

A guide to simple and effective nursery trials

By Andrew Hewson and John Atwood, ADAS UK Ltd

Some growers would like to test pesticides or new growing techniques on different ornamental species in their own nursery environment. However, they are often put off through lack of experience or knowledge in undertaking trials. The principal aim of this factsheet is to give growers the confidence to conduct their own trials, and guide them through the key points to consider using a question and answer format.

Undertaking trials on your own nursery

What stops you?

The time involved and the idea that experimental work is complicated are the major reasons. Growers often begin with the best of intentions but the trial is not designed properly, so its usefulness and integrity are compromised. Sometimes progress falters due to lack of focus and time.

What makes them meaningful?

The statistical analysis of experimental results is essential for scientists and although nursery trials are unlikely to have to meet scientific statistical

requirements, they do need to satisfy the basic rules of good trials practice

if the outcomes are to be worthwhile and credible (Figure 1).



1 Nursery trials are an ideal way of assessing products and treatments in a commercial situation, but need to be well planned and carefully managed to be effective

Initial considerations

Can I make them a success?

There are a number of important points that need to be considered if a trial is to be successful:

- Be clear in what you want to find out and keep things simple.
- Only test one thing at a time and avoid the temptation to include too many different treatments at the same time.
- With herbicide trials for example, decide from the outset if the main

aim is to assess crop safety, weed control or both.

Should I keep them simple?

For most grower trials, simplicity is the key to success. Trials involving lots of treatments, sequential treatments or inter-related treatments are more complicated and will require a well planned trial design and statistical analyses, which are not usually necessary for simple nursery trials.

Will they work on my nursery?

Consider carefully how the trial is to be managed and recorded: who will do this and where will the trial be located on the nursery? Choosing the wrong location can have a big impact on the treatments and results. Designate an appropriate area for the trial, away from busy work areas but near enough to be representative of nursery conditions and not forgotten. Ensure rabbits are excluded as they can cause considerable damage.

Who will manage the trial?

Choose an appropriate staff member to look after the trial, one who is reliable and able to give it the necessary time and commitment. Choosing the wrong person can have disastrous results, particularly if the plants are forgotten or are sold off mid way through the trial.

Will it affect operations?

Trials need to be considered within the context of normal nursery practice. For example, if a trial is being used to screen fungicides, don't include it within areas that will receive routine nursery fungicide applications. Also, ensure that any routine cultural work

like weed control, is carried out in the same way across all the treatments. Similarly, irrigation must be evenly applied across the treatments.

Getting started

Where do I start?

Once you have established the objectives of a trial, decided on a suitable location and identified an appropriate staff member to look after it, the next thing is to draw up a treatment list and decide how the trial is to be laid out.

Remember to keep things simple and not to include too many different treatments because this will complicate the management and recording of the trial.

Which plants should I use?

Be sure to use healthy plant material that is correctly labelled and as

uniform as possible. If trialling growing media or screening pesticide products, try to include a good range of nursery varieties, or at least choose a cross-section of those representing the main groups grown on the nursery (eg members of different plant families such as Rosaceae, the rose family or Compositae, the daisy family).

Trial organisation

Do I include a Control plot?

A Control plot is a group of plants in the trial that you do not treat at all, and it is essential to include such a plot or area, so there is something to contrast and compare the treatment results with. Forgetting to do so is a common failing of some nursery trials. The Control plot may either be an untreated area, or it may represent common nursery practice, for example a standard herbicide treatment or nutritional regime. Occasionally, a trial may benefit from both.

Do I need replication?

The term replication in a trial refers to the repeating of the same plots. This is done to ensure that the results are less affected by any external factors, recording errors or variation between individual plants in different plots. It also enables statistical analysis to be carried out to test the validity of the results.

Replication is not usually necessary for a simple observation trial and will require more space and materials, most notably plant material, which will add to the cost of the trial. However, where different treatment effects may be very subtle and require detailed measurement, replication is advisable.

Using unreplicated layouts

If the trial is not replicated, take particular care to ensure that the treated areas are as similar as possible and not subject to different conditions such as varying degrees of shade or exposure across the plots.

Table 1 demonstrates how the plots in a simple unreplicated observation trial might be laid out. In this trial, the effects of three different residual herbicides are being compared on different herbaceous perennial species.

Further treatments and varieties can be added to expand and develop the trial including for example, different combinations of pesticide products to form programmes. Usually, single product treatments would be screened in the first year before progressing to programmes and tank mixtures in the second year.

Using replicated layouts

If the trial needs to be replicated then the replicated plots need arranging in blocks. The blocks should be positioned so that similar areas are contained within each one, thus minimising any variation which may influence the outcome of the trial, such as shade, different levels of irrigation across a bed and so on. A block for example could consist of a tunnel containing all the treatments, which are then repeated in another, similar tunnel, or the treatments could be repeated in different places on the same bed. These blocks are referred to as the replicates and, for most trials, three replicates will suffice.

The same treatments are contained within each replicate (block). To ensure that extraneous factors do not influence the outcome or results, the treatments should be set out in a random order. This is called randomisation and also helps to ensure that treatment effects

Table 1 Layout of a typical unreplicated observation trial assessing the effects of residual herbicides on herbaceous perennial species

Control	Butisan S	Devrinol	Flexidor 125
Aster	Aster	Aster	Aster
Dianthus	Dianthus	Dianthus	Dianthus
Digitalis	Digitalis	Digitalis	Digitalis

are not influenced by differences due to plot position. For small scale nursery trials, a simple way of doing this is to number each plot position (1 to 30 for the example in Table 2), writing the numbers on pieces of paper, which are then selected blindly to determine the relative position of each treatment.

Table 2 demonstrates how the plots in a replicated trial might be laid out in a randomised way. Plots for each treatment are included once in each replicate. For simplicity, the example used relates to the same residual herbicide trial demonstrated in Table 1.

Similar designs could be used for assessing the efficacy of insecticide or fungicide products. Alternatively, a single crop type could be used, but



2 Ensure the trial is well laid out and clearly labelled so that the treatments are not confused

multiple treatments assessed in a replicated way. For instance, a range of non-chemical weed control products could be assessed on Aster alone.

Is there a limit to how many treatments I can include?

Within reason, there is usually no limit to the number of treatments or plants that can be included in a trial. However, be sure to lay out the trial well and label all treatments to avoid confusion (Figure 2). It is important to keep things as simple as possible and use

replicate plots if treatment effects will require detailed measurements. It is equally important to ensure a sufficient number of plants are used in the trial to be able to judge treatment effects.

Different treatments must not overlap between the plots. For this reason, adequate space must be left between each. Guard plants may also be considered around each plot. These are plants that are not treated or recorded and help to reduce the 'edge effect', thereby protecting the experimental plants from factors that may otherwise create a false impression or reading.

Table 2 Layout of a typical replicated trial assessing the effects of residual herbicides on herbaceous perennial species. The treatments are fully randomised.

Replicate 1	Replicate 2	Replicate 3
Digitalis – Butisan S	Digitalis – Butisan S	Control
Aster – Devrinol	Dianthus - Devrinol	Dianthus - Devrinol
Dianthus - Devrinol	Digitalis – Devrinol	Aster – Butisan S
Digitalis – Flexidor 125	Digitalis – Flexidor 125	Dianthus – Butisan S
Control	Aster – Devrinol	Digitalis – Butisan S
Aster – Butisan S	Control	Digitalis – Devrinol
Dianthus – Butisan S	Dianthus – Flexidor 125	Aster – Devrinol
Digitalis – Devrinol	Aster – Flexidor 125	Aster – Flexidor 125
Dianthus – Flexidor 125	Dianthus – Butisan S	Dianthus – Flexidor 125
Aster – Flexidor 125	Aster – Butisan S	Digitalis – Flexidor 125

Keeping records

Do I need to keep records?

Nursery trials often falter due to poor record keeping and report writing. Without proper records it is impossible to validate the results of the trial or use them as a basis to plan further work.

What do I need to record?

Ensure that you record the layout of the trial, the treatment schedule (products, rates, timings etc) and the plants to be used in the trial.

Ensure that what you record is relevant to what you want to find out, but keep this simple. For example, with pesticide screening, the main areas of interest will be crop safety and/or efficacy of the products. Crop safety is usually assessed in terms of

a) treatment effects on plant vigour, and b) phytotoxicity, ie direct damage to plants. Weed counts (ie recording the number of weeds, and species) are the usual way to monitor efficacy of herbicides. Generally, physical measurements or counts are the best form of data. Scores can be used and are quicker to collect, but they need to be based on a range of pre-determined parameters and be applied consistently throughout the trial.

Note any factors which may influence the results, for example weather conditions or delayed treatment dates.

When recording results on an outdoor trial, choose a fine, dry day for assessing it.

a regular trial diary, recording what was done when and by whom.

It is helpful to keep results on record sheets as demonstrated in Table 3 (over). The trial layout is similar to that included in Table 1. These figures can easily be produced on a spreadsheet program such as 'Excel'.

This table enables average scores to be calculated showing overall treatment effects and tolerance of the different plants. In this example, Herbicide 3 is the safest overall. Aster and Dianthus show good degrees of tolerance, whilst Digitalis is clearly more sensitive to the products used.

Assessments can be made throughout the duration of the trial period (to give a better indication of how things progress) or at the end of the trial after a pre-determined period.

Where do I keep records?

Ideally, keep both a computerised copy and a hard copy. Also keep

What other types of records could I keep?

Take photographs throughout the trial, for example to record particular treatment effects and different stages of the trial. Typical photographs illustrating differences between treatments are provided in Figure 3. In this case, it illustrates the effect of different watering regimes on the establishment and growth of liverworts.



Overhead twice daily



Overhead every 2 days



Capillary

3 Photographs can be used to record treatment effects and provide a useful point of reference when assessing results. In this case, the effect of different irrigation regimes on liverwort growth is illustrated.

Table 3 An example record sheet suitable for assessing crop tolerance when screening different herbicide products for crop safety. In this example, a simple scoring system is used with herbaceous perennials

Variety	Control	Herbicide 1	Herbicide 2	Herbicide 3	Average
Aster	5	3	4	5	4.25
Dianthus	5	3	4	5	4.25
Digitalis	5	1	1	2	2.25
Average	5	2.33	2.33	4	

- | | |
|--|---|
| 1 significant damage (serious stunting, scorching of leaves) | 4 good (no obvious damage or growth reduction, good quality plants) |
| 2 moderate damage (stunting/growth check) | 5 very good (no damage or growth reduction, high quality plants) |
| 3 satisfactory (no obvious damage, some growth reduction) | |

In summary

Nursery trials require time and commitment. Keep them simple and give them careful thought before starting.

The do's of nursery trials

- Be clear in your objectives and what you want to find out
- Ensure you are able to give the trial the time and commitment required
- Keep things simple and don't include too many different treatments
- Include a control plot
- Use replicates if detailed measurements are required
- Choose an appropriate staff member to look after the trial

- Choose an appropriate nursery location for it
- Use healthy, uniform plant material
- Ensure watering is even
- Ensure the treated areas have the same conditions and avoid extremes
- Keep written records with dates, and take photographs regularly
- Repeat the trial over two production cycles to help validate the results
- Write a short trial report detailing the design, treatments, results and conclusions. Include a diary of the trial and photographs
- Don't site the trial in an unsuitable location or split it up around the nursery
- Don't try to manage the trial yourself unless you have time: choose an appropriate staff member to help you
- Don't forget about the trial or sell the plants mid-way through
- Don't forget to check on the trial regularly and assess it at the required intervals
- Don't attempt to do it unless you can give it the commitment required
- Don't start the trial during busy periods unless really necessary

The don'ts of nursery trials

- Don't over complicate things and attempt too many different treatments

Whilst publications issued under the auspices of the HDC are prepared from the best available information, neither the authors nor the HDC can accept any responsibility for inaccuracy or liability for loss, damage or injury from the application of any concept or procedure discussed.

© 2008 Horticultural Development Council. No part of this publication may be reproduced in any form or by any means without prior permission of the Horticultural Development Council.

Design and production: HDR Visual Communication