How to: on-farm trials
How to undertake your own research on-farm

On-farm, there are often more questions than answers. Whilst some questions are best answered in replicated small plot trials, where robust data collection and statistical analysis can be undertaken, others are better addressed using on-farm approaches. This is especially true for anything that requires commercial machinery use or may be influenced by farm practices or geographical variation.

ON-FARM TRIALS

1. What is the question you want to answer?

Having a clearly defined question to answer will ensure you get worthwhile data or observations.

For example:

'Do cover crops increase sugar beet yield?' is broad and will not give you specific answers as cover crops influence nutrition, soil health and pests and diseases, in sugar beet. Instead focus on a specific question such as:

- Do cover crops increase slug numbers?
- Do cover crops supply nitrogen to the following sugar beet crop?

Some questions on certain topics are more straightforward such as:

- Does a specific biostimulant increase yield?

Maybe you have a couple of questions to answer but, whatever you do, make sure they are targeted, defined and clear.

2. Site/field selection

Now you have the questions you want to answer you need to work out where you will locate the trial. This will depend on your research question/s:

- If you are looking at a particular weed or pest this might dictate a certain field. If you wanted to look at BCN control, you need a field with known BCN infestation. If you are interested in mechanical weed control you will want a field with a known and consistent weed pressure.

- To undertake any work relating to nutrition, you need a field with known history, particularly organic inputs. There are two things to consider;
  - o Baseline Nutrients - e.g. If you use a lot of digestate your N levels may already be high, making it difficult to detect differences between N levels
  - o Consistency - manure is less likely to be spread evenly and any differences observed between treatments may be due to areas with and without manure rather than the overlying treatment

- Topography is another key consideration. Slopes often relate to differences in underlying geology and affect crop growth. Features such as hedgerows, large trees and woodland can cause microclimates due to shade or windbreaks. Select an area that is flat or uniformly sloped and away from any features that might cause variation.

3. **Soil tests**

a. You may test your soils regularly and have soil maps which can help identify the most uniform part of a field.

b. If not, it is worth sending samples for N, P, K, Mg and pH testing to ensure that these are the optimal levels for sugar beet (unless you are testing something that requires substandard nutrition, such as a biostimulant). We suggest splitting the trial area into quarters and testing each area separately to look at uniformity (Figure 1).

c. Soil is unlikely to be uniform along the whole strip so an important consideration is where you assess and sample from, keep as uniform as possible across all of the strips.
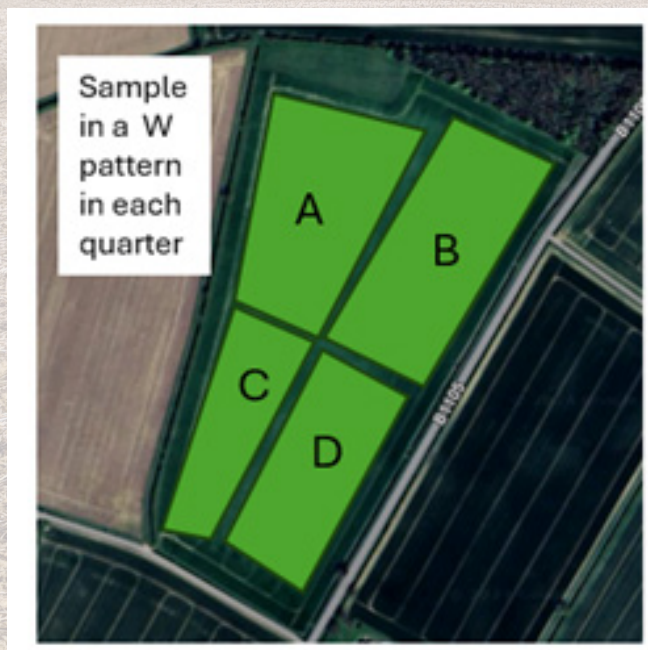
Figure 1. Example of splitting a field into four to soil sample to understand the variation between the four areas.

4.   Treatments

Keep the number of treatments as low as possible to answer your question. This simplifies set-up and management and is more likely to result in a clearer answer.

A control is essential as it enables you to understand whether it is the treatment or environmental impacts having an effect. The control can be on-farm standard practice or an area without any treatment at all, such as no cover crop or standard tillage practice.

Change one thing in a treatment so you know exactly what is driving any differences. For example, with cover crops you could end up with mixes full of numerous species so you won't know what is actually making a difference, a better option would be to have 3 treatments with another species added each time to see what the affect is of adding each species.

5.   Machinery considerations

A key consideration for on-farm trials is the machinery and labour availability, and size. Machinery widths will dictate treatment widths. This can be especially important if you want to do something before drilling beet, such as different cultivations. You will need to know where each treatment is once the beet are drilled as treatment differences may not be visible, so record locations with What3words or log onto GPS.

It is worth noting that anything that requires an overlap such as a spinning disk spreader makes it hard to get rates correct over the width of the strip.

6.   Trial design

The simplest design is a split field, where half the field is one treatment, and the other is the control (Figure 2A). This can answer simple questions such as 'Does a cover crop improve soil structure or does a biostimulant increase yield?'

When asking more complex questions with more treatments, then strip trials are a better option as you can have strips of each treatment (Figure 2B). Width of these will be dependent on the machinery but should be kept the same

Having a strip of each treatment can give a good comparison, but a better approach is to have at least two replications of each treatment (Figure 2C). This ensures that any influences from underlying variation (which we try to eliminate with our site selection but isn't guaranteed) are identifiable and you can be more confident that it is the treatments alone having an effect. The gold standard is to have this randomised. (Figure 2D).
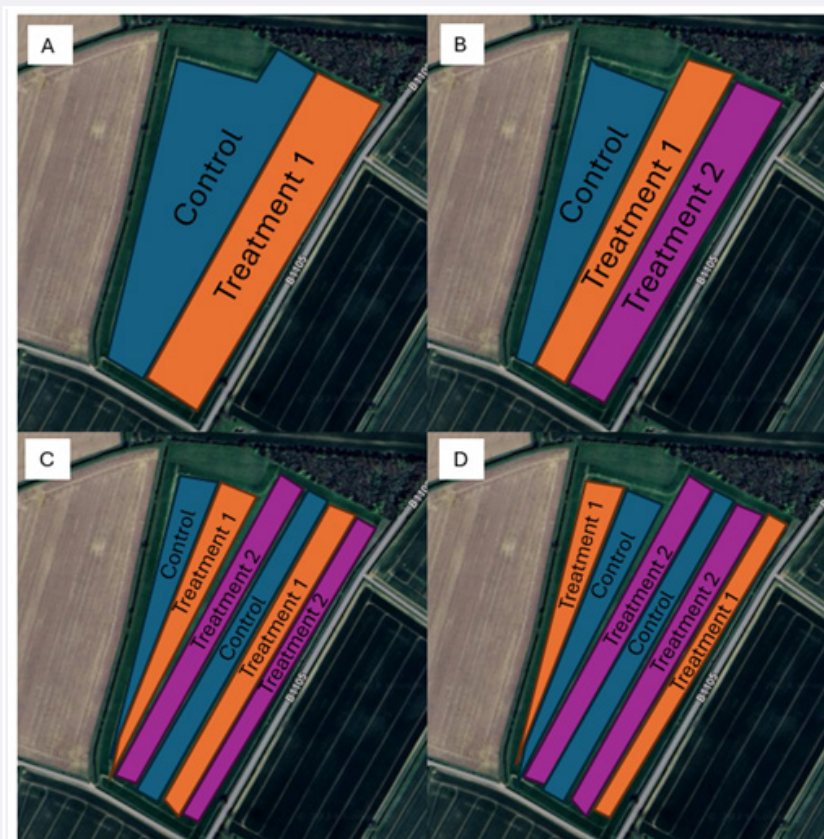

Figure 2. On farm trial designs. (A) Split field. (B) Strips (C) replicated strips (twice replicated) (D) randomised replicated strips (two replications).

7. Assessments

For most questions the most basic assessment is final sugar yield. This likely requires hand digs, BBRO recommends taking at least three yield digs in each strip, ensuring the areas chosen are as uniform as possible between strips. To collect a big enough sample for analysis you should take two neighbouring rows of 1.5m of beet as this equates to a m² sample area. If the beet are small you may need to sample a larger area as you will need a sample of at least 5kg if they are to be sent through the BBRO plot building. The tops and roots can be weighed separately to give a fresh weight, ideally these should be dried and analysed for dry matter as this is a more consistent measure of growth. NRM offer this service. Additionally, BBRO can send beet through the tarehouse to get sugar % if also required but this does come at a cost.

Alternatively, harvest a strip through each treatment and use a weighbridge to record the dirty weight. Then a sample of these beet could be taken for analysis of sugar and impurities. You will also need to record the length of the strip (to the nearest metre) to calculate yield.

Whilst the beet is growing assessments can be made. The right assessment will depend on the question you're addressing but suggestions are as follows:

- Establishment counts (crucial to most questions as you want to ensure a uniform crop for your trial)
- Canopy cover – can use the Canapeo app to give green area or an NDVI sensor
- Early and mid-season biomass digs to assess growth
- Pest assessments such as aphid counts or slug trapping
- VESS and/or infiltration tests assessment to look at soil structure
- Tissue tests to look at plant nutrition
- Soil tests such as CO_2 burst to look at soil health
- Pictures and videos to record observations throughout the season

Ensure you keep clear records so that you know what observations or data refers to so that you can answer your research question.

Ask yourself - will you be able to assess it well?

It is better to do less well than too much that you can't look after/assess as you won't be able to answer your question if you can't get the data and observations you need.

8.   Analysing the data

On the most basic level you can look at the data collected to see if there are any big differences between treatments. A better approach is to use statistics to determine whether the differences observed are random or if they reflect genuine, meaningful differences. For trials which are not replicated or randomised T-tests can be used, whilst for those that are, ANOVA is a good option. Please contact **info@bbro.co.uk** if you have got to this stage and would like help with analysing your data or need further guidance.

Summary

1.   Decide on research question/s
2.   Select a field which is as uniform as possible and has any characteristics you need to answer your questions (pests etc.)
3.   Test your soil and make sure there are no unexpected issues
4.   Ensure you have a control treatment and then decide on what your other treatments will be, keep it as simple as possible
5.   Ensure the trial is designed so it fits the machinery you have access to
6.   Consider how you will lay out your design and if you will replicate and randomise it
7.   Plan your assessments and keep good records
8.   Assess your data, ideally using statistics
9.   Contact BBRO if you need any further help or guidance

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