The DOOR Manual for Plant Nurseries

Reprint – information current in 1996

Let's Do Our Own Research

The DOOR way to practical solutions

REPRINT INFORMATION – PLEASE READ!

For updated information please call 13 25 23 or visit the website www.deedi.qld.gov.au

This publication has been reprinted as a digital book without any changes to the content published in 1996. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

- Contacts—many of the contact details may have changed and there could be several new contacts available. The industry organisation may be able to assist you to find the information or services you require.
- Organisation names—most government agencies referred to in this publication have had name changes. Contact the Business Information Centre on 13 25 23 or the industry organisation to find out the current name and contact details for these agencies.
- Additional information—many other sources of information are now available. Contact an agronomist, Business Information Centre on 13 25 23 or the industry organisation for other suggested reading.

Even with these limitations we believe this information kit provides important and valuable information for intending and existing growers.

This publication was last revised in 1996. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.

This information has been made available to assist users involved in the nursery and garden industry wishing to conduct their own research. This information is not to be used or relied upon by users for any purpose which may expose the user or any other person to loss or damage. Users should conduct their own inquiries and rely on their own independent professional advice.

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Queensland Government

Resources and Trial Implementation

M. N. Hunter

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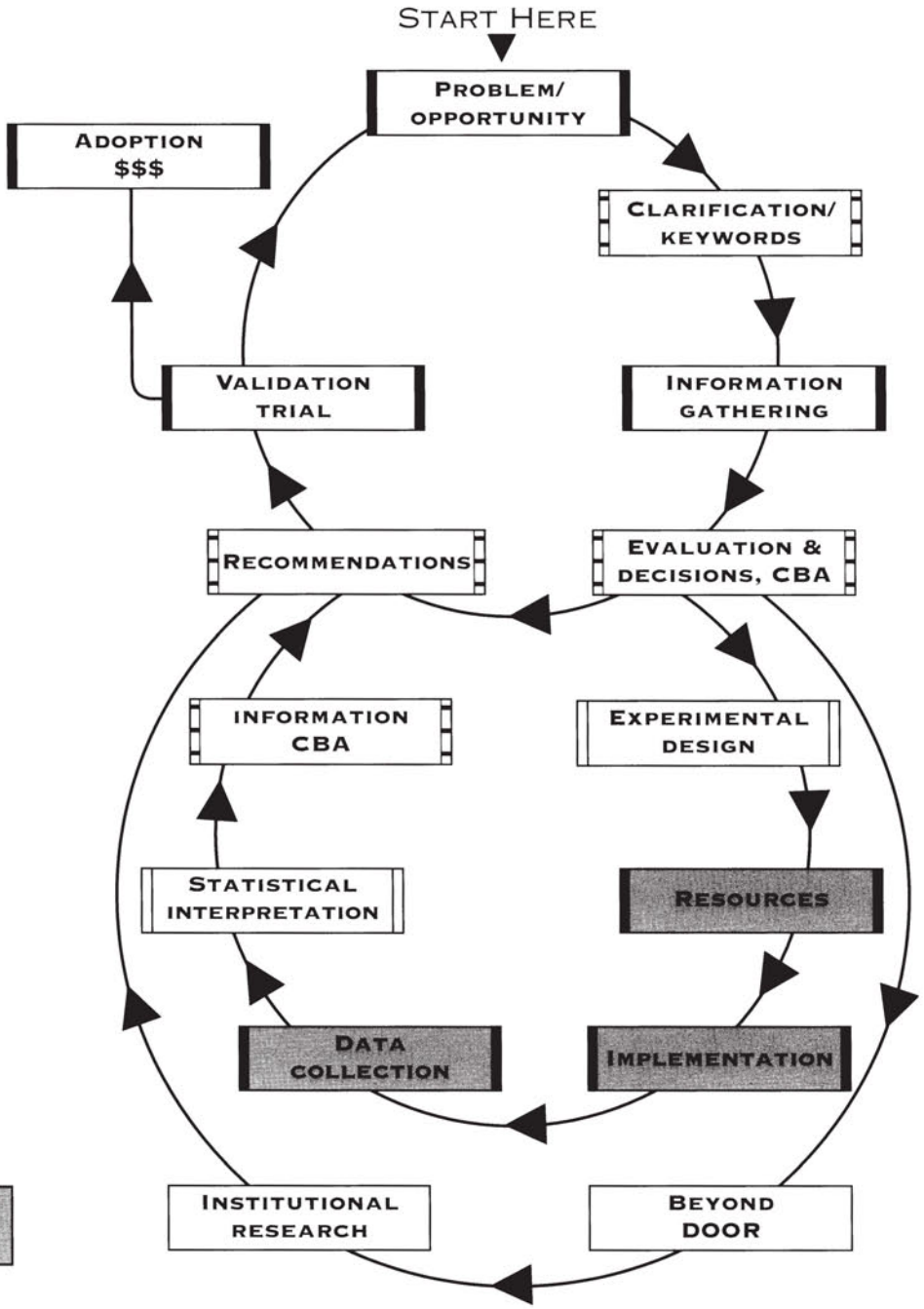
DOOR
Implementation Cycle



LEGEND

CHAPTER TOPIC

ACTION KEY

CONSULTANT ONLY

JOINT

OPERATOR ONLY

CBA = COST–BENEFIT ANALYSIS

6.1 PLANT HUSBANDRY

To be relevant, DOOR experiments must not differ too much from normal nursery operations. However, ensure that variability is minimised within an experiment.

Plants in experiments should not be exposed to uncontrolled variation, such as disease or mite infestation.

6.2 CHECK LIST OF REQUIREMENTS

The DOOR experimental pre-schedule check list appears in appendix 10.This pre-schedule must be completed prior to the start of the experiment. While some of the items cannot be completed until the experiment is concluded, most need to be addressed in one way or another before starting. This becomes a very useful document for anyone else involved in the experiment, as well an informative permanent record of the experiment itself.

6.2.1 STOCK

Minimise variation in early growth by selecting seed that falls within 10 per cent of mean size or weight. Calculate the mean by weighing 100 seed selected at random from the seed lot. Use only seed from the same batch since variations in origin can affect subsequent performance. Pre-germinate seeds and select undamaged uniform seedlings for planting. Plant two to three times more seedlings than are finally required, thinning back to the most even after about 7 days.

Cut off unwanted seedlings at ground level. Do not remove by pulling out because this may disturb the root system of the remaining plants.

Cuttings for testing must be as uniform as possible. If using a number of source plants, allocate cuttings that are from the same plant to individual blocks (or replicates). Slight variations in the vigour of the source plants will then not interfere with treatment effects.

6.2.2 POT SIZE AND COLOUR

All pots used in an experiment must be the same shape, volume and colour and have a similar pattern of drainage holes. Variation in any of these may influence the outcome of the experiment.

6.2.3 MEDIA

Fill pots with the same amount of uniform medium by weighing out media into pots rather than filling pots on a volume basis (although this is an option).Tamp the medium down to the same degree in all pots so that porosity levels are similar. Whatever technique is used, aim to provide uniform growing conditions other than differences associated with the treatments.

Pot media must be thoroughly mixed. Mix media for small pots by rolling the components vigorously in a large, sealed plastic bag with air inside. Media components for larger pots (>10L) should be mixed in a heap.

6.1 PLANT HUSBANDRY

- Manage experimental plants as they are managed in the nursery.
- Minimise the exposure of experimental plants to environmental variation.

6.2 CHECK LIST OF REQUIREMENTS

- Fill out the check lists in appendix 10 before starting the experiment. Make copies for future reference.

6.2.1 STOCK

- Reduce variation by selecting the stock carefully.
- Pre-germinate seeds before using, over-plant and thin back.
- Ensure cuttings are uniform. If not, allocate variation in cuttings to blocks.

6.2.2 POT SIZE AND COLOUR

- Pots need to be the same size, colour and volume and have similar drainage patterns.

6.2.3 MEDIA

- Put the same amount of media in each pot by filling the pots by weight.
- Mix the total amount of media thoroughly before filling the pots.

If you do use premixed media, calculate how much you need for your experiment, put it and a little extra to one side and mix thoroughly by turning the heap over repeatedly with a shovel. This is essential if you are experimenting with some media-dependent factor, constituents of which are unlikely to be mixed very precisely in bulk loads. For example, the effect of water-storing granules or fertilisers could vary dramatically if these constituents are not evenly distributed, and so greatly reduce experimental precision.

6.2.4
AMENDMENTS INCLUDING FERTILISER

- Add own fertilisers, chemicals, etc., to bought media. Weigh and mix quantities evenly.

Do not rely on media suppliers to accurately add and distribute chemicals in the media that you purchase. Chemicals may be added to media as solutions, in suspension or as solids, but they must be distributed evenly. The desired quantity of solution or suspension should be added to enough inert carrier, such as fine sand, that is just moist but not excessively wet. This moist carrier can then be incorporated as with other media. To prevent the possibility of confounding, include the carrier in all treatments even when no fertiliser is added. Dry fertilisers can also be incorporated as above. In fertiliser placement studies, actual placement, such as dibbling, must be carried out in a repeatable and consistent way.

6.2.5
LABELLING

- Label pots accurately and permanently.
- Labels should not obviously indicate the treatment of pots.

Label each experimental unit permanently so it will not fade with time or wash off with water. Give each experimental unit a unique number that is not readily interpreted in terms of treatment applied without reference to an identification list. This will reduce the possibility of unconscious personal bias that can occur with data collecting, particularly those involving subjective assessment. If the treatment is known before the measurement is taken, a bias can be introduced.

Preferably, mark the pots themselves. If using labels, secure them to the pot so that they can't be accidentally removed. Put fine stemmed, marked stakes into closely spaced pots when plant growth obscures markings on pots. Avoid contact between the metal markers and media.

6.3
LAYING OUT AN EXPERIMENT

- Evenly space pots so they do not interfere with one another.
- If necessary, add a guard row around the block.
- If there are environmental variations, arrange treatments across and blocks down the gradient.

Keep pots a minimum distance apart, not interfering with one another. Arrange each block of treatments as closely as you can in the form of a square, accounting for any known variation such as wet or dry spots. Ensure that all plants are reasonably accessible and easy to measure. The easier plants are to measure, the more the operator will be inclined to collect data.

To minimise edge effects, arrange at least one row of control plants around the perimeter of each block, particularly for experiments of 2 months or more. Pots in some experiments may have to be fully guarded to minimise inter-plant competitive effects, especially where large treatment effects on growth are expected (see section 6.4.1 for complete guarding).

While it is preferable to select a site free of environmental gradients such as temperature or shade, when they exist, arrange treatments across gradients and blocks down gradients. Ensure that all plants within a block are exposed to similar conditions of light, draughts,

temperature and irrigation. Statistical analysis can accommodate substantial variation in the effect of environmental factors from block to block but not within a block.

6.4 ENVIRONMENTAL CONTROL

To be as relevant as possible, the whole experiment must be conducted in an environment similar to normal commercial practice. If for some reason the experiment, or part of it, is treated differently from surrounding plants, record this difference and the pots involved. In most cases, such variation may have had little effect on the experimental results, but when unexpected results occur, such information could be vital in providing explanations.

6.4.1 LIGHT

Expose all experimental units to a similar light environment. Be aware of shadow lines and their movement during the day and locate the trial site appropriately. If possible, minimise the competition between plants for light by maintaining adequate space between plants.

If you expect that inter-plant competition for light is going to occur at the optimum pot density then you must include guard plants. They are placed around the data plants to minimise the competitive effects of adjacent treatments, but are not measured as a source of data because their growth is a reflection of both the treatment and the competitive effect.

6.4.2 DRAUGHTS

Plants exposed to draughts are likely to perform differently to others, particularly in nutrient and irrigation experiments. Minimise draught effects by locating the trial within a larger area of the same species and away from doorways, etc.

6.4.3 IRRIGATION

Of all the uncontrolled factors, water supply variation to an experiment may account for much of the trial variability. Assess sprinkler performance before laying out an experiment and ensure uniform water distribution by replacing worn nozzles or by adjusting water pressure. Reassess and map distribution patterns. In setting the experiment up, avoid those spots that are excessively over-, or underwatered and lay out replicates accordingly. Water distribution problems may also be minimised by using properly adjusted individual pot drippers or sprays or the use of sub-irrigation (capillary flow, ebb and flow). (See *Waterwork* (Atkinson & Rolfe, 1995), available from NSW Agriculture, and similar publications.)

6.4 ENVIRONMENTAL CONTROL

- The environment of the experiment must be similar to the commercial environment.

6.4.1 LIGHT

- Light intensity can influence plant growth.
- Use guard plants to minimise light competition between adjacent plants.

6.4.2 DRAUGHTS

- Minimise draughts if likely to affect nutrition and irrigation experiments.

6.4.3 IRRIGATION

- Minimise water supply variation by checking sprinkler systems.

6.5 Environmental monitoring

- Record environmental variables such as light intensity, temperature, etc. These records can explain unusual results and are valuable if repeating an experiment.

6.6 Timing of measurements

- Collect baseline data as a reference.
- Collect data at specific times during the experiment and at the end.
- Time experiments to coincide with the required season, etc.

6.7 Record keeping

- Record data on data sheets.
- Keep records safe and secure.
- Use a bound book for notes.

6.5 Environmental monitoring

To reproduce the effects of a particular practice, be aware of all variables in the environment. As a minimum, collect daily information on maximum and minimum temperature and record the general conditions of the day such as light intensity and humidity, particularly if such conditions are unusual (e.g. heat wave, sudden cold snap, frost or a long period of overcast weather).

If practical, get some measure of how much water is applied to each pot and how much water actually leaches through.

6.6 Timing of measurements

With transplants, measure their height and width as soon as possible after transplanting. This essentially provides baseline data to which subsequent data can be related. Repeat such measurements at least three to four times over the duration of the experiment, or at least at monthly intervals.

Even though a decision on the effectiveness of a particular treatment may be largely decided on data collected at the end of the experiment, data collected throughout the experiment can be of considerable value in working out how the treatment effects developed during the course of the experiment. Such information can tell you when an effect started to emerge and how the magnitude of the response changed over time. Both aspects may have fundamental influences on management recommendations.

Often data will be collected before any effects are visible, but it is just such data that allow you to pinpoint when effects started to emerge.

Appropriate data can be graphed. This allows an estimate of growth to be made and thus the extent by which a particular treatment has delayed or advanced growth.

Conduct experiments at a time when effects of treatments are most likely to occur. This may mean waiting a season or so before carrying out an experiment that relates to a current problem. For example, while a particular watering regime may appear as a problem during the summer months there would be little point in carrying out an experiment in the following autumn period when water demand is at a minimum.

6.7 Record keeping

Keeping proper records is very important. Draw up data sheets and enter data either in pencil or water-fast ink. Copies of data sheets should be stored in a secure file.

Use a notebook for all notes taken about the experiment; never use loose leaves. Include any ideas or thoughts or casual observations in your notes to jog your memory.

From time to time, photocopy the entire contents of the notebook and file with the data copies. Do not worry about the messy appearance of the notebook. If using electronic record-keeping devices, file hard copy as soon as possible.

Start a new notebook with each experiment, filing the old one for easy retrieval and reference. Ensure that all data recorded are legible to others.

6.8 Costs

Experimental work costs money and this is first addressed in the cost-benefit analysis carried out before the selection of the project. Once the project is initiated, keep records of costs of resources, as well as the amount of labour expended, to help cost future research.

6.9 Staff and others

It may be trite, but it's true. Your staff are your most valuable resource and should be treated accordingly. They can prove invaluable in the conduct of DOOR. With their daily activity "at the coal face" they are confronted with problems and opportunities all the time. Create an environment in which staff are encouraged to identify problems and potential solutions. Give staff incentives and involve them in brainstorming sessions.

While staff will be skilled enough to collect data, they should not be given this responsibility until they are familiar with the experiment itself and have some sense of ownership of the aims and outcomes. Only then will you get the level of commitment necessary for this job. Insist on complete honesty and rigour in data collection; emphasise the need for a record to be made of any mistakes. Point out that some of the greatest breakthroughs in science have come about as a result of mistakes.

6.8 Costs

- Do a cost–benefit analysis before starting the experiment.
- Keep records of costs and labour to use for future reference.

6.9 Staff and others

- Create an environment which encourages and involves staff.
- Involve staff in designing experiments and train them in record keeping and data collection.