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 We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research: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

APPENDIX 8

WORD ASSOCIATIONS

PROBLEM IDENTIFICATION—ABC APPROACH

The following list is an alphabetically arranged question list for use in word association exercises.

A Attitudes? Antagonism? Apathy? Adaptability? Aesthetics? Automation?

B Behaviour? Bottlenecks? Bargaining? Bureaucracy? Budgets?

C Communication? Climate? Change? Crises? Complaints? Careers? Conflict?

D Delegation, Decentralisation? Defects? Danger? Difficulties? Deviations? Durability? Deadlines?

E Environment (situation)? Economy? Errors? Ethics (morality)? Experimentation?

F Frustration? Fear? Fantasies? Fun? Failure? Forecasting?

G Garbage (as in computer inputs/outputs)? Goals? Group (processes)?

H Hazards? Half-measures? Hierarchy?

I Indecision? Interaction (inadequate, inappropriate)? Intentions? Insensitivities? Ideas? Ideals?

J Job (design, enrichment, cycle, rotation, security)?

K Knowledge?

L Listening? Loyalty? Leadership? Lemons? Laziness?

M Motivation? Money? Manpower? Material? Methods? Mix-ups? Meetings?

N Negativism? Nitpicking? Negotiation? Needs?

O Organisation? Objectives? Operations? Opportunities? Obstructions?

P Pressures? Performance? Policies? Plans? Personnel? Procedures? Pay? Pessimism? Production

Q Quality? Quantity?

R Resistance (to change)? Rejects? Reward system? Relationships? Responsibility?

S Safety? Standards? Seasonal set-ups? Scheduling? Sales? Secretaries? Staff?

T Training? Turnover? Time management? Timing? Team (building, management)?

U Utilisation? Urban (aspects)? Union? Unity? Unification?

V Vendettas? Venom? Variables? Visibility?

W Waste? Workweek? Workday? Warehouse?

X Expense?

Y Yesterday's breadwinners? You-I?

Z Zero deficits? Zig zags?

APPENDIX 9

PARTIAL PROFIT BUDGET FORMAT

Use the following formats with the partial budgeting section discussed in 4.3.2.

Description of issue		
ADVANTAGES ASSOCIATED WITH THE RESEARCH		
a] Income increase due to research	**CAPITAL**	**ANNUAL INCOME & EXPENSE**
b] Expense decrease due to research		
c] Total benefits (a + b)		
DISADVANTAGES ASSOCIATED WITH THE RESEARCH		
d] Increase in expense		
e] Decrease in income		
f] Total disadvantage (d+e)		
NET PROFIT GAIN DUE TO RESEARCH (C-F)		

PERIOD	1	2	3	4	5	6	7	8	9	10	11	12
ADVANTAGES ASSOCIATED WITH THE RESEARCH												
a] Cash inflow increase due to research												
b] Cash outflow decrease due to research												
c] Total increase (a + b)												
DISADVANTAGES ASSOCIATED WITH THE RESEARCH												
d] Increase in cash outflows												
e] Decrease in cash inflows												
f] Total decrease (d+e)												
NET GAIN DUE TO RESEARCH (C-F)												

APPENDIX 10

EXPERIMENTAL PRE-SCHEDULE CHECK LIST

(TO BE COMPLETED FOR EACH EXPERIMENT)

TITLE	

AIM/OBJECTIVES
•
•
•
•
•

TIMING			
Project start		Experiment start	
Experiment finish		Report complete	

RELEVANT INFORMATION *

* Attach additional items

TREATMENT OF IDENTIFICATION *		
1.	2.	3.
4.	5.	6.
7.	8.	9.
10.	11.	12.
13.	14.	15.
16.	17.	18.
19.	20.	21.

* Attach additional treatments if necessary

EXPERIMENTAL DESIGN			
RANDOMISATION SCHEME	**SAMPLES PER REPLICATE**	**NO. OF REPLICATES**	**NO. OF BLOCKS**

LAYOUT (OVERVIEW AND DIMENSIONS) *

* Attach full layout (with plot details and treatment identification)

MATERIALS (QUANTITY, TYPES, RATES)			
Species, variety		Temperature	
Media		Humidity	
Fertilisers		Monitoring equipment	
Amendments		Labels	
Fungicides		Bags	
Insecticides		Measuring tape	
Herbicides		Scales (range)	
Nematicides		Record sheets	
Irrigation: type frequency		Random numbers	
Pots: colour, size		Specialist equipment	
Light			

MEASUREMENTS		
DEPENDENT VARIABLES TO BE MEASURED	**HOW**	**WHEN (TIMES, FREQUENCY)**
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

MEASUREMENTS

INEPENDENT VARIABLES TO BE MEASURED	HOW	WHEN (TIMES, FREQUENCY)
1.		
2.		
3.		
4.		

STAFF INVOLVED

ACTIVITY	NAMES
Planning Laying out Measuring Maintenance Interpreting	

COST OF ITEMS

(ADDITIONAL TO WHAT WOULD BE NORMALLY EXPENDED)

Item	$	Item	$	Item	$

LABOUR

(ADDITIONAL TO WHAT WOULD BE NORMALLY EXPENDED)

MONTH

PERIOD	1	2	3	4	5	6	7	8	9	10	11	TOTAL
Number of hours*												

* Indicate your valuation of the hourly rate, e.g. a superscript of ^{1} = standard rate, ^{2} =x 2 standard rate, ^{3} = x 3 standard rate. Qualify hours by type of work, e.g. $3M^{1}$ = 3 hours, at the standard rate on measurements; L = laying out experiment; O = overall observations; M = measurements; W = weeding; S= spraying; I = irrigating by hand; E = organising pots, media, labelling and planting.

APPENDIX 11

PROFORMA FOR EXPERIMENT REPORT

TOPIC/TITLE

OPERATORS

CONSULTANT

AIM OF WORK

TREATMENTS

DURATION *Start date:* *Completion date:*

MEASUREMENTS

RESULTS

INTERPRETATION

RECOMMENDED ACTION

FURTHER EXPERIMENTAL WORK

OTHER REPORTS

APPENDIX 12

CASE STUDY: EXPERIMENTAL PRE-SCHEDULE CHECK LIST

THIS IS AN EXAMPLE OF AN EXPERIMENTAL PRE-SCHEDULE CHECK LIST WHICH IS TO BE COMPLETED FOR EACH EXPERIMENT.

TITLE	Response of *Murraya* sp. to container insulation.

AIM/OBJECTIVES

- To establish whether insulation around pots of *Murraya* affects width or height of plant
- To assess the effect of insulation on soil temperature
- To assess how root distribution on the wall of the pot is influenced by insulation
- To see whether the effect of keeping insulation on for 4 months and then removing (and vice versa) had a different effect on shoot or root growth than continuous insulation or its continuous omission

TIMING

Project start	Nov 1994	Experiment start	10/2/95 Start
Experiment finish	25/8/95	Report complete	Oct 1995

RELEVANT INFORMATION *

- Root death can occur at temperatures greater than 48°C depending on time exposed
- Species vary in their response to temperature effects
- With wide spacing, media in white bags are cooler than in black bags
- Temperatures are highest on east and west walls, half down container profile (Arizona)
- Excess temperature of media can affect susceptibility to root rot in hibiscus (California)
- Temperature significantly affects the release rate of Osmocote® (Florida)

Other reports

Ingram, D.L., Martin, C., and Ruter, J. (1989). Effect of heat stress on container grown plants. *International Plant Propagators' Society Combined Proceedings* 39 (pp. 348–353).

Tilt, K., West, D., Goff, W., and Olive, J. (1993). Summary of new containers for nursery production. *International Plant Propagators' Society*, 43 (pp. 363–371).

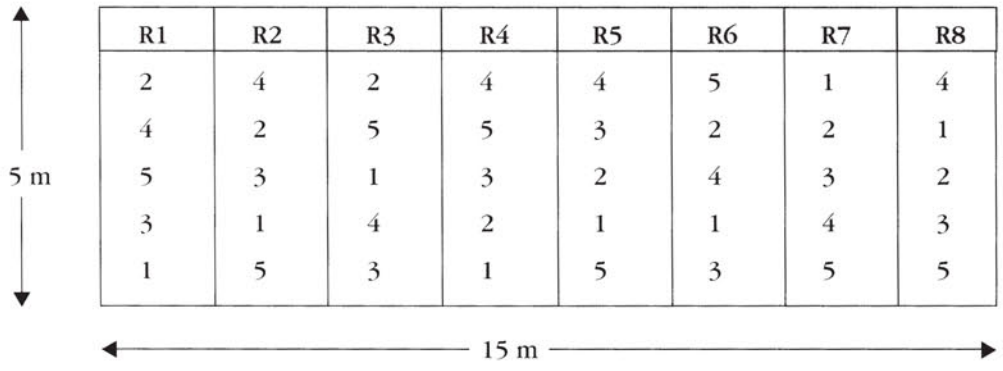
Whitcombe, C.E. (1988). Effects of temperature in containers on plant growth. In *Plant production in containers* (pp. 165–167). Stillwater, OK: Lacebark Publications.

TREATMENT IDENTIFICATION *		
1. Insulate Feb–Sept	2. Insulate Feb–April	3. Insulate May–Sept
4. No insulation	5. Upgraded insulation Feb–Sept	6.
7.	8.	9.
10.	11.	12.
13.	14.	15.
16.	17.	18.
19.	20.	21.

* Attach additional treatments if necessary

EXPERIMENTAL DESIGN			
RANDOMISATION SCHEME	**SAMPLES PER REPLICATE**	**NO. OF REPLICATES**	**NO. OF BLOCKS**
Complete randomisation in each block	1	8	8

LAYOUT (OVERVIEW AND DIMENSIONS) *



* Attach full layout (with plot details and treatment identification)

MATERIALS (QUANTITY, TYPES, RATES)			
Species, variety	*Murraya* spp.	Temperature	natural
Media	15% sand	Humidity	natural
	42% sawdust		
	42% pinebark		
Fertilisers	Nutricote® 6 g/L	Monitoring equipment	Digital thermometer
Amendments		Labels	plastic stick
Fungicides		Bags	
Insecticides		Measuring tape	Retractable builders tape
Herbicides	Rout®, rec. rate	Scales (range)	
Nematicides		Record sheets	done
Irrigation: type frequency	Pot spray, daily, 1 L in 5 mins	Random numbers	done
Pots: colour, size	300 mm, black	Specialist equipment	none
Light	natural		

MEASUREMENTS		
DEPENDENT VARIABLES TO BE MEASURED	**HOW**	**WHEN (TIMES, FREQUENCY)**
1. Height (mm)	From plastic rim to top most growing point	3 times
2. Width (mm)	Maximum width across plant (leaf tip to leaf tip (mm))	3 times
3. Soil temperature (T^0C)	5 cm in and 5 cm deep from west wall	End of experiment
4. No. of roots N,S,E,W	Number intersected by on surface of root ball	Vertical line
5. No. of root balls retained following removal	Present or absent	End of experiment
6.		
7.		
8.		

MEASUREMENTS

INEPENDENT VARIABLES TO BE MEASURED	HOW	WHEN (TIMES, FREQUENCY)
1. Temperature onpot surface. (T°)	Under plant	First and last measurement when root measurements taken daily
2. Maximum and minimum temperature (T°)	Thermometer in shade	Daily
3.		
4.		
5.		
6.		
7.		
8.		

STAFF INVOLVED

ACTIVITY	NAMES
Planning	Martin Hickey
Laying out	Martin and Kevin Hickey, Andrew Detering
Measuring	As above
Maintenance	Kevin Hickey, Andrew Detering
Interpreting	Martin Hickey

COST OF ITEMS

(ADDITIONAL TO WHAT WOULD BE NORMALLY EXPENDED)

Item	$	Item	$	Item	$

LABOUR

(ADDITIONAL TO WHAT WOULD BE NORMALLY EXPENDED)

MONTH

PERIOD	1	2	3	4	5	6	7	8	9	10	11	TOTAL
Number of hours*	$P4^3$ $L3^3$ $L6^1$ $M6^1$		M6				M16 $M6^1$	$J4^3$				
TOTAL (SHE)	33		6				22	12				73

* Indicate your valuation of the hourly rate e.g. a superscript of ^{1} = standard rate, ^{2} =x 2 standard rate, ^{3} = x 3 standard rate. Qualify hours by type of work e.g. $3M^1$ = 3 hours, at the standard rate on measurements; L = laying out experiment; O = overall observations; M = measurements; W = weeding; S= Spraying; I = irrigating by hand; E = organising pots, media, labelling and planting; J = interpretation; P = preparation. Total Standard Hours Equivalent (SHE) ($10/hr)= 73 hours.

APPENDIX 13

CASE STUDY: EXPERIMENT REPORT

BELOW IS AN EXAMPLE OF A REPORT ON A DOOR EXPERIMENT

TOPIC/TITLE Response of *Murraya* sp. to container insulation

OPERATORS M. Hickey, A. Detering, K. Hickey

CONSULTANT M.N. Hunter

AIM OF WORK To establish if there is a plant response to container insulation currently in use in the nursery

TREATMENTS

1. Insulate Feb-Sept
2. Insulate Feb-Apr
3. Insulate May-Sept
4. No insulation Feb-Sept
5. Upgraded insulation Feb-Sept

DURATION *Start date*: 10/2/95 *Proposed completion date*: Sept 95

MEASUREMENTS Plant height; plant width; growth assessment; temperature of medium; root counts on N, E, S, and W faces of root ball

RESULTS see Appendices 1 (Tables) and 2 (Figures)

INTERPRETATION

The positive relationship between media temperature in April and growth (figure 1) supports the idea that better growth in uninsulated pots was directly related to the warmer soil conditions (over the range 24–35°C) and hence enhanced root activity. Since higher temperatures and faster growth occurred in pots without insulation it may be concluded that the use of insulation over the Feb–May period is not warranted. This should be accepted with some caution since responses may have differed had February and March 1995 been a lot hotter.

Application of insulation during the May–Sept period did not delay growth as was expected; in fact growth was slightly enhanced, although not significantly more than in uninsulated pots. Similarly, growth was also enhanced in pots from which insulation was removed over the May–Sept period.

It is clear that insulation has a very large effect on root production; in fact there were significantly fewer total roots (log transformation) on the surface of the root ball in uninsulated pots than where insulation had been used. Roots were relatively evenly spaced in insulated pots. By comparison there were very few roots on the northern face of continuously uninsulated pots (figure 2) . Root numbers were invariably among the highest on the east face, presumably because that face rarely became excessively hot or remained too cool. The southern face also had high root numbers except in pots continuously insulated, presumably because temperatures were too cool. By contrast, numbers on the west face were commonly low, presumably because of excessive temperature. However, it was important to note that even root distribution at the wall of the pot was not, in this study, associated with the most rapid shoot growth, in fact quite the reverse.

An unplanned observation suggested that more of the root ball remained intact in pots in

which insulation had been removed at some stage. As a result, these plants were saleable in September, whereas sale of those with full insulation had to be deferred. This observation probably reflected more rapid root growth as well as shoot growth due to warmer media temperatures. It should be acknowledged that root numbers at the root wall are not necessarily a good indicator of overall root growth. Root tip pruning at the pot wall because of high temperatures may in fact stimulate secondary root development in much the same way as does root-pruning paint.

RECOMMENDED ACTION

Discontinue the use of foil insulation during the cooler months. Investigate the value of bi-coloured pots (dark on one side, silver on the other) and turning pots through 180° depending on whether heat reflection or absorption is required on the exposed surface.

FURTHER EXPERIMENTAL WORK

Carry out further experimental work to establish whether the use of foil is beneficial during the hot summer months. It would be reasonable to expect that the optimum system would be one that absorbs heat during the winter and reflects it during the summer.

APPENDICES

Table 1 Effect of pot insulation on temperature of medium and growth variables in *Murraya paniculata* (28/4/95). Cedar Glen Nursery, Samford.

Period of insulation	Temp. in pots (°C)[1]	Height (cm)	Width (cm)	Increment (cm^2)[2]	Vigour rating[3]
Nil	29.7	66.1	52.4	2094	2.14
May–Sept	29.3	65.1	55.1	2061	2.71
Feb–April	26.9	66.0	48.5	1616	2.86
Feb–Sept	27.0	62.0	45.9	1323	3.43
Feb–Sept[4]	25.6	59.3	46.3	1444	3.86
LSD[5] (P=0.05	1.5	5.3	5.2	534	1.7
Coeff. of varn (%)	5.3	8.2	10.2	30.6	52.7

[1] 5 cm deep, 5 cm from western wall commencing at 2 pm on 28/4/95; [2] Change in height x width over period 10/2–28/4/1995; [3] Rating where 1 = rapid growth and 5 = slow growth; [4] Upgraded version of treatment immediately above; [5] Required difference between values for statistical significance at P = 0.05.

Table 2 Effect of pot insulation on temperature of medium and growth variables of *Murraya paniculata* (25/8/95). Cedar Glen Nursery, Samford.

Period of temp. in insulation pots (°C)[1]		Height (cm)	Width (cm)	Increment (cm^2)[2]
Nil	27.7	75.8	62.6	1272.9
May–Sept	23.7	75.3	66.5	1426.8
Feb–April	27.6	76.4	63.1	1626.1
Feb–Sept	25.0	69.3	55.4	979.4
Feb–Sept[3]	23.7	67.1	58.9	1178.3
LSD[4] (P = 0.05)	1.4	6.2	6.1	588.0
Coeff. of varn (%)	5.16	8.3	9.7	44.2

[1] Temperature of medium, 5 cm deep and 5 cm from western wall, commenced readings at 2 pm 25/8/95; [2] Increment in height x width over period 28/4-25/8/95; [3] Upgraded version of treatment immediately above; [4] Required difference between values for statistical significance at P = 0.05.

Table 3 Effect of period of insulation around pot on number of roots intercepted by vertical line drawn on the north, east, south and west faces of the root ball after removal from the pot and retention of pot bases

Period of insulation	Root number intercepted by vertical transect					Bases[1] retained
	North	East	South	West	Mean	
Nil	6.6	51.4	43.4	17.5	29.7	7
May–Sept	28.4	53.8	50.9	26.3	39.8	8
Feb–April	31.0	52.8	41.6	31.9	39.3	8
Feb–Sept	60.0	57.8	23.8	18.9	40.1	4
Feb–Sept[2]	41.3	48.1	33.3	38.6	40.3	5
LSD[3]	20.8	NS[4]	16.3	NS	11.6	
Coeff. of varn (%)	33.5	45.2	41.3	86.1		

[1] Number of pots from a total of 8, in which the base of the medium remained intact with the rootball; [2] Upgraded version of treatment immediately above. [3] Difference required between values, with a 5 per cent probability. [4] Not significant, P = 0.05.

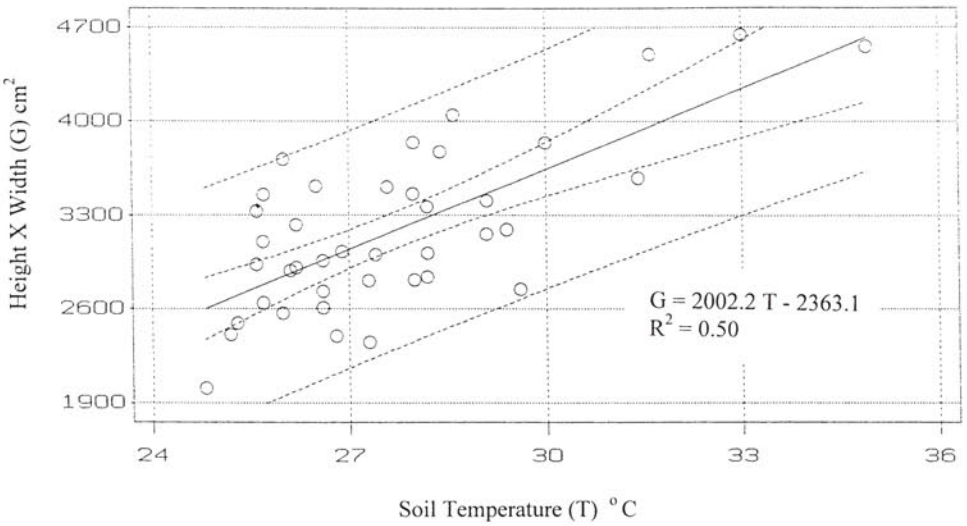


Figure 1 Relationship between soil temperature (5 cm inward and 5 cm deep) on western pot wall and growth of *Murrayas* as estimated by height and width measurements on 28/4/95

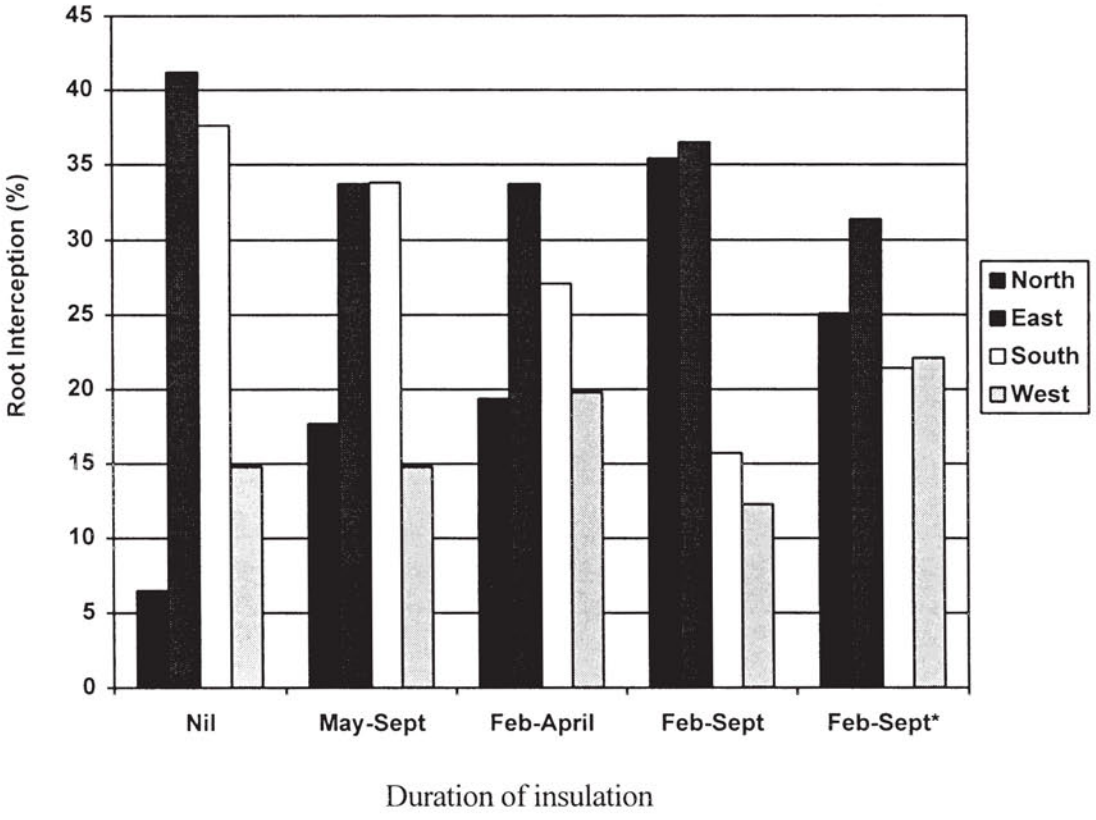


Figure 2 Effect of insulating pots on the proportional (%) distribution of root interceptions in the four quadrants of each pot. Note that Feb-Sept* treatment is similar to Feb-Sept, but with more insulation cover

APPENDIX 14

LIST OF DOOR PROJECTS

Titles of experiments carried out on nurseries by workshop participants:

R. Burfein	Developing the relationship between EC and five nutrients in dam water for the purpose of nursery nutrient management.
S. Collins	Effect of water-influencing additives on media characterisics and growth of an *Impatiens* hybrid in a sand-bark mixture.
J. Goody	Quality water use in a range of species and container sizes in order to maximise water use efficiency
I. Greet	Germination and early growth rates in seedless melon hybrids.
H. Hartwig	Effect of porosity and nutrient on container grown *Calatheas*.
C. Hennessey	Production and shelf life of *Syzygium paniculatum* cv Lilliput in soilless media.
I. Heymink	The need for macronutrients in propagating medis used in striking cuttings of *Murraya paniculata* and *Syzyigium paniculatum*.
M. Hickey	Does pot insulation improve the growth of *Murrayas*?
L. McMullin	Effect of dam water quality (suspended solids, pH, temperature) on chlorine requirements in the disinfestation of recycled water.
M. Plummer	Optimising the compostion of soilless media for advanced trees.
I. Waters	Using solarisation to prevent the occurrence of wilt in sweet basil.

Add new projects as appropriate.

REFERENCES

Atkinson, I. & Rolfe, C. (1995). *Waterwork. A competency based workshop aimed at improving nursery irrigation, drainage and recycling*. Wallongbar: NSW Agriculture, Communication Unit.

Brumfield, R.G. (1989). *Greenhouse cost accounting* (ver 1.0). New Brunswick: Rutgers University, Department of Agricultural Economics and Marketing, New Jersey Agricultural Experiment Station, Cook College Rutgers, State University of New Jersey, New Brunswick, New Jersey 08903.

Carmen, K. & Keith, K. (1994). *Community consultation techniques: Purposes, processes and pitfalls. A guide to planners and facilitators*. Brisbane: Department of Primary Industries Information Series QI94030.

Chamala, S. (1987). 'Adoption processes and extension strategies for conservation farming'. In P.S. Cornish & J.E. Pratley (Eds), *Tillage: New directions in Australian agriculture* (pp. 400–419). Melbourne: Inkata Press.

Chamala, S. (1990). 'Establishing a group: A participative action model'. In S. Chamala & P.D. Mortiss (Eds), *Working together for Landcare: Group management skills and strategies* (pp. 13–38). Brisbane: Australian Academic Press.

Chamala, S. (1991). 'Establishing a group: A model for participative action management'. In P.D. Mortiss & S. Chamala (Eds), *Group management skills for Landcare: A trainer's guide* (pp. 33–60). Brisbane: Australian Academic Press.

Chamala, S. (1995). 'Overview of participative action approaches in Australian land and water management'. In S. Chamala & K. Keith (Eds), *Participative approaches for Landcare: Perspectives, policies and programs* (pp. 3–42). Brisbane: Australian Academic Press.

Covey, S.R. (1989). *The seven habits of highly effective people*. Melbourne: The Business Library.

Doyle, M. & Straws, D. (1982). *How to make meetings work*. New York: Jove Books.

Etington, J.E. (1989). *The winning trainer: Instructors guide* (2nd ed.). Houston, TX: Gulf Publishing.

Hunter, M.N., Hayes, G.W. & Chamala, S. (1996). 'Do-your-own-research in the nursery industry'. In *Proceedings of the 8th Australian Agronomy Conference*, Toowoomba, Queensland (pp. 325–328).

Hunter, M.N., Hayes, G. & Hickey, M. (1996). 'Let's do our own research — and make the most of it'. *The Nursery Papers, 1*, 1–2.

Revans, R. (1982). *The origin and growth of action learning*. Bromley, Kent: Chartwell-Bratt.

Robson, M. (1993). *Problem solving in groups*. Aldershot, Hants.: Gower Publications.