the paddock or block – i.e. in locations other than within the trial strip. In such a way, a strip trial design can be a powerful experimental tool.

Figure 2 illustrates the results of a case study trial using the simple strip approach. In this trial, the strip design was used to evaluate the effect of applying compost in a vineyard, on pruning weights, an indicator of vine vegetative growth or vine vigour. The results show that differences in pruning weights (kg/vine) between compost and control treatments were generally larger at locations with lower elevations (m). This information provided the grower with insights on where targeted management, if adopted, might help to improve uniformity in canopy size.

Perceived advantages of the strip approach

The growers and consultants we interviewed thought that the strip approach produced rigorous and informative results that could improve their confidence in management decisions.

One grower said: *“It has increased the confidence in aspects or thoughts that I would have had in managing the vineyard... therefore I’ll be more confident in future seasons in what I’m doing”*.

Participants said that trial results using the strip approach could improve their understanding of the impact of spatial variability on crop responses to treatments. The improved understanding may then improve vineyard management.

They also regarded the strip approach as efficient and easy to implement.

Another grower said: *“If we can do the strip trials to allow us to have variation in the block from a scientific point of view, but do it in one row, that’s spot-on mate... So, there are two major things, it will save time, save cost of damage. And the other thing would be that it allows you to expand the experiment more which allows for every dollar spent. You can get a bigger result from a smaller area”*.

The participants intended to apply the strip approach to their own trials where appropriate.

Barriers to adoption

The main barriers to adoption of the strip approach for grape growers include 1) limited resources for collecting trial data, 2) skills and knowledge for analysing trial data, and 3) capacity for applying trial results for targeted management.

Data collection may be less of an issue for broadacre growers than grape growers, given a likely higher adoption rate of yield monitors and other sensing technologies in the grain sector than in the wine sector in Australia.

Supporting uptake of spatial approaches

Participants’ positive attitudes towards the strip approach suggest opportunities for farming businesses to apply spatial

approaches for their own on-farm trials to make more informed decisions with greater confidence.

Importantly, questions of interest are initiated by the farming business with a commercial outcome in mind. The trial design must then integrate with the farmers’ normal operations and produce reliable results that support confident management decisions.

To support uptake by farming enterprises, more collaborative trials are needed to understand and demonstrate the value of spatial approaches to farmers, consultants and institutional researchers. Shifting the mindset of researchers may be needed, at least for those who judge the benefits of a trial based on its ability to statistically differentiate treatments.

Additional case studies will also help shape the types of professional services needed to assist with trial implementation, data collection, analysis and interpretation.

As more farmer-centric trials are conducted, they will likely generate further insights about applying spatial approaches in real-world farming contexts, thus helping improve the experimental approaches used to better suit farmers’ needs and situations.

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