going to be in opposition to them) These rolls come in widths of about 200 mm, so you have to bend and cut them in half, making a sheet 100 mm × 100 mm

Now you require moist sphagnum moss for each sheet of tin foil, one handful of moss in the centre of the sheet. (The foil is very sharp, so treat with respect.) Using the secateurs, you now place them around the stem of the *Ficus* branch and squeeze gently till you can hear a light noise as you cut into the cambium. Now gently go around with the same tension till you have completely cut around the outer layer.

Again repeat the same operation 1″ or so above or below the first cut With the sharp point of the secateurs cut up the back, then with the handle end where the saw tooth is, move that around and remove the collar of bark Here you dust or paint rooting hormone in the cut area. The air layer is usually 1½″ to 2 feet long

Now with the moist sphagnum moss in the sheet of aluminum foil, wrap the foil around the exposed branch and squeeze the edges of the foil together. Some people tie a stake above and below the air layer, otherwise sometimes the top may break off.

Using this method it takes about 6 weeks or more before roots grow into the sphagnum moss.

EFFECT OF PROPAMOCARB AND pH ON THE GROWTH OF FERNS AND *PILEA*

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Abstract. Propamocarb applied at the rate of 0 17 mg per litre of medium every three weeks, stimulated the growth of *Pilea cadierei* 'Minima' apparently in the absence of any phycomycetous fungi, against which it has a narrow spectrum of activity It however inhibited the growth of the ferns, *Thelypteris nymphalis*, *Polypodium membranifolium*, *Nephrolepsis exaltata* 'Fluffy Ruffles' and *Pteris tremula*, but had no significant effect on the growth of *Cyrtonium falcatum* or *Selaginella kraussiana* There was no interaction between propamocarb and the pH of the medium The optimum pH for *T nymphalis* dry weight was 5 96, frond area 5 97, *C falcatum* dry weight 5 98, frond area 6 01, *P membranifolium* dry weight 6 41, *N exalata* dry weight 6 12, frond area 6 08, *P tremula* dry weight 6 11, frond area 6 03, *Salaginella* dry weight 6 30 The optimum pH for the growth of *P cadierei* was equal to or in excess of 6 57

REVIEW OF LITERATURE

Propamocarb has been recently registered as a fungicide in New South Wales for the control of *Pythium* in ornamental

crops It also has activity against a range of other Phycomycetous fungi, i.e. *Phytophthora*, *Peronospora*, *Pseudoperonospora*, and *Bremia*.

The manufacturers of the product claim that it is relatively non-phytotoxic. Even after repeated application and at high dosage rates no growth retardation has been observed, and in many instances crops have shown an increased foliar and flower development (1,2,3). It's residual life is usually 3 to 4 weeks, this being increased by low pH conditions (1,2,3). Ferns are relatively slow-growing plants and any stimulation of growth would be of great commercial significance.

The aim of this experiment is to examine the stimulatory effects of propamocarb on growth of a number of ferns free of pathogens over a range of media pH.

MATERIALS AND METHODS

The ferns *Thelypteris nymphalis*, *Cyrtomium falcatum*, *Polypodium membranifolium*, *Nephrolepsis exaltata* 'Fluffy Ruffles', *Pteris tremula* and *Selaginella kraussiana* and the non-fern *Pilea cadierei* 'Minima' were grown in a glasshouse with 60% shade and a 17 to 27°C, day-night temperature at the Gosford Horticultural Research Station from 15th August to 24th October, 1980. The 125 mm pots used to grow the plants contained 1 liter of a 50% sphagnum peat, 25% sand, 25% perlite medium with 1 g superphosphate, 0 25 g magnesium sulphate, and 0 12 g of both potassium sulphate and potassium nitrate added per liter before steaming at 70°C for 30 minutes. After steam 4 g/liter of a 16N-4.4P-8.3K resin-coated slow-release fertilizer (Nutricote® 4-5 month formulation) was added. Plants were irrigated after 1 and 4 weeks with a 23N-4P-18K liquid fertilizer with added trace elements (Aquasol®) at the rate of 0.15 g/pot, and at other times with chlorinated tapwater.

The treatments were:

(1) The medium was adjusted to a range of pH's by adding a 2·2 (w/w) mixture of $CaCO_3$ and $MgCO_3$, which was added at the rates of 0, 1, 2, 4 and 8 g/l.

(2) Fungicide application: Either 0.00 or 0.17 mg of propamocarb was added per pot in a drench at the commencement of and every three weeks during the course of the experiment (a total of 4 applications).

Treatments were applied in factorial arrangement giving a total of 10 treatments and there were 10 replicates per treatment.

After 10 weeks, leaf area (where possible) was measured with a photoelectric area meter and the dry weight of the

aerial portion of the plants was determined A 2·1, water-medium ratio was used to determine pH.

RESULTS

pH. The rate of calcium and magnesium carbonate was related to the pH by the equation.

$$\log pH = 0\,16 + 0\,66 \log (X + 1) \qquad \text{equation 1 } (r = 0\,99)$$

where X is the rate per litre of liming materials.

This equation shows that the pH increased at a diminishing rate as the rate of calcium and magnesium carbonate increased.

Growth responses. Initially the data was analysed as a two factor analysis of variance. No interactions were significant, thus only the main effects of fungicide and liming material are considered.

The effect of propamocarb. Results are given in Table 1 Application of propamocarb significantly increased the growth rate of *P. cadierei* but either had no effect on *C. falcatum*, *S. kraussiana*, or reduced the growth rate of the ferns tested (*T. nymphalis*, *P. membranifolium*, *N. exalata*, *P. tremula*)

Treated *P. tremula* plants were also a much darker green and had a shorter frond length than untreated controls.

Table 1. The effect of propamocarb on the growth and ferns and *Pilea*

Species	Parameter measured (g or cm^2)	Propamocarb not added	Propamocarb added	Level of significance (P = 0 05)
T nymphalis	Dry wt	2 06	1 61	significant
	Frond area	602	441	significant
C falcatum	Dry wt	1 54	1 47	not significant
	Frond area	387	356	not significant
P membranifolium	Dry wt	1 86	1 66	significant
	Frond area	728	530	not significant
N exalata	Dry wt	2 97	2 68	significant
	Frond area	605	580	not significant
P tremula	Dry wt	2 42	1 66	significant
	Frond area	784	527	significant
S kraussiana	Dry wt	2 30	2 34	not significant
P cadierei	Stem dry wt	0 51	0 63	significant
	Leaf dry wt	1 71	1 99	significant
	Leaf area	360	413	significant

The effect of liming materials (calcium and magnesium carbonates). The results are given in Table 2. The optimum level of liming materials was derived from differentiation of the second degree polynomial regression equation:

$$Y = 1 + aX + bX^2 \qquad \text{equation 2}$$

where X is the rate of liming material and Y is the parameter measured. The optimum pH level was derived from equation 1 by substitution of the optimum value of X.

The optimum value for the liming materials for the growth of ferns tested lies between 4 07 and 6.08 g/*l* and the optimum pH values for ferns tested between 5.97 and 6.41. The regression equation for *P cadierei* indicated that the optimum level of liming materials (and hence pH) had not been reached in this experiment The data given for *P. cadierei* in Table 2 was the highest rate of liming materials used and the highest pH reached

Table 2 Optimum pH and rate of liming materials (magnesium and calcium carbonates) for the growth of ferns and *Pilea*

Species	Parameter measured	Optimum rate of liming materials g/l	Optimum pH	Level of significance (P=0 05)
T *nymphalis*	Dry wt	4 07	5 96	significant
	Frond area	4 11	5 97	significant
C *falcatum*	Dry wt	4 16	5 98	significant
	Frond area	4 59	6 01	significant
P *membranifolium*	Dry wt	6 75	6 41	significant
	Frond area	5 52	6 22	not significant
N *exalata*	Dry wt	4 91	6 12	significant
	Frond area	4 71	6 08	significant
P *tremula*	Dry wt	4 87	6 11	significant
	Frond area	4 45	6 03	significant
S *kraussiana*	Dry wt	6 08	6 30	significant
P *cadierei*	Stem Dry wt	8[1]	6 57[1]	significant
	Leaf Dry wt	8[1]	6 57[1]	significant
	Leaf area	8[1]	6 57[1]	significant

[1] This was the highest rate level used in this experiment

DISCUSSION

Propamocarb stimulated the growth of *P. cadierei*. The manufacturer suggests the mode of action in stimulating plant growth is by the control of previously unconsidered sub-clinical effects of pathogens (1) Since the *P. cadierei* plants were vegetatively propagated they may have been infected with a phyctomycetous fungi, although they showed no visible symptoms of this on either the roots or foliage. The fungicide, however, inhibited the growth of a number of ferns when applied at a rate to which a large number of plants have exhibited no phytotoxicity (1,2,3). In the case of *Pteris* it also caused noticable visual symptoms, viz a shortening, distortion and greening of the funds The usual symptoms of propamocarb phytotoxicity is necrotic tipping of leaves (1). The effect of propamocarb was not modified by pH. This may have been due to the reapplication of the fungicide at regular intervals maintaining a critical level in the medium despite the higher rate of destruction of the fungicide at high pH levels.

Although propamocarb may stimulate the growth of a wide range of plants it may also have an inhibitory effect; especially on ferns. Before propamocarb is applied generally in any nursery there is a need to determine its effect on the

target species, particularly in the absence of potential pathogens

The optimum pH for the growth of ferns in this experiment was 5.96 to 6.41 and that of *P. cadierei* was equal to, or in excess of 6 57. Recommendations for the optimum medium pH vary widely. Baker (4) recommends a pH of between 5.5 and 6.5 for growing most plants while Bunt (5) recommends a pH of between 5.0 and 5 5 for growing most plants in medium high in organic matter. Hipp and Morgan (6) recommend a pH of 4.5 for growing *Nephrolepsis exalata* 'Rooseveltii'. This is contrasted to the pH of 6 7 recommended by Hoshizaki (7) for fern culture. The pH of a medium has a large effect on the availability of nutrients in potting medium as does the organic matter content (4). The different nutrient regimes and media used by these writers probably accounts for most of the differences in optimum pH for the growth of ferns under different environmental conditions Nurserymen should be aware that pH can have a large effect on the growth of plants and it may be worthwhile for them to do experiments under their own conditions

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RAPID PROPAGATION OF CITRUS IN CONTAINERS

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Abstract. Closer spacing of citrus trees, rapid expansion, and a more dynamic situation means that the need is for a cheaper and faster method of propagation A method is described of producing citrus on a rootstock in containers in less than one year The work was done with *Poncirus trifoliata* It was grown immediately from seed throughout the winter, microbudded, the scion induced to grow and material was ready for early summer planting This method is compared with another which produced material in one year where the rootstock was grown during the summer and