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Period of Investigation: June 1994 - August 1995

Date of issue of report: March 1996

No. of pages in report: 73

No. of copies of report: 14

This is copy No. 3: Issued to Horticultural Development Council

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I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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Final Report March 1996

HNS 15e (Phytotoxicity)

Vine Weevil : Evaluation of suSCon Green for use during propagation of hardy nursery stock in modules

(undertaken on behalf of HDC, Crop Care (Australia) and Fargro Ltd)

1994 - 1995

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Commenced: June 1994
Completed: August 1995

Key words: vine weevil, hardy nursery stock, propagation, rooting media, suSCon Green, chlorpyrifos, modules

CONTENTS

RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

APPLICATION

Safety of use of suSCon Green incorporation into rooting media for propagation of a range of nursery stock and alpine species was investigated, since earlier work (HNS 15b) had shown the importance of protecting all stages of the production cycle against vine weevil. Species included those previously identified as having some sensitivity to suSCon Green, and these were propagated in modules of varying volumes in either 50:50 peat:bark or coir:bark mixes. Complementary work by ADAS monitored efficacy of the treatments in controlling vine weevil (see separate report). Adverse effects on rooting were minimal at rates of suSCon Green incorporation up to 1.0 kg/m^3, at which reasonable control of vine weevil larvae was also achieved. Results are discussed in relation to a possible 'buffering' effect of the pine bark in increasing the safety of use of suSCon Green.

SUMMARY

Previous work by ADAS has demonstrated that suSCon Green can give excellent control of vine weevil larvae for at least two seasons if correctly incorporated in the growing media at the appropriate rate. However, in phytotoxicity screening trials at Efford, with both liners and 3 litre containers, some species showed a degree of sensitivity to the chemical in the form of either reduced top and/or root growth (see HDC report HNS 15b). This in the main was slight at the recommended rates of suSCon Green incorporation in the mix, but nonetheless suggested that problems might be encountered if mixing was uneven, leading to some pots having a higher dose rate. The inclusion of pine bark in peat-based mixes reduced the amount of phytotoxicity observed.

During the earlier trials it was shown that if the liner or plug had not been treated, then vine weevil larvae could hatch and survive in the central untreated core of media, causing severe damage in some cases by their close proximity to the stem. Rooted plugs of the herbaceous species *Sedum* 'Autumn Joy', which did not have suSCon Green incorporated, suffered severe vine weevil damage in 3 litre containers, even though they had the recommended rate of suSCon Green included at potting-on. On examination the vine weevil larvae in the treated pots were found to be confined to the central core of the original untreated plug, where they had not come into contact with the active ingredient of suSCon Green, chlorpyrifos, which is relatively immobile.

Evaluation of safety of use of suSCon Green during propagation was therefore important, since cuttings could be considered to be at a more sensitive stage of growth than established plants. For this reason a lower than currently recommended rate of suSCon Green was also used (500 g/m^3). A large proportion of nursery stock propagation is now done in modules, with size used

dependent on species vigour, length of time to be spent in the module and potting schedules. In this work three module sizes were compared for *Azalea* 'Blue Danube' and *Hypericum* 'Hidcote' (25, 55 and 80 ml cell volumes), in order to see if the increasing level of suSCon Green in the larger module would have any effect on propagation results. Mossy Saxifrage and Heathers were included in a small module (12 ml cell volume) and the more vigorous *Elaeagnus x ebbingei* and *Prunus laurocerasus* 'Otto Luyken' were propagated in the larger module (80 ml cell volume).

Use of peat-free media for propagation is also increasing, especially as improved propagation results have been recorded in coir (nursery communications). Previous work in containers, however, had indicated that species sensitivity to suSCon Green could be increased in coir-based mixes. Consequently, in this propagation trial an industry standard of a 50:50 peat:granulated pine bark mix was compared with a 50:50 coir:granulated pine bark mix. This allowed the inclusion of a low level of controlled release fertilizer, with the bark providing a buffer against salt damage to the cutting, which once rooted is able to benefit from the availability of nutrients.

Propagation was either under intermittent mist for summer struck cuttings (*Azalea, Hypericum*, Mossy Saxifrage, Heathers) or under low polythene covers for the autumn strike of *Elaeagnus* and *Prunus*.

Little adverse effects on rooting of the species included in the work were seen at rates of suSCon Green up to 1.0 kg/m^3, and final percentage of cuttings rooted was unaffected even at the higher rate of 1.5 kg/m^3. However, at 1.5 kg/m^3 there were indications of slower rooting of *Azalea, Elaeagnus*, *Prunus* and *Erica*, and a small, but significant, reduction in root development of *Azalea*, *Hypericum*, Mossy Saxifrage and *Elaeagnus*. These effects were not large enough, however, to affect establishment and subsequent growth following potting, which was similar regardless of previous treatment.

These results initially appear at odds with those obtained in the liner and larger container growth stages in earlier work (HNS 15b), where roots of *Azalea* and *Erica* appeared sensitive to suSCon Green, and top growth of *Elaeagnus* and *Hypericum* was also affected, especially at the 1.5 kg/m^3 rate of incorporation. However, plants appeared to be more sensitive in straight peat or coir mixes, while the propagation mixes used here were a 50:50 mix of peat or coir with matured granulated pine bark. In previous work with Crop Care (Incitec) and the HDC Project HNS 15b, it was shown that plants could tolerate a higher rate of suSCon Green incorporation if granulated pine bark was present. This, together with the current propagation results, suggest that the presence of the pine bark could be providing a safety buffering effect. This could be particularly important during propagation where unrooted and rooting material is at its most sensitive stage of production. Whether suSCon Green is safe to use in a straight peat or coir mix without the presence of pine bark requires further investigation.

The rate of 1.0 kg/m^3 suSCon Green incorporated in the 50:50 peat:bark rooting media appears a suitable rate for both efficacy and safety of use, for while only a limited range of species were included in the work, they covered a number of 'sensitive' species. 500 g/m^3 was insufficient to achieve satisfactory control of vine weevil larvae (see ADAS 'efficacy' report).

Where the various sizes of plugs were compared, the increasing volume, and hence greater amount of suSCon Green present, had no apparent adverse effect on propagation. Again the bark could also be providing a buffering effect here.

With *Azalea* all three plug sizes produced similar results, apart from faster emergence of roots from the base of the smaller cells. However, with the more vigorous *Hypericum* 'Hidcote', which was held for a month after the final propagation record before potting, a benefit of the larger plug (80 ml) was observed in respect of cutting vigour and early growth. Growth of plants from the smaller plugs had caught up by the end of the trial.

Coir:bark mixes, in general, out-performed peat:bark mixes, both in terms of achieving faster rooting, improved rooting percentages with some species (*Elaeagnus, Prunus*) and increased density of root development. This result confirms that observed by the industry. However, coir appears to be a favoured media of vine weevil larvae, which could be a problem unless adequate control measures are taken. The efficacy work by ADAS indicated reasonable control achieved where suSCon Green was incorporated at 1.0 kg/m^3, but even distribution of granules is important to achieve the required control. Unfortunately evenness of distribution becomes an increasing problem as cell size reduces, despite thorough mixing.

In conclusion, previous work has shown the importance of protecting all stages of crop production against vine weevil, and in this trial incorporation of suSCon Green at rates up to 1.0 kg/m^3 in propagation mixes containing either peat:bark or coir:bark appeared safe for the limited range of species included. These, however, included a number which had previously shown some sensitivity to suSCon Green in the growing on stages. At 1.5 kg/m^3 suSCon Green incorporation there were indications of adverse effects beginning to show, not on percentage rooting, but on the degree of root development. However, this did not affect growth in the liner stage, where none of the previous suSCon Green treatments appeared to have any influence on subsequent growth. 1.0 kg/m^3 suSCon Green appeared the most suitable rate trialled, 500 g/m^3 not giving adequate control of vine weevil larvae in the ADAS efficacy work, and 1.5 kg/m^3 beginning to show signs of phytotoxicity. It must be stressed that these conclusions relate to propagation media containing 50% granulated pine bark, with the hypothesis that the bark is providing a safety buffering effect, since greater phytotoxic symptoms had been observed with the sensitive species in the growing-on stages in straight peat or coir mixes. This needs further investigation.

EXPERIMENTAL SECTION

INTRODUCTION

Previous work by ADAS has demonstrated that suSCon Green can give excellent control of vine weevil larvae for at least two seasons if correctly incorporated in the growing media at the appropriate rate. However, in phytotoxicity screening trials at HRI Efford in liners and three litre containers, some species have shown a degree of sensitivity to the chemical in the form of either reduced top and/or root growth (see HDC report HNS 15b). This, in the main, has been slight at the recommended rates of suSCon Green incorporation in the mix, but nonetheless suggested that problems might be encountered if mixing were uneven, leading to some pots having higher dose rates.

During these earlier trials it was shown that if the liner or plug had not been treated, then vine weevil larvae could hatch and survive in this central core of media, causing damage. Rooted plugs of herbaceous species which did not have suSCon Green incorporated suffered severe vine weevil damage in 3 litre containers, even though they had the recommended rate of suSCon Green incorporated at potting on. On examination the vine weevil larvae in the treated pots were found to be confined to the central core of the original untreated plug, where they had not come into contact with the active ingredient of suSCon Green, chlorpyrifos, a relatively immobile chemical.

Evaluation of safety of use of suSCon Green during propagation was therefore important, since cuttings could possibly be more sensitive than older plant material. For this reason a lower than currently recommended rate of suSCon Green was also used. A large proportion of nursery stock propagation is now done in modules, with size used dependant on species vigour. In this work three module sizes were compared for *Azalea* and *Hypericum*, in order to see if the increasing level of suSCon Green in the larger modules would have any effect on propagation results. Mossy Saxifrage and Heathers were also included in a small module, and the more vigorous *Elaeagnus x ebbingei* and *Prunus laurocerasus* 'Otto Luyken' were included in a larger module.

Use of peat-free media for propagation is also increasing, especially as improved propagation results have been recorded in coir. Previous work in container production, however, had indicated that species sensitivity to suSCon Green could be increased in a coir-based mix. Consequently, in this propagation trial an industry standard of 50:50 peat:granulated pine bark mix was compared against a 50:50 coir:granulated pine bark mix. This allowed the inclusion of a low level of controlled release fertilizer, a standard practice where matured pine bark is used, since its property of locking up nutrients offers a buffer against salt damage to the cutting, which once rooted, benefits from the nutrients available.

MATERIALS AND METHODS

Propagation

Cuttings, taken from Efford clonal stock beds, were inserted into plug trays at the most appropriate time of year for each species and rooted either under intermittent mist or low polythene covers. After weaning plug trays were held under frost protected glass on capillary matting, with hand watering as necessary, until assessed.

Treatments

***Rooting Media*:** i. 50% Irish Shamrock medium peat: 50% pine bark (Cambark 100)
ii 50% Coir (Roffey Lignocell): 50% Cambark 100

All rooting media contained 0.5 kg/m^3 Osmocote 5-6 months mini granules.

***Rates of suSCon Green*:** Nil
500 g/m^3
1000 g/m^3
1500 g/m^3

Species/Module Size

	PG273 (12 ml)	PG150 (25 ml)	PG77 (55 ml)	PG54 (80 ml)
Evergreen *Azalea* 'Blue Danube'		✓	✓	✓
Hypericum 'Hidcote'		✓	✓	✓
Alpine: Mossy Saxifrage	✓			
Elaeagnus x ebbingei				✓
Prunus laurocerasus 'Otto Luyken'				✓
Heather: *Erica erygena* 'Irish Dusk'	✓			
Calluna vulgaris 'Sunrise'	✓			

Design

Randomised block design with 3 (*Azalea, Hypericum*) or 4 replicates.

Plot size: 54 recorded cuttings for *Elaeagnus* and *Prunus*, 50 for *Azalea* and Mossy Saxifrage, 40 for Heathers and 30 for *Hypericum*.

Assessments

1. Time taken for roots to come through the base of the cell plugs. Monitored weekly, with the Collins Date recorded when roots became visible at the base of the plug. (Collins Date: 1 Jan = Day 1, 31 Jan = Day 31, 1 Feb = Day 32 etc through to Day 365 for 31 December.)

   Not all cuttings which rooted had roots emerging from the base of the cell. These were recorded as rooted when the final record was taken pre-potting.

2. % rooting.

3. Speed of rooting.

4. % root visible around plug-ball on 10 cuttings/plot.

5. Cutting top growth score of 1-5 (5 = best).

6. 10 plugs/plot washed out to record:

   a) length of roots
   b) density of root on a score of 1-5 (5 = most root).

7. Photographs as appropriate.

Growing on

Following the final rooting records, 10 plants/plot were potted-on into 90 mm pots in a standard peat-based mix with 750 g/m³ suSCon Green incorporated.

These were grown-on in an unheated polythene roof-netting sided twin span structure on drained sand beds with low level irrigation.

Final records included a score of top growth (1-5, 5 = best) and percentage visible root over the pot-ball. The assessment date for each species varied according to time of propagation/potting date.

Species	Date Stuck	Final Prop. Record	Potted on in 90 mm	Final Assessment
Azalea	22.7.94	26.10.94	14.11.94	19.6.95
Hypericum	14.9.94	14.11.94	12.12.94	29.6.95
Mossy Saxifrage	4.8.94	12.9.94	7.11.94	25.5.95
Elaeagnus	11.11.94	29.3.95	16.4.95	4.8.95
Prunus	11.11.94	29.3.95	16.4.95	7.8.95

NB. The *Sedum* 'Autumn Joy' which became floral before cuttings could be taken, was substituted by *Hypericum*, a species which had shown sensitivity to suSCon Green in the container phytotoxicity work in HNS 15b.

Poor rooting of the heather *Calluna vulgaris* 'Sunrise' from the initial strike (1 August 1994) led to a second strike on 25 August 1994. In addition to *C.v.* 'Sunrise', *Erica erygena* 'Irish Dusk' was also included. *C.v.* 'Sunrise' again gave very poor rooting and results of this species have been omitted. *E.e.* 'Irish Dusk' produced better rooting and propagation results are presented. However, following a severe *Botrytis* infection, this species was not potted-on, being substituted by a late autumn propagation of *Elaeagnus ebbingei*, as a species which had shown phytotoxicity to higher rates of suSCon Green, in container trials (HNS 15b).

Statistical Analysis

The trial was analysed using Standard Analysis of Variance (ANOVA). The degrees of freedom (d.f.), standard error (SED) and least significant difference to 5% (LSD), on which the significance tests were based, are presented in the tables to aid interpretation of the results.

RESULTS

Azalea 'Blue Danube'

Date stuck:	22 July 1994
Final propagation record:	26 October 1994
Potted on:	14 November 1994
Final assessment:	19 June 1995

See Appendix II, Tables 1-7 pages 22-29 for results.

This species had shown evidence of sensitivity to higher rates of suSCon Green (1.0-1.25 kg/m^3) in container mixes, especially coir and peat where reduced top and root growth occurred, but also in a peat:bark mix (25% bark) where a small reduction in root growth was observed.

However, at the propagation stage incorporation of suSCon Green up to 1.5 kg/m^3 appeared to have no adverse effect on final percentage of cuttings rooted or density of root, though there was a small but significant delay in roots emerging from the base of the plug at 1.5 kg/m^3. In addition, the percentage of cuttings with a root length >6 cm was lower in this higher rate of suSCon Green. Incorporation of suSCon Green in the rooting media did not appear to affect top growth or quality of the cutting.

The main effect observed during propagation with this species was the influence of the coir:bark mix, which produced a small but significant improvement in root development in respect of visible root over the plug surface and density of root, plus a higher proportion of cuttings with roots longer than 6 cm.

The influence of plug size on rooting was minimal, good quality cuttings being produced in all three sizes. As was to be expected, more visible root was present in the smaller plugs at an earlier date, but actual density and length of root was similar from all three plug sizes when washed out (see Plate 2, Appendix III, page 60).

Effects of propagation treatments on subsequent growth in liner pots (90 mm) were small, with no significant differences in growth being monitored as a result of previous propagation treatments.

Hypericum **'Hidcote'**

Date stuck:	14 September 1994
Final propagation record:	14 November 1994
Potted on:	12 December 1994
Plants pruned:	8 March 1995
Final assessment:	29 June 1995

See Appendix II, Tables 8-17 pages 30-40 for results.

Hypericum 'Hidcote' was one of the species which showed a marked sensitivity to incorporation of suSCon Green in the container media at rates between 1.0-1.5 kg/m^3. Consequently when the need arose for a substitute species to replace *Sedum* 'Autumn Joy', which had become floral before cuttings were taken, *Hypericum* was a natural choice.

However, as with *Azalea*, no adverse effects on percentage of cuttings rooted, speed of rooting or density of root growth were seen as a result of suSCon Green incorporation in the rooting media. Influence on mean root length was variable, with a small, but significant reduction appearing to occur at 1.0 kg/m^3, but not at 1.5 kg/m^3. Volume of root visible on the outside of the plug was also somewhat reduced at 1.5 kg/m^3 compared to the untreated media, but again differences were small. Incorporation of suSCon Green had no adverse effect on quality of the cutting top growth, either overall size or shoot length.

As with *Azalea*, there was an increase in density of root growth in the coir:bark mix, and cuttings rooted slightly faster in this mix.

Plug size did not affect percentage rooting, but with this vigorous species, root development had increased in the larger plugs (77-54) compared with the small plug (150), where roots quickly exploited the available volume. This was reflected in the improved shoot length in these larger plugs at the final propagation assessment.

The plants were pruned once following potting-on and fresh weight of the prunings taken. The use of suSCon Green during propagation appeared to have no influence on subsequent growth, but it was noticeable that early growth was more vigorous where the large plug (54) had been used, again reflecting the improved root development/early growth seen in this plug. By the final assessment effects of previous treatments on top growth were small and did not prove significant.

Mossy Saxifrage

Date stuck:	4 August 1994
Final propagation record:	12 September 1994
Potted on:	7 November 1994
Final assessment:	25 May 1995

See Appendix II, Tables 18-26 pages 41-45 for results.

Mossy Saxifrage is very susceptible to vine weevil attack and must have protection at all stages of growth.

Only the PG273 plug tray (12 ml cell volume) was used for this species.

Incorporation of suSCon green in the propagation stage had no adverse effect on percentage of cuttings rooted or speed of rooting, though visible root present over the plug surface did appear to be reduced where suSCon Green was incorporated, especially in the coir:bark mix. However, on washing roots out there only appeared to be a significant reduction in density of root development at 1.5 kg/m^3 suSCon Green inclusion.

As with the other species, the main factor in influencing propagation was rooting media, with improved speed of rooting in coir:bark compared with peat:bark, when looking at the percentage of cuttings rooted 25 days after insertion. This was not so clear cut when looking at mean day of root emergence from the base of the plug, which had to take into account the delay of the final few cuttings to root. Coir:bark mixes did not appear to have roots of greater density, compared with peat:bark, apart from the untreated plots. Here not only did root development increase, but also top growth compared to the other plots. This could well have been related to the faster rooting observed in this treatment.

Propagation treatments did not appear to influence subsequent growth once potted-on.

Elaeagnus x ebbingei

Date stuck:	11 November 1994
Final propagation record:	29 March 1995
Potted on:	16 April 1995
Final assessment:	4 August 1995

See Appendix II, Tables 27-33 pages 46-50 for results.

Following a severe *Botrytis* infection in *Erica erygena* 'Irish Dusk', which precluded it being potted on, *Elaeagnus ebbingei* was substituted as an indicator for suSCon Green sensitivity, following previous observations on adverse effects of its incorporation at higher rates in container mixes.

This species was propagated in the PG54 plug tray (80 ml cell volume).

During propagation, while speed of rooting appeared to be slower in plots with suSCon incorporated, final percentage rooted was not significantly affected. There was, however, a small but significant reduction in visible root over the surface of the plug, density of root growth and root length as a result of suSCon Green incorporation at 1.0-1.5 kg/m^3, especially in the peat:bark mix. Quality of the top growth of the cutting was not affected by treatment at this stage.

As with other species there was improved rooting where coir:bark was used, both in final percentage rooted, speed of rooting and root development.

Despite the reduced root development observed during propagation where suSCon Green was incorporated at 1.0-1.5 kg/m^3, this appeared to have little effect on subsequent growth following potting. Final growth assessments showed no significant differences between plants in either top or root growth as a result of previous treatments.

Erica erygena **'Irish Dusk'**

Date stuck: 25 August 1994
Final propagation record: 14 December 1994

See Appendix II, Tables 41-45 pages 56-58 for results.

Incorporation of suSCon Green in the rooting media had no obvious adverse effect on percentage rooting or root development in this trial, despite heathers having shown some sensitivity to suSCon Green incorporated in the container mixes in HNS 15b (albeit a different species). There was, however, a small but significant delay in rooting at 1.5 kg/m^3 suSCon Green incorporation. Treatments had no obvious effect on cutting top growth.

An apparent improvement in rooting where coir:bark was used did not prove to be significant in this trial.

This species was not potted-on due to a severe *Botrytis* attack. It was replaced by *Elaeagnus ebbingei*.

DISCUSSION

This report deals with phytotoxicity screening of various rates of suSCon Green incorporation across a range of hardy nursery stock species during propagation in modules. Rates of suSCon Green included 500 g/m^3, 1.0 kg/m^3 (1000 g) and 1.5 kg/m^3 (1500 g), with 1.0 kg/m^3 considered the standard for container mixes containing greater than 20% granulated pine bark. The lower than recommended rate of 500 g/m^3 was included since it was felt that unrooted/rooting cuttings could be more sensitive to the chemical than the liner or larger container stages. In all, six species were included, two of which were propagated in modules with cell sizes ranging from 25 ml to 80 ml (*Azalea* 'Blue Danube', *Hypericum* 'Hidcote'), in order to monitor whether the increasing presence of suSCon Green in the larger module would have an influence on propagation. In addition a coir:bark as well as a peat:bark rooting media was included since coir is becoming more widely used in HNS propagation, but previous work had suggested that any adverse effects of suSCon Green could become more pronounced in coir-based mixes. However, in this work both peat and coir were used in combination with 50% granulated pine bark, since a 50:50 peat:bark mix is considered to be one of the industry standards for propagation.

Some substitution of species was necessary since the *Sedum* 'Autumn Joy' flowered before cuttings could be taken, and an attack of *Botrytis* following rooting of the heathers made them unsuitable for monitoring effects of propagation treatments on subsequent growth. Consequently *Hypericum* 'Hidcote' replaced *Sedum*, and *Elaeagnus x ebbingei* the heather. Both of these species had shown sensitivity to suSCon Green in previous container trials.

Little adverse effect on rooting of the species included in the trial was seen at suSCon Green incorporation up to 1.0 kg/m^3, and final percentage of cuttings rooted was unaffected at the highest rate of 1.5 kg/m^3. However, at 1.5 kg/m^3 suSCon Green incorporation there were indications of slower rooting of *Azalea*, *Elaeagnus*, *Prunus* and *Erica* and a small but significant reduction in root development of *Azalea*, *Hypericum* Mossy Saxifrage and *Elaeagnus*. These effects were not large enough, though, to affect establishment and subsequent growth following potting.

These results initially appear at odds with those obtained in the liner and larger container growth stages in earlier work (HNS 15b), where roots of *Azalea* and *Erica* appeared sensitive to suSCon Green, and top growth of *Elaeagnus* and *Hypericum* were also affected, especially at the 1.5 kg/m^3 rate of incorporation. However, in this work plants appeared to be more sensitive to suSCon Green in straight peat or coir mixes, while the propagation mixes were a 50:50 mix of peat or coir with matured granulated pine bark (Cambark). In previous work with Crop Care (Incitec) and in the HDC Project HNS 15b it was shown that plants could tolerate a higher rate of suSCon Green incorporation if granulated pine bark was present. This, together with the current propagation results, suggest that the presence of the pine bark could be providing a safety buffering effect. This could be particularly important during propagation where unrooted and

rooting material is at its most sensitive stage of production. At present a 50:50 mix incorporating peat:pine bark is considered to be one of the industry standards as far as propagation media goes. Use of coir as a rooting media is also increasing, often as a 100% mix. Whether suSCon Green is safe to use in a straight peat or coir mix, without the presence of pine bark, requires further investigation. In growing media only 20-30% bark addition to the mix is used, and then not as a standard practice, particularly in larger containers due to its cost. Its use becomes more cost effective in propagation mixes where it not only improves aeration of the media, but also allows the use of a low level of controlled release fertilizer, buffering the unrooted cutting against excess nutrient, but allowing uptake immediately roots develop which helps maintain cutting quality.

The rate of 1.0 kg/m^3 suSCon Green incorporated in the 50:50 peat:bark rooting media appears a suitable rate for both efficacy and safety of use, for while only a limited range of species were included in the phytotoxicity work they covered a number of 'sensitive' species. 500 g/m^3 was insufficient to achieve satisfactory control of vine weevil larvae (see ADAS 'efficacy' report).

Where the various sizes of plugs were compared, the increasing volume, and hence greater amount of suSCon Green present, had no obvious adverse effects on propagation. Again the bark could be also providing a buffering effect here.

With *Azalea* all three plug sizes produced similar results, apart from faster emergence of roots from the base of the smaller cells. However, with the more vigorous *Hypericum* 'Hidcote', which was held for a month after the final propagation record before potting, a benefit of the larger plug (80 ml) was observed in respect of cutting vigour and early growth. Growth of plants from the smaller plugs had caught up by the end of the trial.

Coir:bark mixes, in general, out-performed peat:bark mixes, both in terms of achieving faster rooting, improved rooting percentages with some species (*Elaeagnus, Prunus*) and increased density of root development. This result confirms that observed by the industry. However, coir appears to be a favoured media of vine weevil larvae which could cause problems unless adequate control measures are taken. The efficacy work by ADAS indicated reasonable control achieved where suSCon Green was incorporated at 1.0 - 1.5 kg/m^3, but even distribution of granules is important to achieve the required control. Unfortunately evenness of distribution becomes an increasing problem as cell sizes reduce, despite thorough mixing.

Analysis of the number of granules/litre of rooting media done on a bulk sample from module trays without cuttings present was done by ADAS Cambridge. From this data it was possible to calculate the expected and actual number of granules present per plug. Overall, a higher than expected amount of suSCon Green appears to be present, but this could be accounted for, in part, by settling of the rooting media after cutting insertion. When a limited number of granule counts were done in individual cells (PG150 - 25 ml), a variation of up to 50% around the

expected rate was monitored, and could account for the variability in control observed, since chlorpyrifos is relatively immobile.

Number of suSCon Green granules per module*

	Rate suSCon Green					
	500 g/m³		1.0 kg/m³		1.5 kg/³	
	Expected	Actual	Expected	Actual	Expected	Actual
PG150 (25 ml)	17	16	34	42	50	63
PG 77 (55 ml)	37	36	74	93	111	139
PG54 (80 ml)	54	52	108	135	162	202

* Based on ADAS bulk sample analysis, with 1350 granules of suSCon Green per gramme.

In summary, previous work had shown the importance of protecting all stages of crop production against vine weevil, and in this trial incorporation of suSCon Green at rates up to 1.0 kg/m³ in propagation mixes containing either peat:bark or coir:bark appeared safe for the limited range of species included. These, however, included a number which had previously shown some sensitivity to suSCon Green in the growing on stages. At 1.5 kg/m³ suSCon Green incorporation there were indications of adverse effects beginning to show, not on percentage rooting, but on the degree of root development. However, this did not affect subsequent growth in the liner stage, where none of the previous propagation treatments appeared to have any marked influence on subsequent growth. 1.0 kg/m³ suSCon Green appeared the most suitable rate trialled, 500 g/m³ not giving adequate control of vine weevil larvae in the ADAS efficacy work, and 1.5 kg/m³ beginning to show signs of phytotoxicity. It must be stressed, however, that these conclusions relate to propagation media containing 50% granulated pine bark, with the hypothesis that the bark is providing a safety buffering effect, since greater phytotoxic symptoms have been observed with the sensitive species in the growing-on stages in straight peat or coir mixes.

CONCLUSIONS

The objective of the work was to evaluate the safety of suSCon green incorporation in peat:bark and coir:bark rooting media for propagation of hardy nursery stock in modules. Species propagated during the summer under mist included *Azalea* 'Blue Danube', *Hypericum* 'Hidcote' and Mossy Saxifrage, with the evergreens *Elaeagnus x ebbingei* and *Prunus laurocerasus* 'Otto Luyken' rooted under low polythene covers over the winter. *Azalea, Hypericum* and *Elaeagnus* had shown sensitivity to suSCon Green incorporation above recommended rates in earlier container trials. The main results can be summarised as follows:

- Adverse effects on rooting of all species were minimal at 1.0 kg/m^3 suSCon Green.

- At the rate of 1.5 kg/m^3 suSCon Green, while final percentage rooting was unaffected, there were indications of slower and/or reduced root development with some species (*Azalea, Elaeagnus, Hypericum*).

- Phytotoxicity symptoms were less than anticipated, compared to previous results seen in the liner and container growing on stages, particularly in 100% peat and coir mixes (see HNS 15b report), and it is suggested that the matured pine bark used in a 50:50 combination with peat or coir for propagation mixes, could be providing a safety buffering action. This would be particularly important during propagation where cuttings are at their most sensitive stage, and warrants further investigation.

- Three sizes of module were compared for *Azalea* and *Hypericum*, with similar propagation results being obtained regardless of size of cell. It had been thought that the increasing volume of suSCon Green present in the larger cells might be detrimental for the sensitive species. The fact that this was not the case could again be attributed to the presence of pine:bark providing a buffering effect.

- Overall, the 50:50 mix of coir:bark produced improved rooting results compared to the peat:bark mix.

- Efficacy work by ADAS showed the rate of 500 g/m^3 suSCon Green to be less effective in achieving satisfactory control of the vine weevil larvae. Reasonable control was achieved at rates of 1.0-1.5 kg/m^3. Based on the results of both the efficacy and phytotoxicity, 1.0 kg/m^3 suSCon Green incorporation in 50:50 peat:bark or coir:bark rooting media appears a satisfactory rate. This will need confirmation across a wider range of species.

- Results relate to mixes containing 50% granulated pine bark. Safety of use of suSCon Green in 100% peat or coir rooting media requires further work.

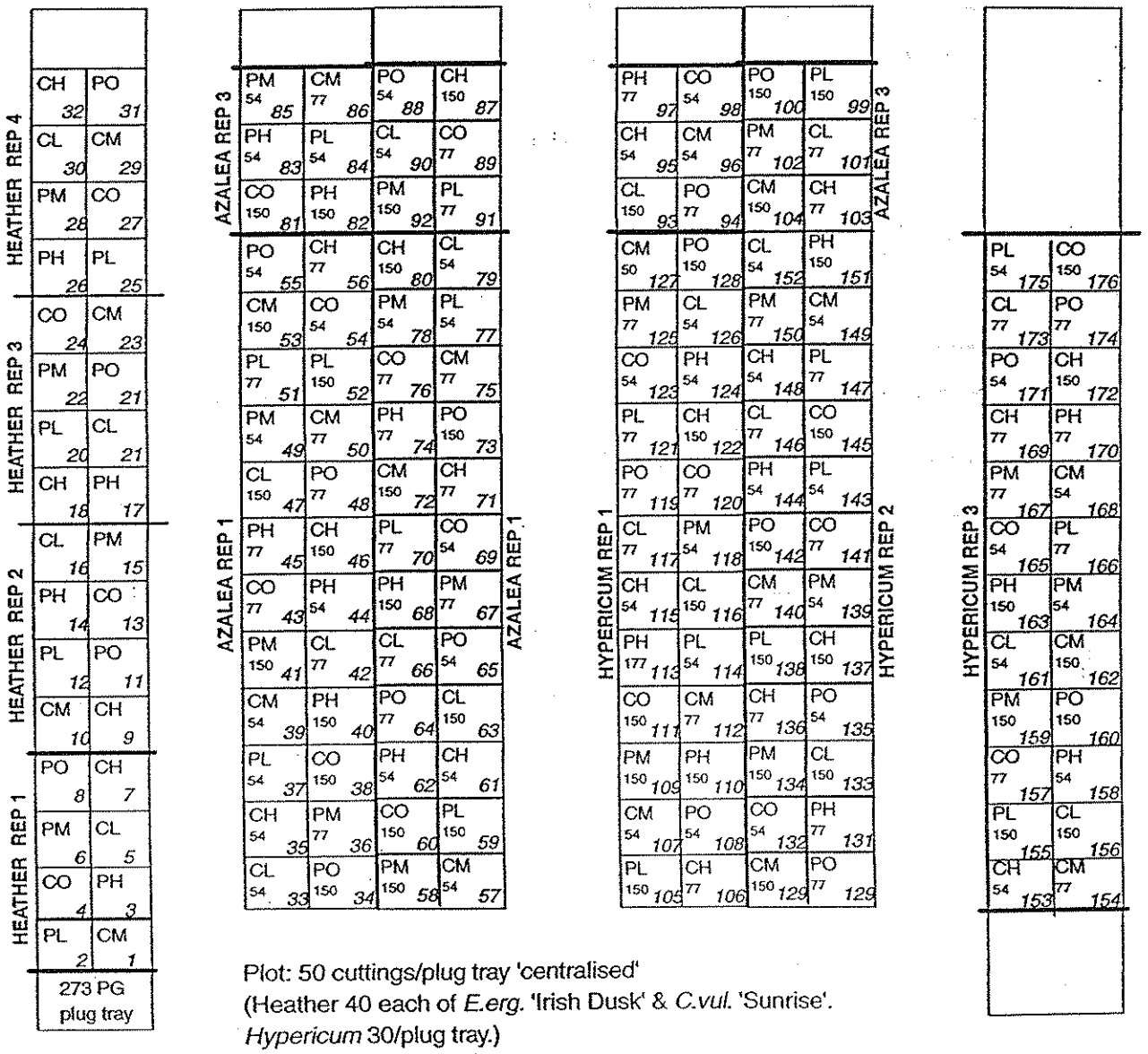
APPENDICES

APPENDIX I

Vine Weevil: Evaluation of suSCon Green for use during propagation of hardy nursery stock in modules

(HNS 15e - 1994)

Trial Layout - Site: J8



Plot: 50 cuttings/plug tray 'centralised'
(Heather 40 each of *E.erg.* 'Irish Dusk' & *C.vul.* 'Sunrise'.
Hypericum 30/plug tray.)
Rooting environment: Netting enclosed mist

KEY:

C = 50% Coir:50% Cambark fine
P = 50% Peat:50%Cambark fine

150 : PG 150 tray
77 : PG 77 tray
54 : PG 54 tray

O = No suSCon
L = 500g cp/m^3
M = 1.0 kg cp/m^3
H = 1.5 kg cp/m^3

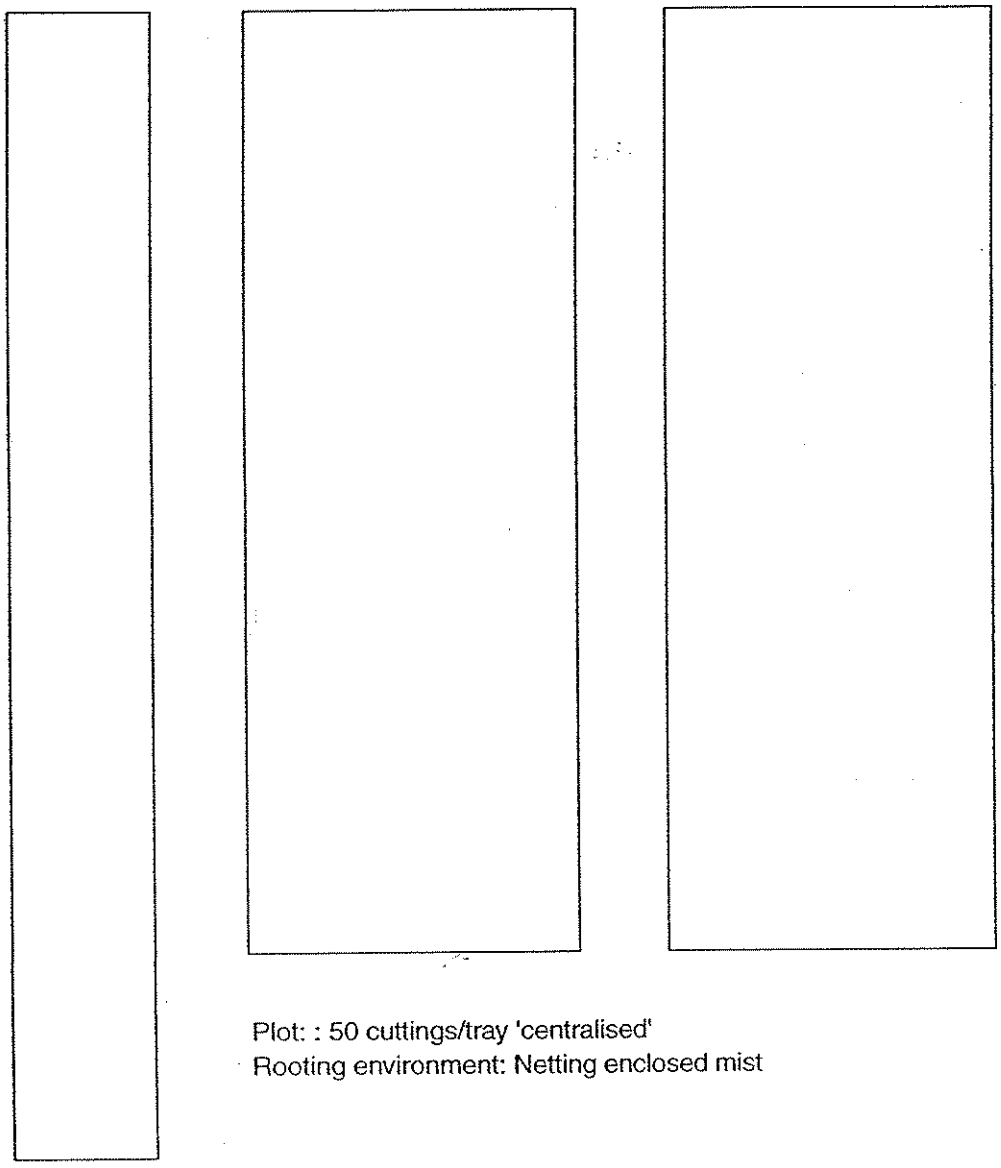
APPENDIX I

Vine Weevil: Evaluation of suSCon Green for use during propagation of hardy nursery stock in modules

(HNS 15e - 1994)

N

Trial Layout - Site: J8, Bench 4



Plot: : 50 cuttings/tray 'centralised'
Rooting environment: Netting enclosed mist

MOSSY SAXIFRAGE

REP 1	CM 207	PL 208
	PH 205	CL 206
	CH 203	PM 204
	PO 201	CO 202
REP 2	PL 199	PH 200
	CO 197	CL 198
	CM 195	PO 196
	PM 193	CH 194
REP 3	CH 191	PO 192
	PM 189	CL 190
	PL 187	CM 188
	CO 185	PH 186
REP 4	CL 183	PM 184
	PO 181	CH 182
	PH 179	CO 180
	CM 177	PL 178

All Saxifrage in 273 plugs

KEY:

C = 50% Coir:50% Cambark fine
P = 50% Peat:50% Cambark fine

O = No suSCon L = 500g cp/m^3
M = 1.0kg cp/m^3 H = 1.0 kg cp/m^3

APPENDIX I

Vine Weevil: Evaluation of suSCon Green for use during propagation of hardy nursery stock in modules

(HNS 15e - 1994)

N

Trial Layout - Site: J8, Bench 2

	PRUNUS		ELAEAGNUS		
REP 4	PL 239	CH 240	CL 272	PM 271	REP 4
	CO 237	PM 238	PH 270	CO 269	
	CM 235	CL 236	CM 268	PO 267	
	PO 233	PH 234	PL 266	CH 265	
REP 3	PL 231	CO 232	CH 264	PO 263	REP 3
	CM 229	CH 230	PM 262	CL 261	
	PO 227	PH 228	CO 260	PH 259	
	CL 225	PM 226	CM 258	PL 257	
REP 2	PH 223	CM 224	PH 256	CO 255	REP 2
	CL 221	PO 222	CM 254	CPL 253	
	PL 219	CH 220	CH 252	PO 251	
	CO 217	PM 218	PM 250	CL 249	
REP 1	CL 215	CH 216	PL 248	CM 247	REP 1
	PO 213	PM 214	CO 246	PO 245	
	PH 211	CO 212	CH 244	CL 243	
	CM 209	PL 210	PM 242	PH 241	

Plug size: PG54
Plot: 54 cuttings/plug tray
Rooting environment: Heat assisted, low polythene covers

KEY:

C = 50% Coir:50% Cambark fine
P = 50% Peat:50%Cambark fine

O = No suSCon L = 500g cp/m^3
M = 1.0 kg cp/m^3 H = 1.0 kg cp/m^3

APPENDIX II

Table 1 *Azalea* 'Blue Danube' : Final percentage rooted by 26 October 1994

(figures are a mean of 3 replicates, 50 cuttings/plot)

Date stuck: 22 July 1994

a. Average effect of rooting media

Angle Transformed Data		Actual % Rooted	
Peat:Bark	**Coir:Bark**	**Peat:Bark**	**Coir:Bark**
67.6	72.6	81	87

(d.f. 46) *SED* ± *3.55*
LSD 5% ± *7.2*

b. Average effect of plug size

Angle Transformed Data			Actual % Rooted		
Plug Size			**Plug Size**		
150	**77**	**54**	**150**	**77**	**54**
67.9	73.6	68.7	81	88	83

(d.f. 46) *SED* ± *4.34*
LSD 5% ± *8.8*

c. Average effect of suSCon Green

Angle Transformed Data				Actual % Rooted			
Rate suSCon Green g/m³				**Rate suSCon Green g/m³**			
Nil	**500**	**1000**	**1500**	**Nil**	**500**	**1000**	**1500**
71.2	70.0	70.9	68.2	85	83	88	81

(d.f. 46) *SED* ± *5.01*
LSD 5% ± *10.2*

APPENDIX II

Table 1 (continued)

d. Average effects of rooting media x plug size x suSCon Green on final % rooted

Rooting Media	Rate suSCon g/m³	Angle Transformed Data Plug Size 150	77	54	Actual % Rooting Plug Size 150	77	54
50:50 Peat:Bark	Nil	77.1	66.5	66.8	91	76	81
	500	58.7	74.4	52.2	72	89	61
	1000	69.1	64.8	73.9	86	81	92
	1500	69.2	76.0	62.3	77	94	71
50:50 Coir:Bark	Nil	63.7	78.8	74.4	73	94	93
	500	67.9	87.3	79.4	79	99	95
	1000	75.6	73.9	67.8	93	89	85
	1500	61.6	67.3	73.1	75	85	84

(d.f. 46) SED ± 12.28
LSD 5% ± 24.9

e. Number of days to 50% root emergence from base of plug

Rooting Media	Rate suSCon g/m³	Plug Size 150	77	54
50:50 Peat:Bark	Nil	59	76	82
	500	63	79	78
	1000	61	84	84
	1500	65	84	83
50:50 Coir:Bark	Nil	59	71	74
	500	54	74	86
	1000	68	79	82
	1500	64	79	86

APPENDIX II

Table 2 *Azalea* 'Blue Danube': Mean day of root emergence

(figures are a mean of 3 replicates, 50 cuttings/plot, expressed in Collins Day format)

Date stuck: 22 July 1994

a. Average effect of rooting media

Rooting Media	Mean Day	
		(d.f. 46)
Peat:Bark	282.7	*SED* ± *1.18*
Coir:Bark	280.4	*LSD 5%* ± *2.4*

b. Average effect of plug size

Plug Size	Mean Day	
150	269.5	*(d.f. 46)*
77	285.6	*SED* ± *1.45*
54	289.6	*LSD 5%* ± *2.9*

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	Mean Day	
Nil	279.6	
500	280.2	*(d.f. 46)*
1000	282.7	*SED* ± *1.67*
1500	283.8	*LSD 5%* ± *3.4*

d. Average effects of rooting media, plug size and suSCon Green on mean root emergence day

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	77	54	150	77	54
Nil	266.4	285.7	291.1	267.0	279.0	286.7
500	269.9	288.7	286.3	266.2	280.0	290.0
1000	270.1	288.5	291.9	270.2	285.3	290.0
1500	272.0	290.3	291.8	272.4	287.2	289.1

(d.f. 46) *SED* ± *4.10*
LSD 5% ± *8.3*

APPENDIX II

Table 3 *Azalea* 'Blue Danube' : Percentage visible root cover over plug by 8 November 1994

(figures are a mean of 3 replicates, 10 cuttings/plot)

Date stuck: 22 July 1994

a. Average effect of rooting media

Rooting Media	% Root Cover	
		(d.f. 46)
Peat:Bark	13.88	*SED ± 1.479*
Coir:Bark	18.45	*LSD 5% ± 3.00*

b. Average effect of plug size

Plug Size	% Root Cover	
		(d.f. 46)
150	25.24	*SED ± 1.811*
77	12.04	*LSD 5% ± 3.67*
54	11.21	

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	% Root Cover	
Nil	17.33	
500	16.37	*(d.f. 46)*
1000	15.64	*SED ± 2.091*
1500	15.30	*LSD 5% ± 4.24*

d. Average effects of rooting media x plug size x suSCon Green on % root cover

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	**77**	**54**	**150**	**77**	**54**
Nil	20.83	11.67	10.33	32.33	12.67	16.17
500	17.00	10.07	9.50	31.67	15.00	15.00
1000	23.33	15.17	8.63	27.33	9.57	9.83
1500	20.60	10.83	8.53	28.83	11.33	11.67

(d.f. 46) *SED ± 5.122*
LSD 5% ± 10.38

APPENDIX II

Table 4 *Azalea* 'Blue Danube' : Density of root growth in plug by 8 November 1994

(figures are a mean of 3 replicates, 10 cuttings/plot)

Root density score = visual score from 1-5 of volume of root present, after washing, against selected indicators.
5 = most root present.

a. Average effect of rooting media

Rooting Media	Root Density Score	
		(d.f. 46)
Peat:Bark	3.56	*SED* ± *0.107*
Coir:Bark	3.89	*LSD 5%* ± *0.22*

b. Average effect of plug size

Plug Size	Root Density Score	
150	3.65	*(d.f. 46)*
77	3.80	*SED* ± *0.132*
54	3.73	*LSD 5%* ± *0.27*

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	Root Density Score	
Nil	3.72	
500	3.76	*(d.f. 46)*
1000	3.76	*SED* ± *0.152*
1500	3.66	*LSD 5%* ± *0.31*

d. Average effects of rooting media x plug size x suSCon Green on root density (5 = most)

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	77	54	150	77	54
Nil	3.47	3.93	3.43	3.67	3.73	4.10
500	3.53	3.47	3.23	3.77	4.33	4.20
1000	3.67	3.67	3.73	3.80	3.93	3.77
1500	3.37	3.83	3.43	3.93	3.50	3.90
	(d.f. 46)		*SED* ± *0.372*			
			LSD 5% ± *0.75*			

APPENDIX II

Table 5 *Azalea* **'Blue Danube' : Percentage of cuttings with root length >6 cm when washed out (8 November 1994)**

(figures are a mean of 3 replicates, 10 cuttings/plot)

Date stuck: 22 July 1994

a. Average effect of rooting media

Rooting Media	% Cuttings
Peat:Bark	68
Coir:Bark	78

b. Average effect of plug size

Plug Size	% Cuttings
150	87
77	64
54	68

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	% Cuttings
Nil	77
500	77
1000	80
1500	59

d. Average effects of rooting media, plug size and suSCon Green on % cuttings with roots >6 cm when washed out

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	77	54	150	77	54
Nil	90	60	63	96	70	80
500	80	66	44	87	83	100
1000	93	66	76	96	73	77
1500	84	50	48	70	47	56

APPENDIX II

Table 6 *Azalea* 'Blue Danube' : Cutting top growth score on 26 October 1994

(figures are a mean of 3 replicates, 50 cuttings/plot)

Top growth score = visual score from 1-5 against selected indicators (5 = largest) Date stuck: 22 July 1994

a. Average effect of rooting media

Rooting Media	Top Growth Score	
		(d.f. 46)
Peat:Bark	2.75	*SED* ± *0.184*
Coir:Bark	2.86	*LSD 5%* ± *0.37*

b. Average effect of plug size

Plug Size	Top Growth Score	
150	3.08	*(d.f. 46)*
77	2.71	*SED* ± *0.225*
54	2.63	*LSD 5%* ± *0.46*

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	Top Growth Score	
Nil	2.78	
500	2.94	*(d.f. 46)*
1000	2.89	*SED* ± *0.260*
1500	2.61	*LSD 5%* ± *0.53*

d. Average effects of rooting media, plug size and suSCon Green on cutting top growth

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	**77**	**54**	**150**	**77**	**54**
Nil	3.00	2.33	2.33	2.66	3.67	2.67
500	3.00	2.67	2.33	3.67	3.00	3.00
1000	3.67	2.67	2.67	3.33	2.33	2.67
1500	3.00	3.00	2.33	2.33	2.00	3.00

(d.f. 46) *SED* ± *0.637*

LSD 5% ± *1.29*

APPENDIX II

Table 7 *Azalea* 'Blue Danube': Influence of propagation treatments on subsequent liner growth by 19 June 1995

(figures are a mean of 3 replicates, 10 plants/plot)

Plants potted 14 November 1994

a. Top Growth (visual score of 1-5, 5 = largest)

Rate suSCon g/m³	Peat:Bark Plug Size 150	77	54	Coir:Bark Plug Size 150	77	54
Nil	2.60	3.08	2.87	2.47	3.28	2.86
500	2.66	2.80	2.60	3.04	3.04	2.96
1000	2.87	2.91	2.81	2.80	2.93	3.08
1500	2.86	2.60	2.50	3.05	2.40	2.98
	(d.f. 46)		*SED ±*	*0.441*		
			LSD 5% ±	*0.89*		

b. Root Growth (visual assessment of % root cover over pot-ball)

Rate suSCon g/m³	Peat:Bark Plug Size 150	77	54	Coir:Bark Plug Size 150	77	54
Nil	36.12	46.29	47.59	42.04	50.41	50.00
500	44.59	45.14	48.37	42.67	41.88	46.07
1000	44.44	42.55	42.93	46.52	51.33	49.22
1500	40.52	45.00	44.67	42.74	40.00	47.46
	(d.f. 46)		*SED ±*	*5.158*		
			LSD 5% ±	*10.46*		

APPENDIX II

Table 8 *Hypericum* 'Hidcote' : Final percentage rooted by 14 November 1994

(figures are a mean of 3 replicates, 30 cuttings/plot)

Date stuck: 14 September 1994

a. Average effect of rooting media

Angle Transformed Data		Actual % Rooted	
Peat:Bark	**Coir:Bark**	**Peat:Bark**	**Coir:Bark**
77.0	76.3	91	90

(d.f. 46) *SED* ± *2.12*
LSD 5% ± *4.3*

b. Average effect of plug size

Angle Transformed Data			Actual % Rooted		
Plug Size			Plug Size		
150	**77**	**54**	**150**	**77**	**54**
78.7	74.7	76.4	93	89	90

(d.f. 46) *SED* ± *2.59*
LSD 5% ± *5.3*

c. Average effect of suSCon Green

Angle Transformed Data				Actual % Rooted			
Rate suSCon Green g/m^3				Rate suSCon Green g/m^3			
Nil	**500**	**1000**	**1500**	**Nil**	**500**	**1000**	**1500**
75.5	79.6	77.3	74.1	91	91	91	89

(d.f. 46) *SED* ± *2.99*
LSD 5% ± *6.1*

APPENDIX II

Table 8 (continued)

d. Average effects of rooting media x plug size x suSCon Green on final % rooted

Rooting Media	Rate suSCon g/m³	Angle Transformed Data Plug Size 150	77	54	Actual % Rooting Plug Size 150	77	54
50:50 Peat:Bark	**Nil**	78.5	70.4	76.9	93	87	91
	500	86.5	75.4	73.1	99	90	80
	1000	75.4	78.9	79.6	93	90	91
	1500	75.4	73.3	80.3	93	87	96
50:50 Coir:Bark	**Nil**	75.0	82.9	69.3	90	96	86
	500	90.0	72.1	80.3	100	83	96
	1000	77.0	80.3	72.6	92	96	86
	1500	72.1	64.6	78.9	83	79	94

(d.f. 46) *SED ± 7.34*

LSD 5% ± 14.89

APPENDIX II

Table 9 *Hypericum* 'Hidcote' : Mean day of root emergence

(figures are a mean of 3 replicates, 30 cuttings/plot, expressed in Collins Day format)

Date stuck: 14 September 1994

a. Average effect of rooting media

Rooting Media	Mean Day	
		(d.f. 46)
Peat:Bark	296.7	*SED ± 0.71*
Coir:Bark	291.6	*LSD 5% ± 1.5*

b. Average effect of plug size

Plug Size	Mean Day	
150	288.9	*(d.f. 46)*
77	295.7	*SED ± 0.88*
54	297.8	*LSD 5% ± 1.8*

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	Mean Day	
Nil	293.7	
500	294.4	*(d.f. 46)*
1000	293.7	*SED ± 1.01*
1500	294.8	*LSD 5% ± 2.1*

d. Average effects of rooting media x plug size x suSCon Green on mean root emergence day

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	77	54	150	77	54
Nil	291.2	297.2	301.0	287.3	292.1	293.3
500	290.0	302.3	297.7	285.6	295.4	295.2
1000	289.2	298.3	302.3	285.9	290.5	296.1
1500	293.1	297.5	300.1	288.6	292.5	296.7

(d.f. 46) *SED ± 2.47*

LSD 5% ± 5.0

APPENDIX II

Table 10 *Hypericum* 'Hidcote' : Percentage visible root cover over plug by 1 December 1994

(figures are a mean of 3 replicates, 10 cuttings/plot)

Date stuck: 14 September 1994

a. Average effect of rooting media

Rooting Media	% Root Cover	
		(d.f. 46)
Peat:Bark	9.18	*SED ± 0.606*
Coir:Bark	10.93	*LSD 5% ± 1.23*

b. Average effect of plug size

Plug Size	% Root Cover	
150	11.81	*(d.f. 46)*
77	9.58	*SED ± 0.743*
54	8.78	*LSD 5% ± 1.51*

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	% Root Cover	
Nil	11.34	
500	9.80	*(d.f. 46)*
1000	9.92	*SED ± 0.857*
1500	9.18	*LSD 5% ± 1.74*

d. Average effects of rooting media x plug size x suSCon Green on % root cover

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	**77**	**54**	**150**	**77**	**54**
Nil	9.17	11.50	8.63	15.96	11.38	10.96
500	9.83	8.33	7.17	14.67	9.17	9.62
1000	14.50	7.54	7.75	8.83	10.00	10.88
1500	9.90	7.96	7.90	11.62	10.33	7.33

(d.f. 46) *SED ± 2.100*

LSD 5% ± 4.26

APPENDIX II

Table 11 *Hypericum* 'Hidcote' : Density of root growth by 1 December 1994

(figures are a mean of 3 replicates, 10 cuttings/plot)

Date stuck: 14 September 1994

Root density score = visual score from 1-5 of volume of root present, after washing, against selected indicators. 5 = most root present.

a. Average effect of rooting media

Rooting Media	Root Density Score	
		(d.f. 46)
Peat:Bark	2.45	*SED ± 0.078*
Coir:Bark	2.96	*LSD 5% ± 0.16*

b. Average effect of plug size

Plug Size	Root Density Score	
150	2.48	*(d.f. 46)*
77	2.78	*SED ± 0.095*
54	2.85	*LSD 5% ± 0.19*

c. Average effect of suSCon Green

Rate suSCon Green g/m³	Root Density Score	
Nil	2.74	
500	2.73	*(d.f. 46)*
1000	2.64	*SED ± 0.110*
1500	2.69	*LSD 5% ± 0.22*

d. Average effects of rooting media x plug size x suSCon Green on root density (5 = most)

Rate suSCon g/m³	Peat:Bark Plug Size 150	77	54	Coir:Bark Plug Size 150	77	54
Nil	2.16	2.64	2.63	3.03	2.90	3.08
500	2.30	2.33	2.67	2.67	3.30	3.10
1000	2.50	2.37	2.47	2.43	3.10	3.00
1500	2.07	2.48	2.73	2.66	3.09	3.10

(d.f. 46) *SED ± 0.269*
LSD 5% ± 0.55

APPENDIX II

Table 12 *Hypericum* 'Hidcote' : Mean root length grade when washed out - 1 December 1994

(figures are a mean of 3 replicates, 10 cuttings/plot)

Date stuck: 14 September 1994

Grade 1 = 0-2 cm, Grade 2 = 2-4 cm, Grade 3 = 4-6 cm, Grade 4 = 6-8 cm

a. Average effect of rooting media

Rooting Media	Mean Root Length Grade	
		(d.f. 46)
Peat:Bark	3.86	*SED* ± *0.121*
Coir:Bark	4.05	*LSD 5%* ± *0.24*

b. Average effect of plug size

Plug Size	Mean Root Length Grade	
150	3.95	*(d.f. 46)*
77	3.77	*SED* ± *0.148*
54	4.15	*LSD 5%* ± *0.30*

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	Mean Root Length Grade	
Nil	4.18	
500	3.88	*(d.f. 46)*
1000	3.79	*SED* ± *0.171*
1500	3.98	*LSD 5%* ± *0.35*

d. Average effects of rooting media x plug size x suSCon Green on mean root length grade

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	**77**	**54**	**150**	**77**	**54**
Nil	3.90	3.70	4.03	4.62	4.00	4.80
500	4.07	3.29	4.17	3.80	4.07	3.88
1000	4.00	3.63	3.91	3.50	3.77	3.91
1500	3.67	3.68	4.23	4.03	4.02	4.27

(d.f. 46) *SED* ± *0.4179*
LSD 5% ± *0.847*

APPENDIX II

Table 13 *Hypericum* **'Hidcote' : Percentage of cuttings with root length >6 cm when washed out on 1 December 1994**

(figures are a mean of 3 replicates, 10 cuttings/plot)

Date stuck: 14 September 1994

a. Average effect of rooting media

Rooting Media	% Cuttings
Peat:Bark	61.9
Coir:Bark	71.8

b. Average effect of plug size

Plug Size	% Cuttings
150	67.4
77	56.3
54	76.9

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	% Cuttings
Nil	70.8
500	68.8
1000	62.2
1500	65.5

d. Average effects of rooting media x plug size x suSCon Green on % cuttings with roots <6 cm when washed out

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	77	54	150	77	54
Nil	72	46	65	86	60	96
500	57	39	96	73	76	72
1000	63	54	64	64	53	75
1500	53	57	77	71	65	70

APPENDIX II

Table 14 *Hypericum* 'Hidcote' : Cutting top growth score on 29 November 1994

(figures are a mean of 3 replicates, 30 cuttings/plot)

Date stuck: 14 September 1994

Top growth score = visual score from 1-5 against selected indicators (5 = largest)

a. Average effect of rooting media

Rooting Media	Top Growth Score	
		(d.f. 46)
Peat:Bark	3.29	*SED* ± *0.212*
Coir:Bark	3.61	*LSD 5%* ± *0.43*

b. Average effect of plug size

Plug Size	Top Growth Score	
		(d.f. 46)
150	3.38	*SED* ± *0.260*
77	3.57	*LSD 5%* ± *0.53*
54	3.42	

c. Average effect of suSCon Green

Rate suSCon Green g/m^3	Top Growth Score	
Nil	3.33	
500	3.44	*(d.f. 46)*
1000	3.50	*SED* ± *0.300*
1500	3.53	*LSD 5%* ± *0.61*

d. Average effects of rooting media x plug size x suSCon Green on top growth score (5 = largest)

Rate suSCon g/m^3	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	**77**	**54**	**150**	**77**	**54**
Nil	3.33	3.00	3.00	3.33	3.67	3.67
500	3.00	3.33	3.33	3.67	3.33	4.00
1000	3.67	4.02	3.00	3.33	4.00	3.00
1500	3.00	3.52	3.33	3.67	3.67	4.00
	(d.f. 46)		*SED* ± *0.735*			
			LSD 5% ± *1.49*			

APPENDIX II

Table 15 *Hypericum* 'Hidcote' : Mean shoot length grade of cutting at 29 November 1994

(figures are a mean of 3 replicates, 10 cuttings/plot)

Date stuck: 14 September 1994

Grade 1 = 0-2 cm, Grade 2 = 2-4 cm, Grade 3 = 4-6 cm, Grade 4 = 6-8 cm

a. Average effect of rooting media

Rooting Media	Mean Shoot Length Grade	
		(d.f. 46)
Peat:Bark	4.90	*SED* ± *0.164*
Coir:Bark	5.23	*LSD 5%* ± *0.33*

b. Average effect of plug size

Plug Size	Mean Shoot Length Grade	
150	4.59	*(d.f. 46)*
77	5.08	*SED* ± *0.201*
54	5.53	*LSD 5%* ± *0.41*

c. Average effect of suSCon Green

Rate suSCon Green g/m³	Mean Shoot Length Grade	
Nil	5.12	
500	5.08	*(d.f. 46)*
1000	5.17	*SED* ± *0.232*
1500	4.89	*LSD 5%* ± *0.47*

d. Average effects of rooting media x plug size x suSCon Green on mean shoot length

Rate suSCon g/m³	Peat:Bark Plug Size 150	77	54	Coir:Bark Plug Size 150	77	54
Nil	4.27	5.29	5.23	4.98	5.20	5.77
500	4.07	4.76	5.50	5.07	5.23	5.88
1000	5.10	5.25	5.40	4.27	5.40	5.60
1500	4.37	4.25	5.33	4.62	5.25	5.50

(d.f. 46) *SED* ± *0.568*; *LSD 5%* ± *1.15*

APPENDIX II

Table 16 *Hypericum* 'Hidcote' : Fresh Weight of prunings (g) 8 March 1995

(figures are a mean of 3 replicates, 10 plants/plot)

Plants potted: 12 December 1994

a. Average effect of rooting media

Rooting Media	Fresh Weight (g)	
		(d.f. 46)
Peat:Bark	0.91	*SED* ± *0.046*
Coir:Bark	1.08	*LSD 5%* ± *0.09*

b. Average effect of plug size

Plug Size	Fresh Weight (g)	
150	0.88	*(d.f. 46)*
77	0.97	*SED* ± *0.057*
54	1.14	*LSD 5%* ± *0.12*

c. Average effect of suSCon Green

Rate suSCon Green g/m³	Fresh Weight (g)	
Nil	1.04	
500	0.90	*(d.f. 46)*
1000	1.04	*SED* ± *0.065*
1500	1.00	*LSD 5%* ± *0.13*

d. Average effects of rooting media x plug size x suSCon Green on fresh weight (g) of prunings

Rate suSCon g/m³	Peat:Bark Plug Size			Coir:Bark Plug Size		
	150	77	54	150	77	54
Nil	0.71	1.02	1.08	0.93	1.09	1.42
500	0.71	0.77	0.97	0.94	0.98	1.03
1000	0.93	0.93	1.10	1.05	1.06	1.18
1500	0.82	0.83	1.06	0.92	1.07	1.29

(d.f. 46) *SED* ± *0.160*
LSD 5% ± *0.32*

APPENDIX II

Table 17 *Hypericum* **'Hidcote' : Influence of propagation treatments on subsequent liner growth by 29 June 1995**

(figures are a mean of 3 replicates, 10 plants/plot)

Plants potted 12 December 1994

a. Top Growth (visual score of 1-5, 5 = largest)

Rate suSCon g/m³	Peat:Bark Plug Size 150	77	54	Coir:Bark Plug Size 150	77	54
Nil	3.27	3.13	3.07	3.22	3.27	3.40
500	3.25	3.27	3.29	3.60	3.27	2.99
1000	3.13	3.56	2.73	3.25	3.33	3.80
1500	3.13	2.71	3.01	3.42	3.54	3.20

(d.f. 46) *SED* ± *0.312*

LSD 5% ± *0.63*

b. Root Growth (visual assessment of % root cover over pot-ball)

Rate suSCon g/m³	Peat:Bark Plug Size 150	77	54	Coir:Bark Plug Size 150	77	54
Nil	9.72	8.33	12.50	9.72	8.33	12.50
500	7.90	9.40	9.18	7.90	9.40	9.18
1000	8.69	10.30	11.13	8.69	10.30	11.13
1500	11.26	10.26	9.00	11.26	10.26	9.00

(d.f. 46) *SED* ± *1.593*

LSD 5% ± *3.23*

APPENDIX II

Table 18 Mossy Saxifrage : Final percentage rooted by 12 September 1994

(figures are a mean of 4 replicates, 50 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

	Rate suSCon Green g/m^3				Media
Media	**Nil**	**500**	**1000**	**1500**	**Mean**
Peat:Bark	99	99	99	100	99.3
Coir:Bark	100	100	100	100	100.0
suSCon Mean	99.5	99.5	99.5	100.0	

Table 19 Mossy Saxifrage : Percentage cuttings rooted 25 days after insertion

(figures are a mean of 4 replicates, 50 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

	Rate suSCon Green g/m^3				Media
Media	**Nil**	**500**	**1000**	**1500**	**Mean**
Peat:Bark	26	26	19	26	24.3
Coir:Bark	65	52	46	56	54.8
suSCon Mean	45.5	39.0	32.5	41.0	

APPENDIX II

Table 20 Mossy Saxifrage : Mean day of root emergence from base of plug

(figures are a mean of 4 replicates, 50 cuttings/plot and expressed in Collins Day format)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	248.5	248.5	249.5	248.5	248.8	*SED ± 1.06*
Coir:Bark	244.5	245.8	246.5	245.4	245.6	*LSD 5% ± 2.2*
	SED ± 2.11		*LSD 5% ± 4.4*			
suSCon Mean	246.5	247.2	248.1	246.9	*(d.f. = 21)*	
	SED ± 1.49		*LSD 5% ± 3.1*			

Table 21 Mossy Saxifrage : Percentage visible root cover over plug by 12 September 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	17.7	14.5	14.3	11.9	14.6	*SED ± 2.20*
Coir:Bark	30.0	17.5	14.3	18.1	20.0	*LSD 5% ± 4.6*
	SED ± 4.39		*LSD 5% ± 9.13*			
suSCon Mean	23.9	16.0	14.3	15.0	*(d.f. = 26)*	
	SED ± 3.11		*LSD 5% ± 6.5*			

APPENDIX II

Table 22 Mossy Saxifrage : Percentage of cuttings with a root density score of 5 when washed out on 12 September 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

Root density scored 1-5 on washed roots (5 = most)

	Rate suSCon Green g/m^3				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	100.0	92.5	90.0	75.0	83.7	*SED ± 3.49*
Coir:Bark	90.0	87.5	82.5	75.0	89.4	*LSD 5% ± 7.2*
	SED ± 6.97		*LSD 5% ± 14.5*			
suSCon Mean	95.0	90.0	86.2	75.0	*(d.f. = 21)*	
	SED ± 4.93		*LSD 5% ± 10.2*			

Table 23 Mossy Saxifrage : Mean root length grade by 12 September 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

Root length grades: 1 = 0-2 cm, 2 = 2-4 cm, 3 = 4-6 cm, 4 = 6-8 cm

	Rate suSCon Green g/m^3				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	3.15	3.78	3.70	3.55	3.54	*SED ± 0.106*
Coir:Bark	3.53	3.58	3.60	3.40	3.53	*LSD 5% ± 0.22*
	SED ± 0.211		*LSD 5% ± 0.44*			
suSCon Mean	3.34	3.68	3.65	3.48	*(d.f. = 21)*	
	SED ± 0.149		*LSD 5% ± 0.31*			

APPENDIX II

Table 24 Mossy Saxifrage : Percentage cuttings with roots >6 cm by 12 September 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean
Peat:Bark	42.5	55.0	57.5	47.5	50.6
Coir:Bark	37.5	70.0	62.5	52.5	55.6
suSCon Mean	40.0	62.5	60.0	50.0	

Table 25 Mossy Saxifrage : Cutting top growth score by 12 September 1994

(figures are a mean of 4 replicates, 50 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 4 August 1994

Growth score 1-5 (5 = best)

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	2.25	2.00	2.00	2.75	2.25	*SED ± 0.413*
Coir:Bark	4.00	2.50	2.75	2.00	2.81	*LSD 5% ± 0.86*
	SED ± 0.826		*LSD 5% ± 1.72*			
suSCon Mean	3.13	2.25	2.38	2.38	*(d.f. = 21)*	
	SED ± 0.584		*LSD 5% ± 1.22*			

APPENDIX II

Table 26 Mossy Saxifrage : Influence of propagation treatments on subsequent liner growth by 25 May 1995

(figures are a mean of 4 replicates, 10 plants/plot)

Plug size: PG 273 (12 mls) Date potted: 7 November 1994

a. Top Growth (visual score of 1-5, 5 = largest)

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	3.74	3.73	3.65	3.50	3.65	*SED ± 0.238*
Coir:Bark	4.00	3.53	3.65	3.50	3.67	*LSD 5% ± 0.50*
	SED ± 0.477		*LSD 5% ± 0.99*			
suSCon Mean	3.87	3.63	3.49	3.64	*(d.f. = 21)*	
	SED ± 0.337		*LSD 5% ± 0.70*			

b. Root Growth (visual assessment of % root cover over pot-ball)

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	9.35	9.30	8.08	11.25	9.49	*SED ± 1.223*
Coir:Bark	11.53	10.90	10.48	8.20	10.28	*LSD 5% ± 2.54*
	SED ± 2.477		*LSD 5% ± 5.09*			
suSCon Mean	10.44	10.10	9.28	9.73	*(d.f. = 21)*	
	SED ± 1.730		*LSD 5% ± 3.60*			

APPENDIX II

Table 27 *Elaeagnus x ebbingei* : Final percentage rooted by 29 March 1995

(figures are a mean of 4 replicates, 54 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

a. Data analysed as Angle Transformations

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	60.8	59.0	52.7	51.3	55.9	*SED ± 3.34*
Coir:Bark	71.3	57.7	66.0	67.8	65.7	*LSD 5% ± 6.5*
	SED ± 6.68		*LSD 5% ± 13.9*			
suSCon Mean	66.0	58.3	59.4	59.6	*(d.f. = 21)*	
	SED ± 4.72		*LSD 5% ± 9.8*			

b. Actual % rooted

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean
Peat:Bark	75.9	72.7	63.0	60.2	68.0
Coir:Bark	89.4	69.0	82.4	85.2	81.5
suSCon Mean	82.7	70.9	72.7	72.7	

APPENDIX II

Table 28 *Elaeagnus x ebbingei* : Percentage of cuttings rooted by 28 February 1995

(figures are a mean of 4 replicates, 54 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

	Rate suSCon Green g/m³				Media
Media	**Nil**	**500**	**1000**	**1500**	**Mean**
Peat:Bark	44.9	33.3	29.2	15.7	30.8
Coir:Bark	66.7	39.8	45.8	45.4	49.4
suSCon Mean	55.8	36.6	37.5	30.6	

Table 29 *Elaeagnus x ebbingei* : Mean day of root emergence from base of plug

(figures are a mean of 4 replicates, 54 cuttings/plot, expressed in Collins Day format)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	48.4	51.5	50.5	58.6	52.2	*SED ± 1.44*
Coir:Bark	41.3	48.5	50.0	49.7	47.4	*LSD 5% ± 3.0*
	SED ± 2.885		*LSD 5% ± 6.00*			
suSCon Mean	50.4	46.0	50.7	52.1	*(d.f. = 21)*	
	SED ± 2.04		*LSD 5% ± 4.2*			

APPENDIX II

Table 30 *Elaeagnus x ebbingei* : Percentage visible root cover over plug by 3 April 1995

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	4.28	4.15	3.18	2.98	3.64	*SED ± 0.526*
Coir:Bark	6.30	7.83	3.60	4.23	5.49	*LSD 5% ± 1.09*
	SED ± 1.052		*LSD 5% ± 2.19*			
suSCon Mean	5.29	5.99	3.39	3.60	*(d.f. = 21)*	
	SED ± 0.744		*LSD 5% ± 1.55*			

Table 31 *Elaeagnus x ebbingei* : Density of root growth by 3 April 1995

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

Root density score = visual score from 1-5 of volume of root present, after, washing, against selected indicators.
5 = most root present

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	2.58	2.43	1.80	1.93	2.18	*SED ± 0.131*
Coir:Bark	2.83	2.90	2.63	2.53	2.72	*LSD 5% ± 0.27*
	SED ± 0.262		*LSD 5% ± 0.55*			
suSCon Mean	2.70	2.66	2.21	2.23	*(d.f. = 21)*	
	SED ± 0.185		*LSD 5% ± 0.38*			

APPENDIX II

Table 32 *Elaeagnus ebbingei* : Mean root length grade when washed out on 3 April 1995

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

Root length Grade 1 = 0-2 cm, Grade 4 = 6-8 cm, Grade 6 = 10-12 cm, Grade 8 = 14-16 cm.

	Rate suSCon Green g/m^3				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	6.60	6.85	4.93	4.77	5.79	*SED ± 0.561*
Coir:Bark	7.92	6.68	6.70	6.80	7.03	*LSD 5% ± 1.17*
	SED ± 1.122		*LSD 5% ± 2.33*			
suSCon Mean	7.26	6.76	5.81	5.79	*(d.f. = 21)*	
	SED ± 0.793		*LSD 5% ± 1.65*			

APPENDIX II

Table 33 *Elaeagnus x ebbingei* : Influence of propagation treatments on subsequent liner growth by 4 August 1995

(figures are a mean of 4 replicates, 10 plants/plot)

Plug size: PG 54 (80 ml) Date potted: 16 March 1994

a. Top Growth (visual score of 1-5, 5 = largest)

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	2.75	2.85	2.80	2.60	2.75	*SED % ± 0.122*
Coir:Bark	2.80	2.68	3.05	2.83	2.84	*LSD 5% ± 0.25*
	SED ± 0.245		*LSD 5% ± 0.51*			
suSCon Mean	2.78	2.76	2.93	2.71	*(d.f. = 21)*	
	SED ± 0.173		*LSD 5% ± 0.36*			

b. Root Growth (visual assessment of % root cover over pot-ball)

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	11.8	9.0	10.6	9.8	10.3	*SED ± 0.35*
Coir:Bark	11.1	10.5	10.5	10.5	10.6	*LSD 5% ± 0.7*
	SED ± 0.70		*LSD 5% ± 1.5*			
suSCon Mean	11.4	9.8	10.5	10.1	*(d.f. = 21)*	
	SED ± 0.49		*LSD 5% ± 1.0*			

APPENDIX II

Table 34 *Prunus laurocerasus* 'Otto Luyken' : Final percentage rooted by 29 March 1995

(figures are a mean of 4 replicates, 54 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

a. Data analysed as Angle Transformations

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	61.1	64.4	66.7	60.3	63.1	*SED ± 2.14*
Coir:Bark	90.0	83.2	88.0	85.3	86.6	*LSD 5% ± 4.5*
	SED ± 4.28		*LSD 5% ± 8.9*			
suSCon Mean	75.6	73.8	77.4	72.8	*(d.f. = 21)*	
	SED ± 3.03		*LSD 5% ± 6.3*			

b. Actual % rooted

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean
Peat:Bark	76.4	80.6	83.3	74.1	78.6
Coir:Bark	100.0	97.2	99.5	98.6	98.8
suSCon Mean	88.2	88.9	91.4	86.4	

APPENDIX II

Table 35 *Prunus laurocerasus* 'Otto Luyken' : Percentage of cuttings rooted by 28 February 1995

(figures are a mean of 4 replicates, 54 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean
Peat:Bark	29.6	41.2	36.1	27.8	33.7
Coir:Bark	54.6	42.6	49.5	35.6	45.6
suSCon Mean	42.1	41.9	42.8	31.7	

Table 36 *Prunus laurocerasus* 'Otto Luyken': Mean day of root emergence from base of plug

(figures are a mean of 4 replicates, 54 cuttings/plot and expressed in Collins Day format)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	42.9	39.2	42.6	42.6	41.8	*SED ± 1.99*
Coir:Bark	25.7	30.9	31.7	31.9	30.1	*LSD 5% ± 4.2*
	SED ± 3.99		*LSD 5% ± 8.3*			
suSCon Mean	34.3	35.1	37.2	37.2	*(d.f. = 21)*	
	SED ± 2.83		*LSD 5% ± 5.9*			

APPENDIX II

Table 37 *Prunus laurocerasus* 'Otto Luyken': Percentage visible root cover over plug by 30 March 1995

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	1.93	1.58	1.70	1.24	1.61	*SED ± 0.213*
Coir:Bark	1.27	1.42	1.27	1.33	1.33	*LSD 5% ± 0.44*
	SED ± 0.426		*LSD 5% ± 0.89*			
suSCon Mean	1.60	1.50	1.49	1.28	*(d.f. = 21)*	
	SED ± 0.301		*LSD 5% ± 0.63*			

Table 38 *Prunus laurocerasus* 'Otto Luyken': Density of root growth by 30 March 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

Root density score = visual score from 1-5 of volume of root present, after, washing, against selected indicators.
5 = most root present

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	2.05	2.25	2.18	2.00	2.12	*SED ± 0.073*
Coir:Bark	2.15	2.13	2.20	2.25	2.18	*LSD 5% ± 0.15*
	SED ± 0.145		*LSD 5% ± 0.30*			
suSCon Mean	2.10	2.19	2.19	2.13	*(d.f. = 21)*	
	SED ± 0.103		*LSD 5% ± 0.21*			

APPENDIX II

Table 39 *Prunus laurocerasus* 'Otto Luyken' : Mean root length grade when washed out on 3 April 1995

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 54 (80 ml) Date stuck: 11 November 1994

Root length Grade 1 = 0-2 cm, Grade 5 = 8-10 cm, Grade 6 = 10-12 cm, Grade 7 = 12-14 cm.

	Rate suSCon Green g/m^3				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	5.73	6.80	7.47	7.08	6.77	*SED ± 0.312*
Coir:Bark	6.05	6.47	6.95	6.90	6.59	*LSD 5% ± 0.65*
	SED ± 0.624		*LSD 5% ± 1.30*			
suSCon Mean	5.89	6.64	7.21	6.99	*(d.f. = 21)*	
	SED ± 0.441		*LSD 5% ± 0.92*			

APPENDIX II

Table 40 *Prunus laurocerasus* 'Otto Luyken': Influence of propagation treatments on subsequent liner growth by 7 August 1995

(figures are a mean of 4 replicates, 10 plants/plot)

Plug size: PG 54 (80 ml) Date potted: 16 March 1994

a. Top Growth (visual score of 1-5, 5 = largest)

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	2.95	3.08	3.03	2.80	2.96	*SED % ± 0.063*
Coir:Bark	2.93	2.88	3.08	2.80	2.92	*LSD 5% ± 0.13*
	SED ± 0.126		*LSD 5% ± 0.26*			
suSCon Mean	2.94	2.98	3.05	2.80	*(d.f. = 21)*	
	SED ± 0.089		*LSD 5% ± 0.19*			

b. Root Growth (visual assessment of % root cover over pot-ball)

Media	Rate suSCon Green g/m³ Nil	500	1000	1500	Media Mean	
Peat:Bark	8.62	7.50	8.12	8.00	8.06	*SED ± 0.314*
Coir:Bark	8.58	7.50	7.35	7.75	7.79	*LSD 5% ± 0.65*
	SED ± 0.627		*LSD 5% ± 1.30*			
suSCon Mean	8.60	7.50	7.74	7.88	*(d.f. = 21)*	
	SED ± 0.443		*LSD 5% ± 0.92*			

APPENDIX II

Table 41 *Erica erygena* 'Irish Dusk' : Final percentage rooted by 14 December 1994

(figures are a mean of 4 replicates, 40 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 25 August 1994

a. Data analysed as Angle Transformations

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	66.5	62.3	71.8	65.0	66.4	*SED ± 2.80*
Coir:Bark	72.3	72.7	63.6	70.5	69.8	*LSD 5% ± 5.8*
	SED ± 5.60		*LSD 5% ± 11.6*			
suSCon Mean	69.4	67.5	67.7	67.8	*(d.f. = 21)*	
	SED ± 3.96		*LSD 5% ± 8.2*			

b. Actual % rooted

	Rate suSCon Green g/m³				Media
Media	**Nil**	**500**	**1000**	**1500**	**Mean**
Peat:Bark	83.1	76.3	88.8	80.0	82.1
Coir:Bark	90.6	87.5	76.9	88.8	86.0
suSCon Mean	86.9	81.9	82.9	84.4	

APPENDIX II

Table 42 *Erica erygena* 'Irish Dusk': Mean day of root emergence from base of plug

(figures are a mean of 4 replicates, 40 cuttings/plot and expressed in Collins Day format)

Plug size: PG 273 (12 mls) Date stuck: 25 August 1994

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	288.1	287.0	289.8	290.8	288.9	*SED ± 1.14*
Coir:Bark	286.8	288.2	290.5	293.9	289.8	*LSD 5% ± 2.4*
	SED ± 2.29		*LSD 5% ± 4.76*			
suSCon Mean	287.5	287.6	290.1	292.3	*(d.f. = 21)*	
	SED ± 1.62		*LSD 5% ± 3.4*			

Table 43 *Erica erygena* 'Irish Dusk': Percentage visible root cover over plug by 21 December 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 25 August 1994

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	2.05	1.90	2.18	1.93	2.01	*SED ± 0.098*
Coir:Bark	2.23	2.10	2.15	1.95	2.11	*LSD 5% ± 0.20*
	SED ± 0.196		*LSD 5% ± 0.41*			
suSCon Mean	2.14	2.00	2.16	1.94	*(d.f. = 21)*	
	SED ± 0.138		*LSD 5% ± 0.29*			

APPENDIX II

Table 44 *Erica erygena* 'Irish Dusk': Density of root growth by 21 December 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 25 August 1994

Root density score = visual score from 1-5 of volume of root present, after, washing, against selected indicators.
5 = most root present

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	2.70	2.22	2.98	2.90	2.70	*SED ± 0.211*
Coir:Bark	2.80	2.85	2.45	3.00	2.77	*LSD 5% ± 0.44*
	SED ± 0.422		*LSD 5% ± 0.88*			
suSCon Mean	2.75	2.54	2.71	2.95	*(d.f. = 21)*	
	SED ± 0.298		*LSD 5% ± 0.62*			

Table 45 *Erica erygena* 'Irish Dusk' : Cutting top growth score on 12 December 1994

(figures are a mean of 4 replicates, 10 cuttings/plot)

Plug size: PG 273 (12 mls) Date stuck: 25 August 1994

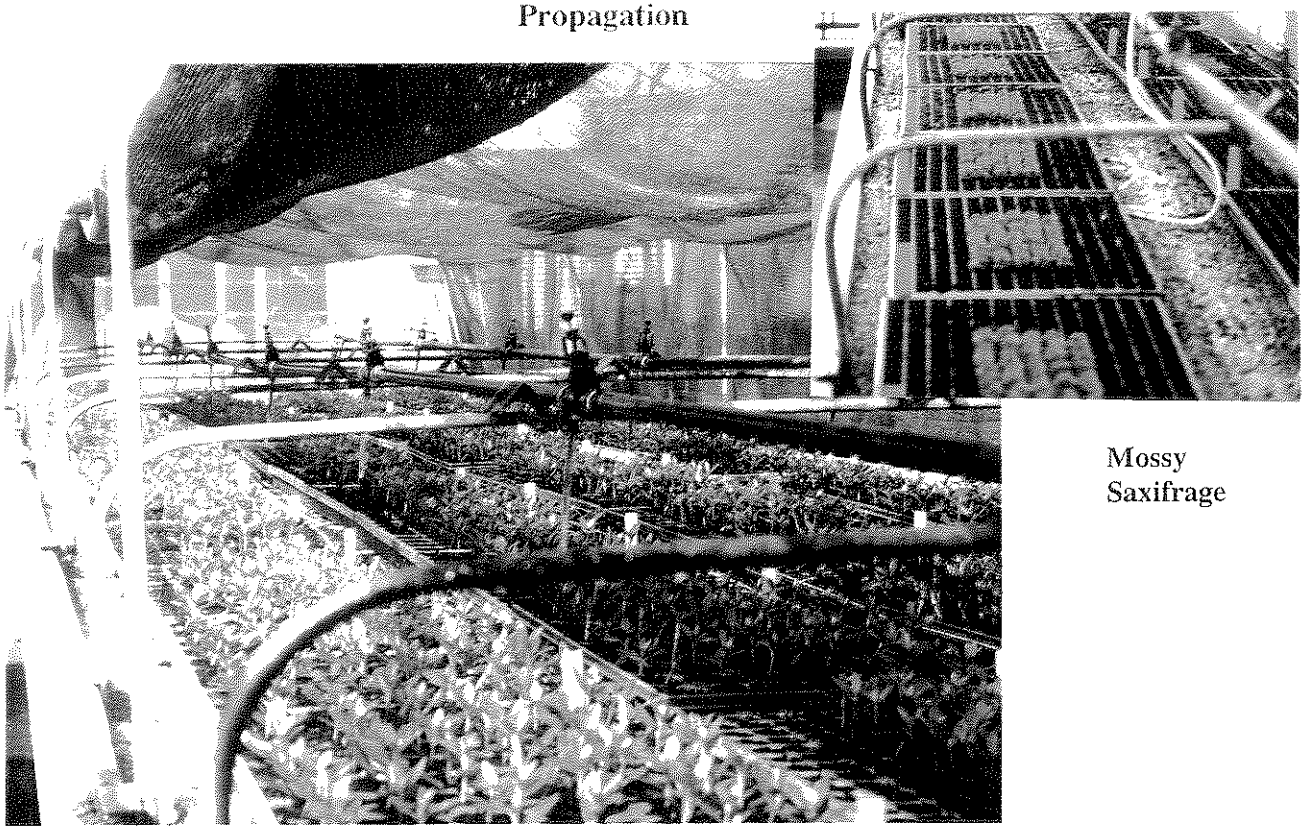
Top growth score = visual score from 1-5 against selected indicators (5 = largest)

	Rate suSCon Green g/m³				Media	
Media	**Nil**	**500**	**1000**	**1500**	**Mean**	
Peat:Bark	3.05	2.60	2.67	3.05	2.84	*SED ± 0.231*
Coir:Bark	3.33	2.72	2.37	3.35	*2.94*	*LSD 5% ± 0.48*
	SED ± 0.462		*LSD 5% ± 0.96*			
suSCon Mean	3.19	2.66	2.52	3.20	*(d.f. = 21)*	
	SED ± 0.327		*LSD 5% ± 0.68*			

APPENDIX III

Plate 1

Propagation



Mossy Saxifrage

Azalea 'Blue Danube' under netting enclosed mist

Hypericum 'Hidcote' growing on

APPENDIX III

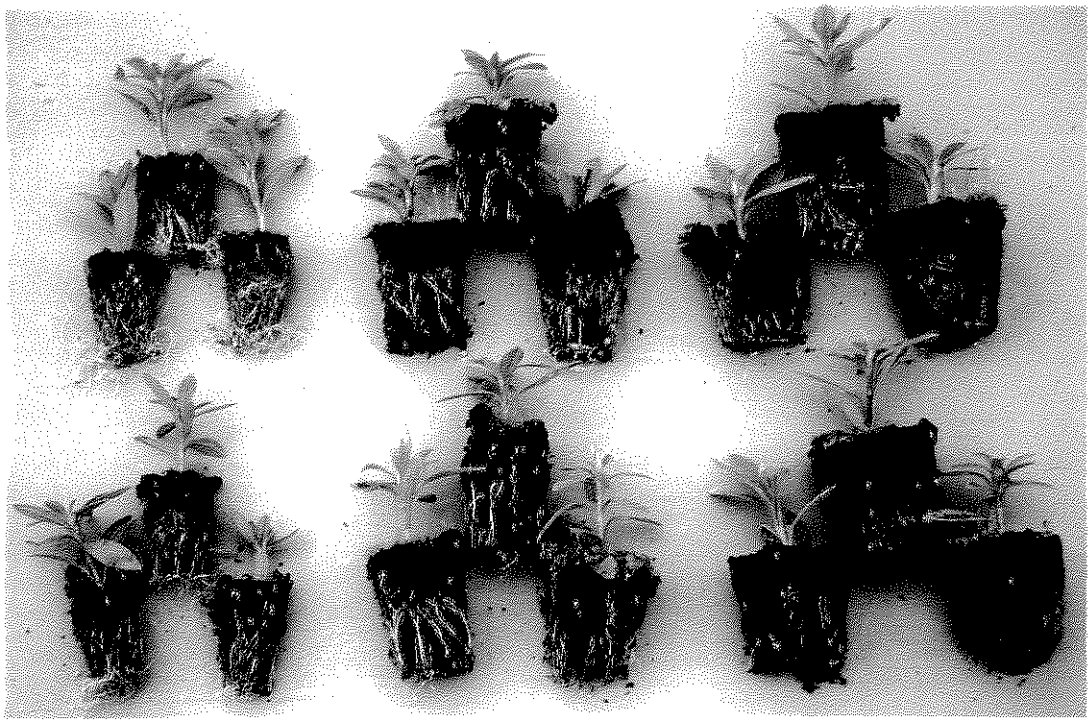
Plate 2

(photographed 15 November 1994)

Azalea 'Blue Danube'

50:50 Peat:Bark

Rate suSCon Green g/m³

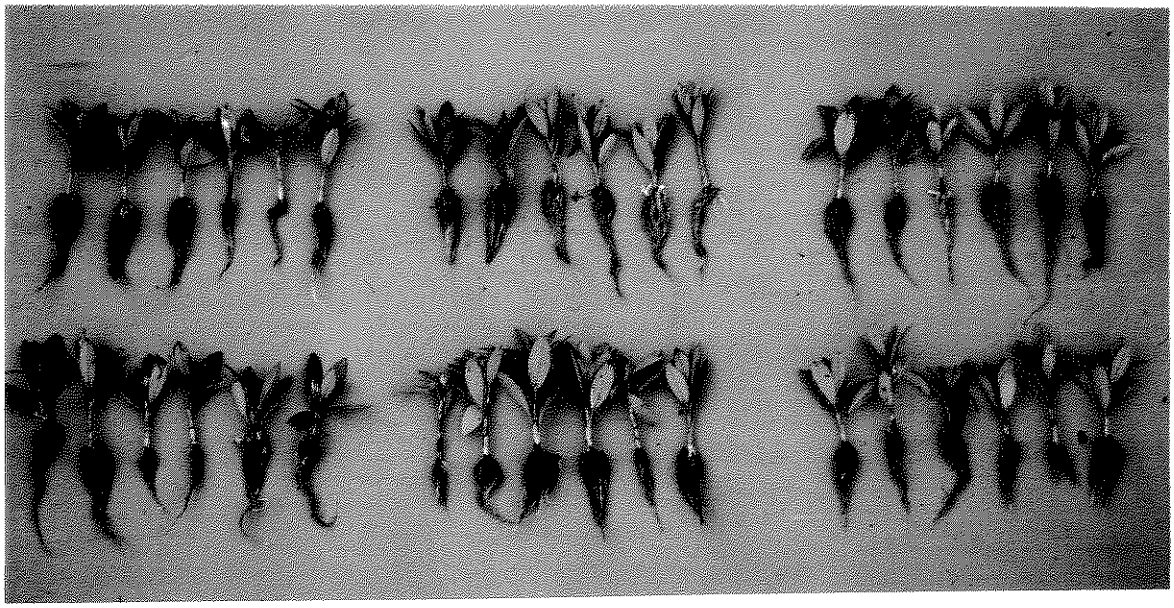


Nil

1500g

PG150 Plugs PG77 Plugs PG54 Plugs

Roots washed out



Nil

1500g

PG150 Plugs PG77 Plugs PG54 Plugs

APPENDIX III

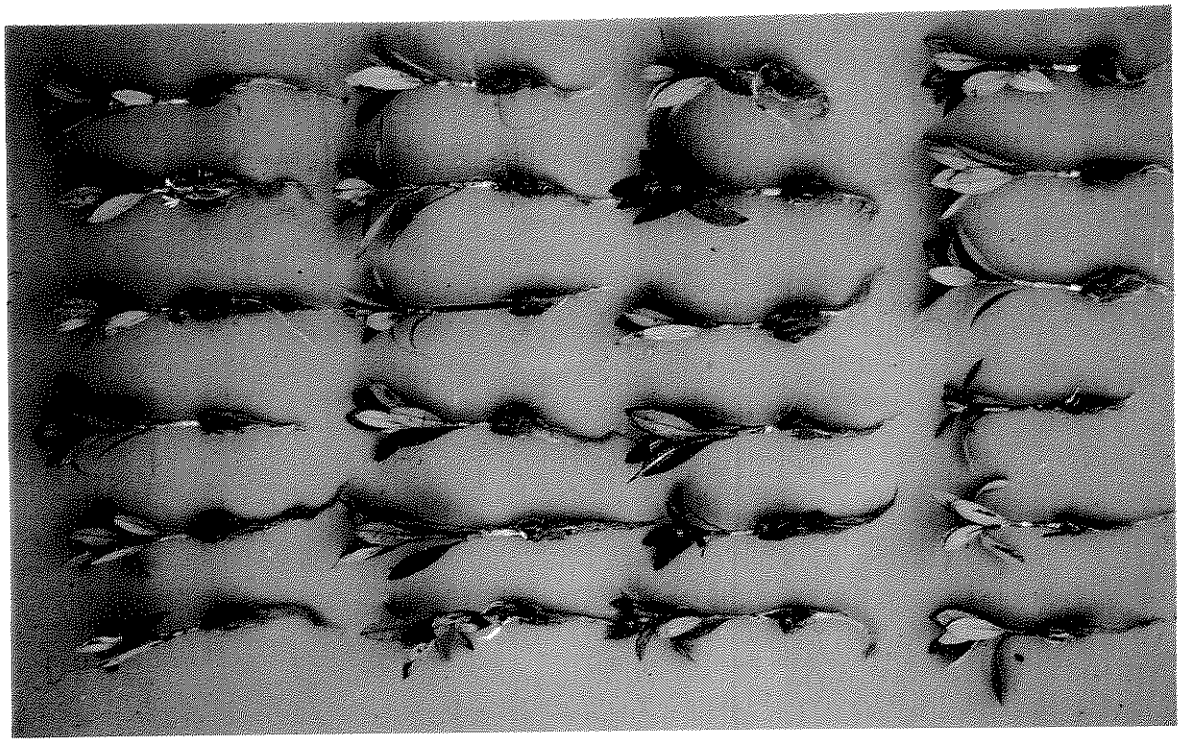
Plate 3

Azalea 'Blue Danube'

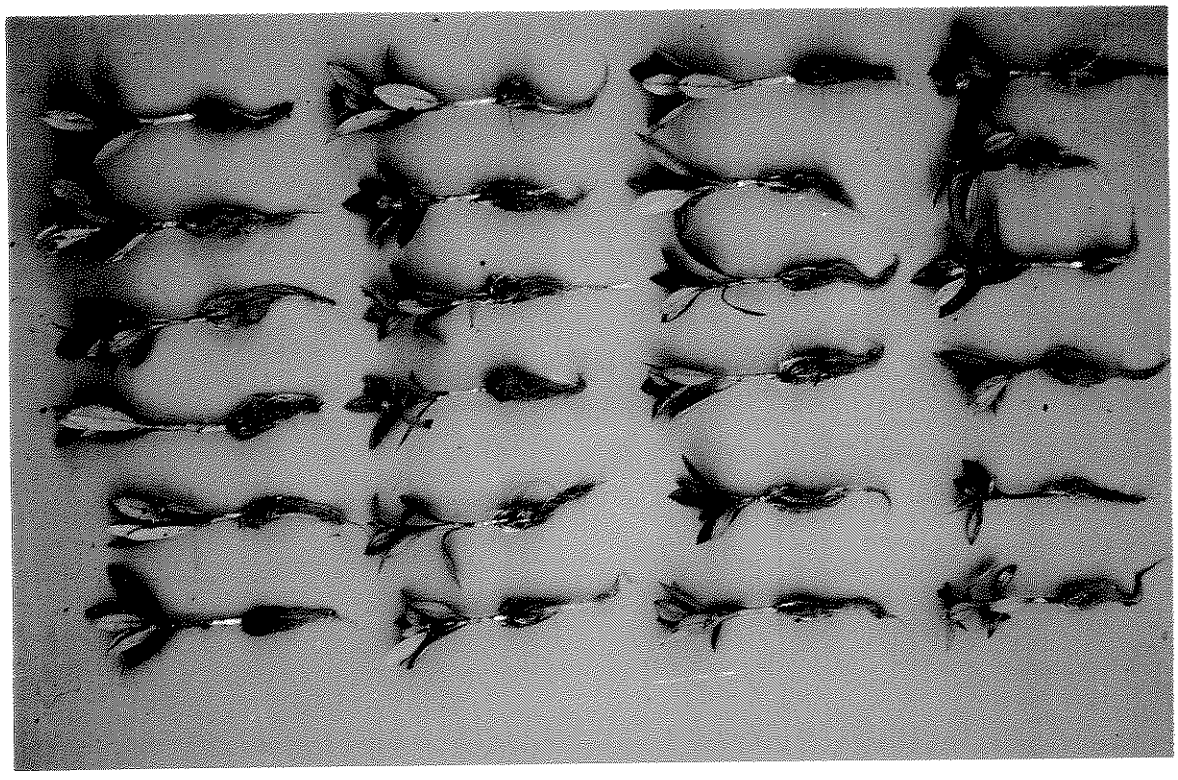
(photographed 15 November 1994)

PG77 Plugs

50:50 Peat:Bark



Rate suSCon Green g/m³	Nil	500g	1000g	1500g



50:50 Coir:Bark

APPENDIX III

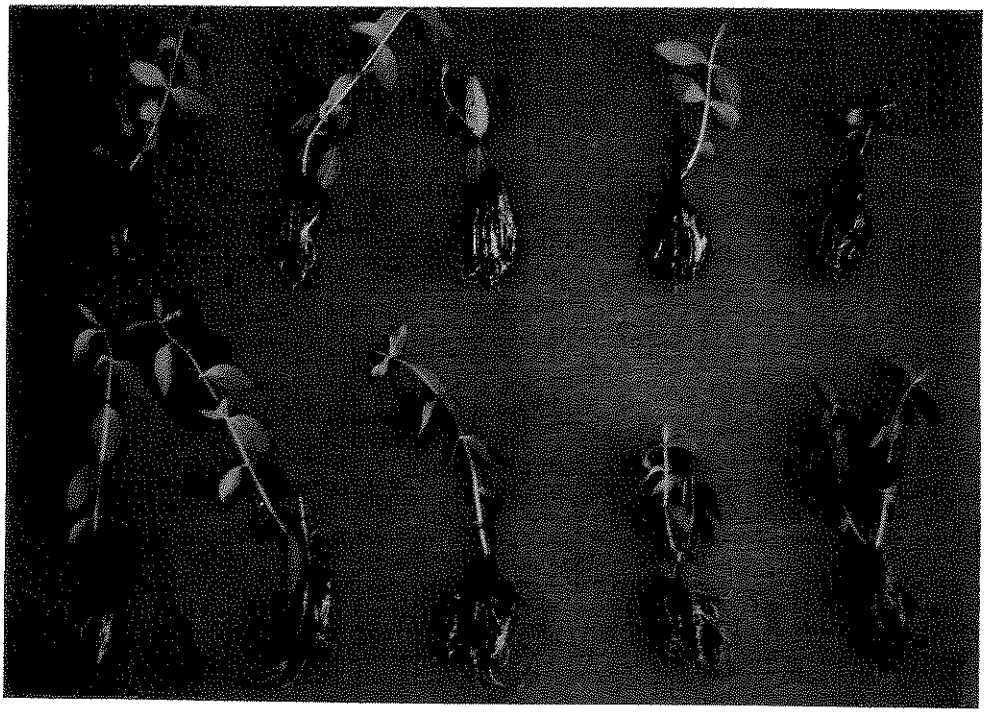
Plate 4

(photographed 22 December 1994)

Hypericum 'Hidcote'

50:50 Peat:Bark

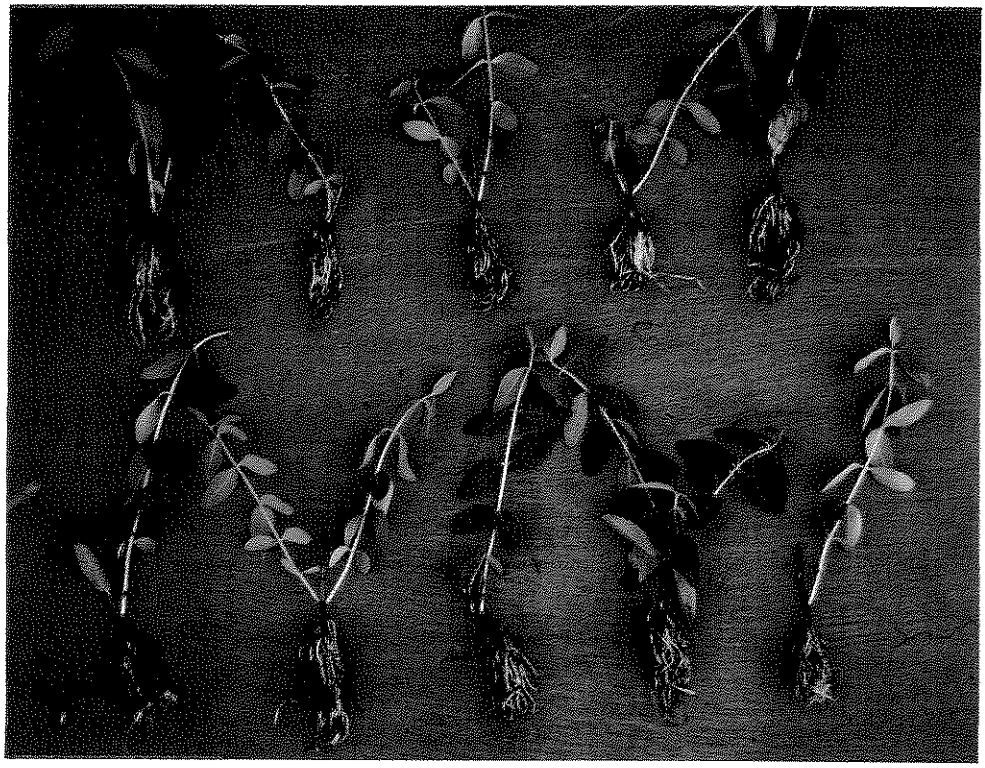
Rate suSCon Green g/m³



Nil

1500g

50:50 Peat:Bark



Nil

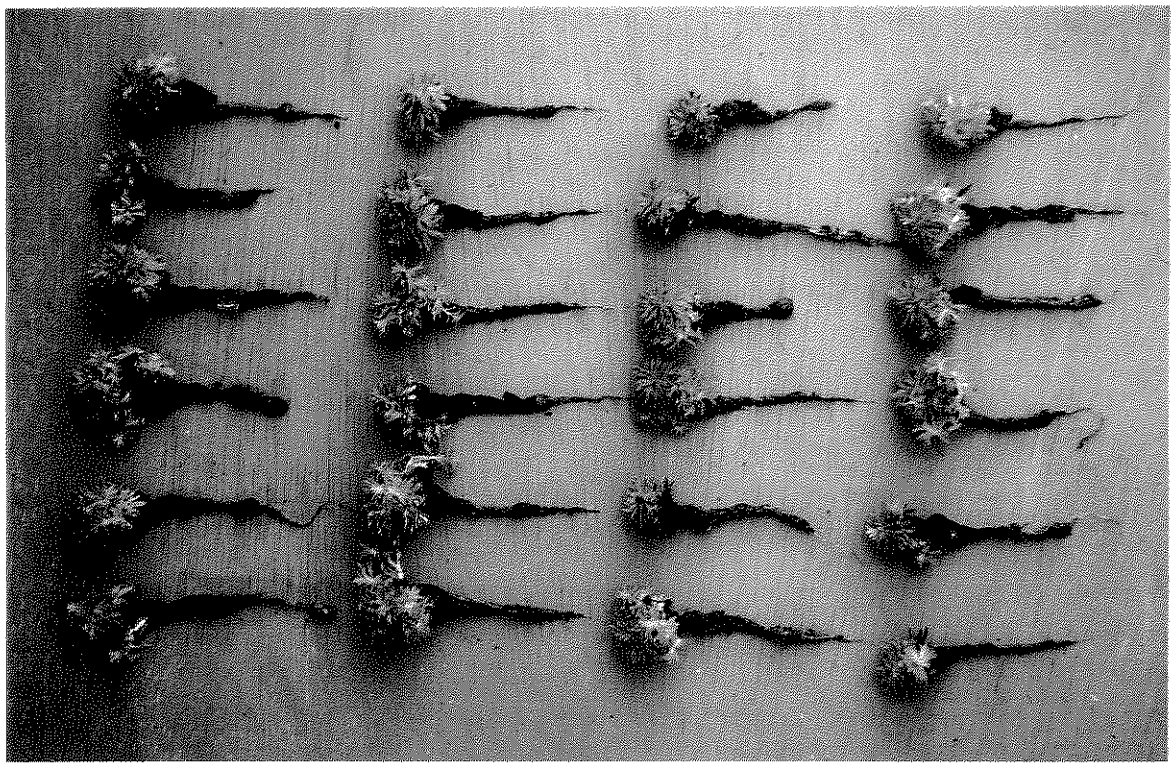
1500g

50:50 Coir:Bark

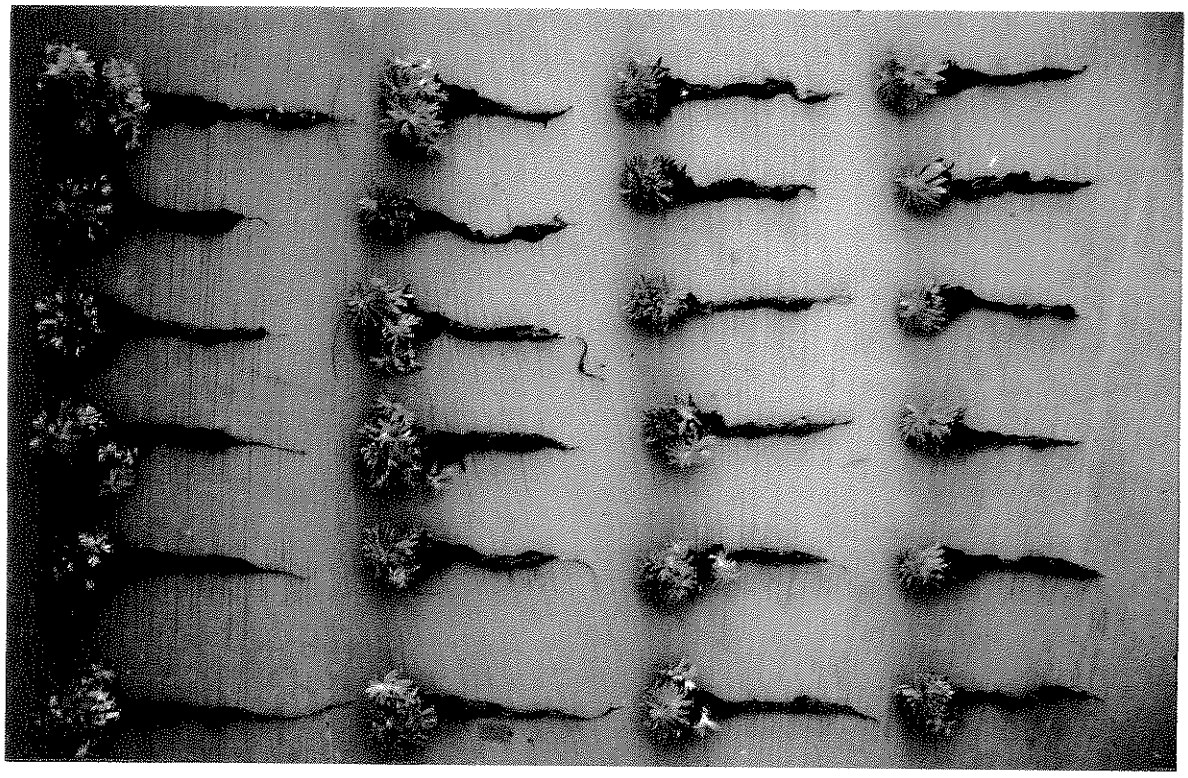
APPENDIX III Plate 5 Mossy Saxifrage

(photographed 15 November 1994)

50:50 Peat:Bark



Rate suSCon Green g/m³	Nil	500g	1000g	1500g

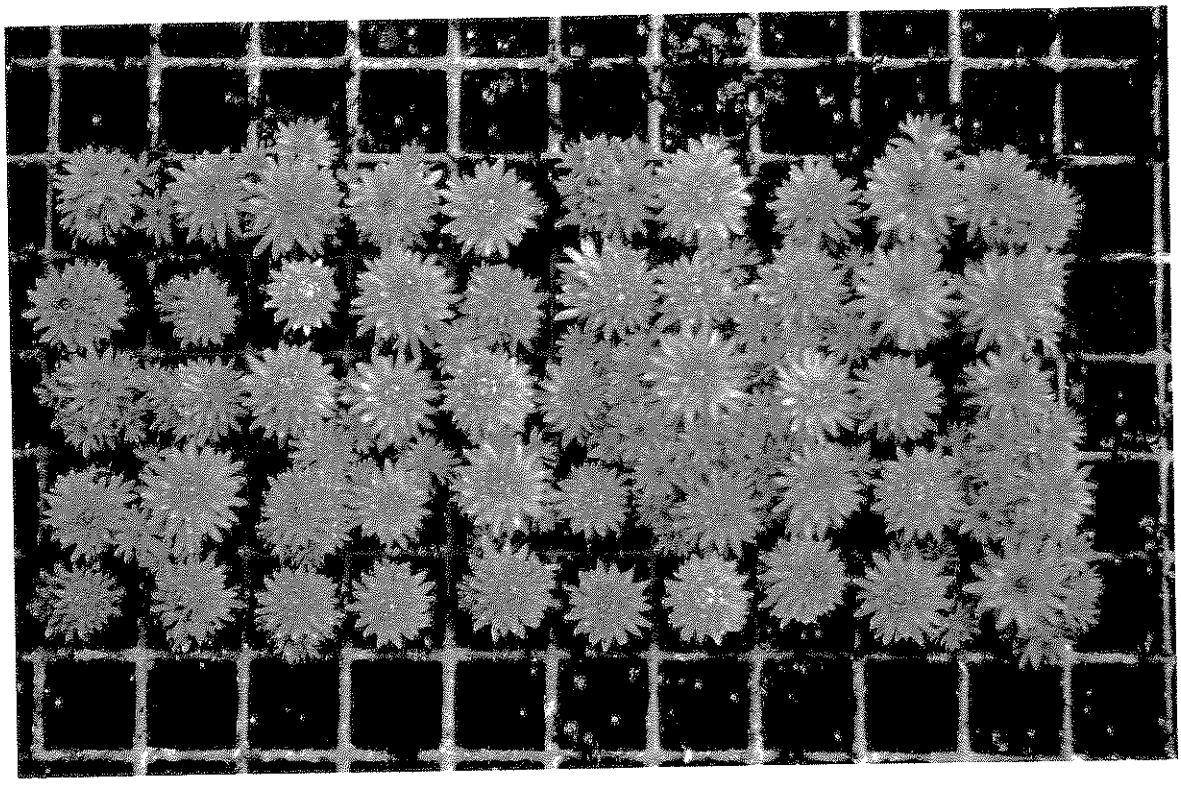


50:50 Coir:Bark

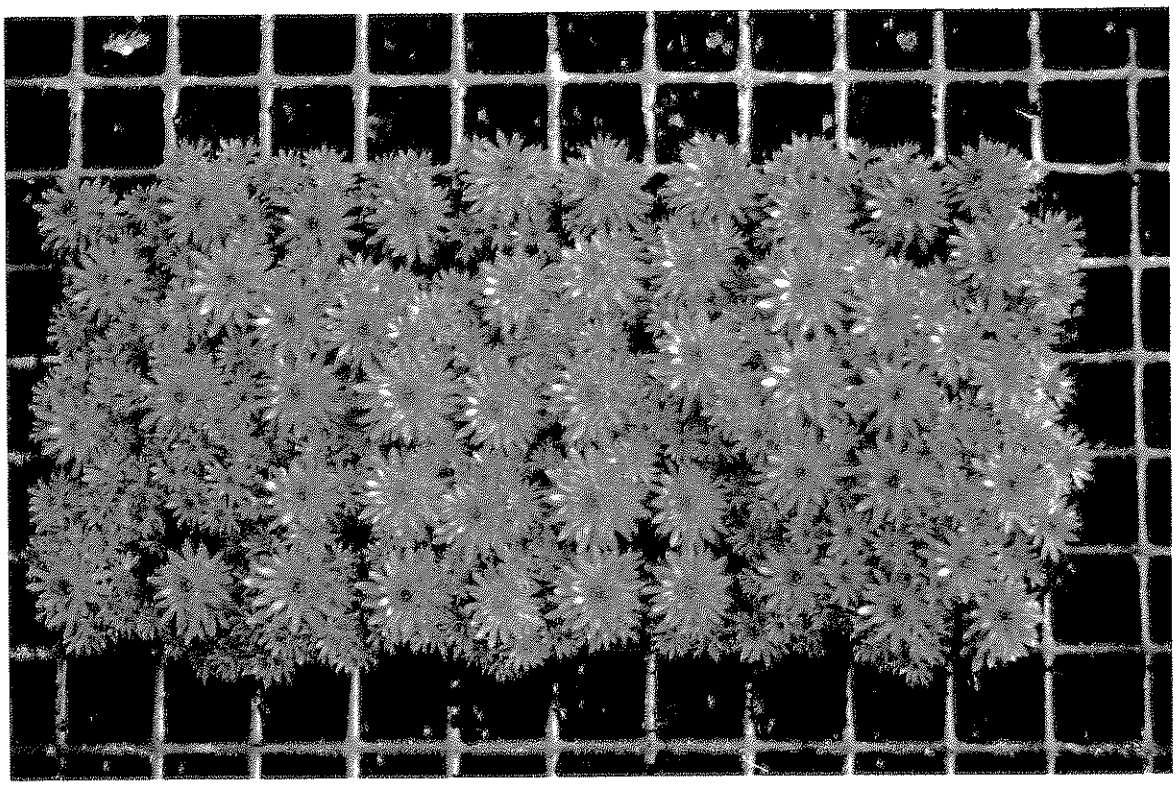
APPENDIX III Plate 6 Mossy Saxifrage

Plant Size (photographed 4 November 1994)

Grade 1

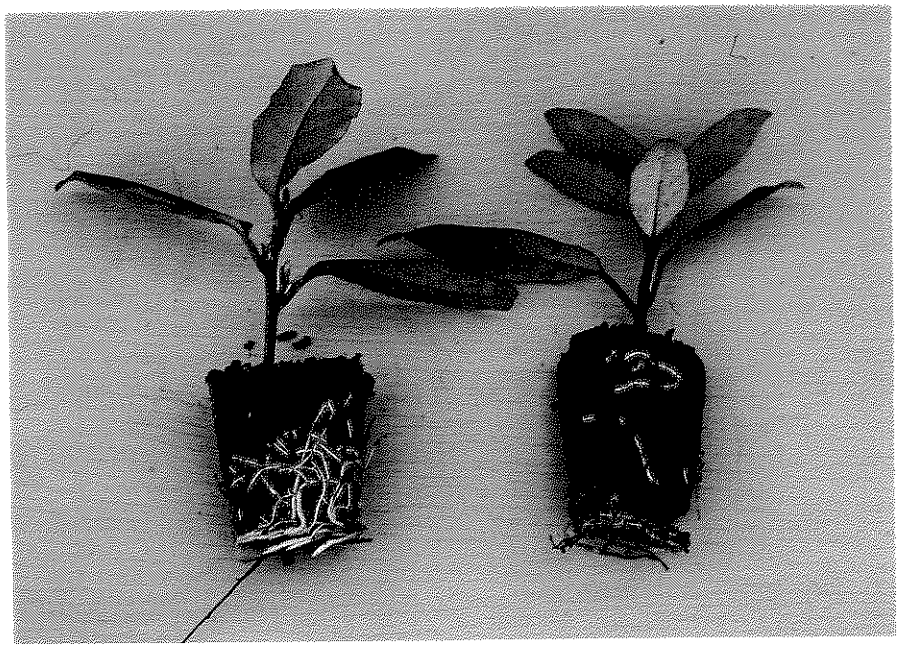


Grade 5



APPENDIX III Plate 7 *Elaeagnus x ebbingei*

(photographed 20 April 1995)

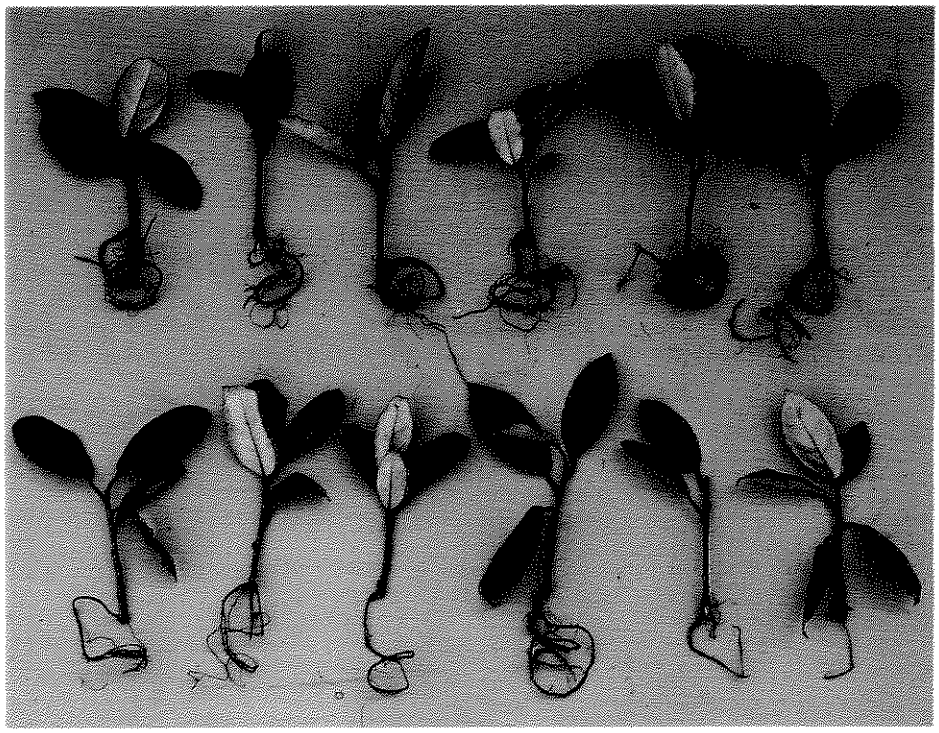


50:50
Coir:Bark

Nil 1500g

Rate suSCon Green g/m³

Rate suSCon
Green g/m³

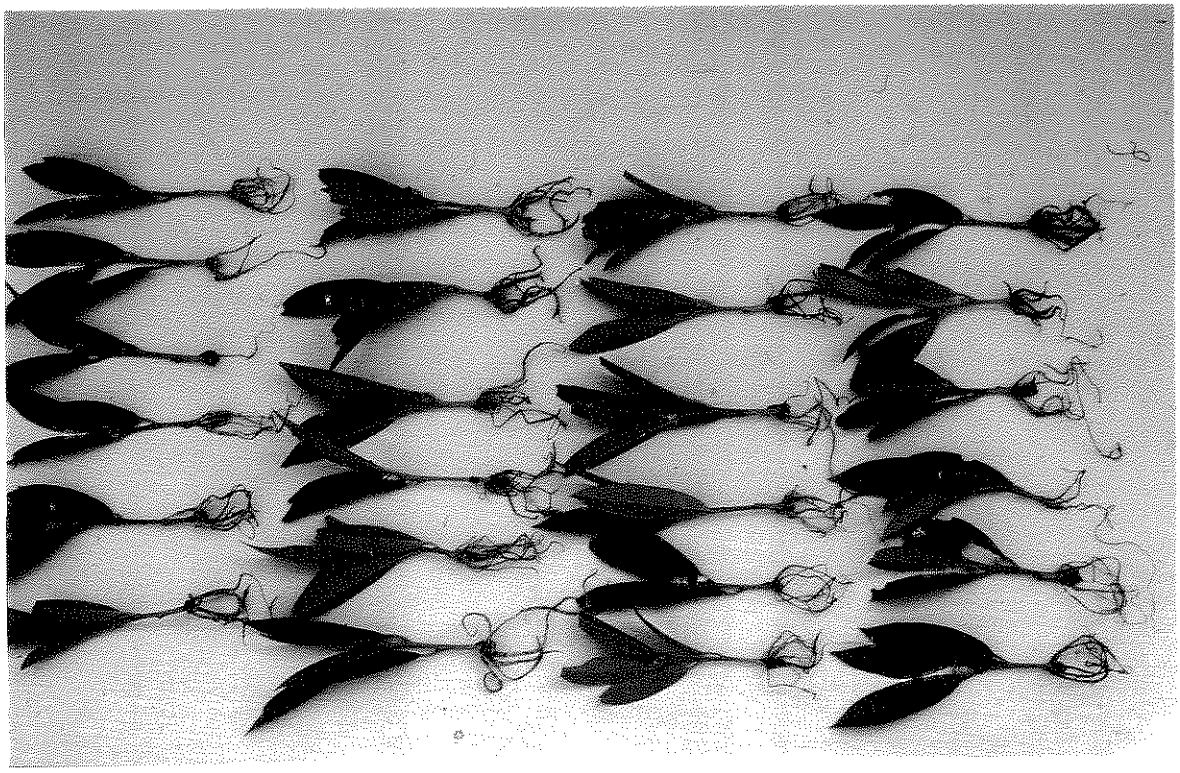


Nil

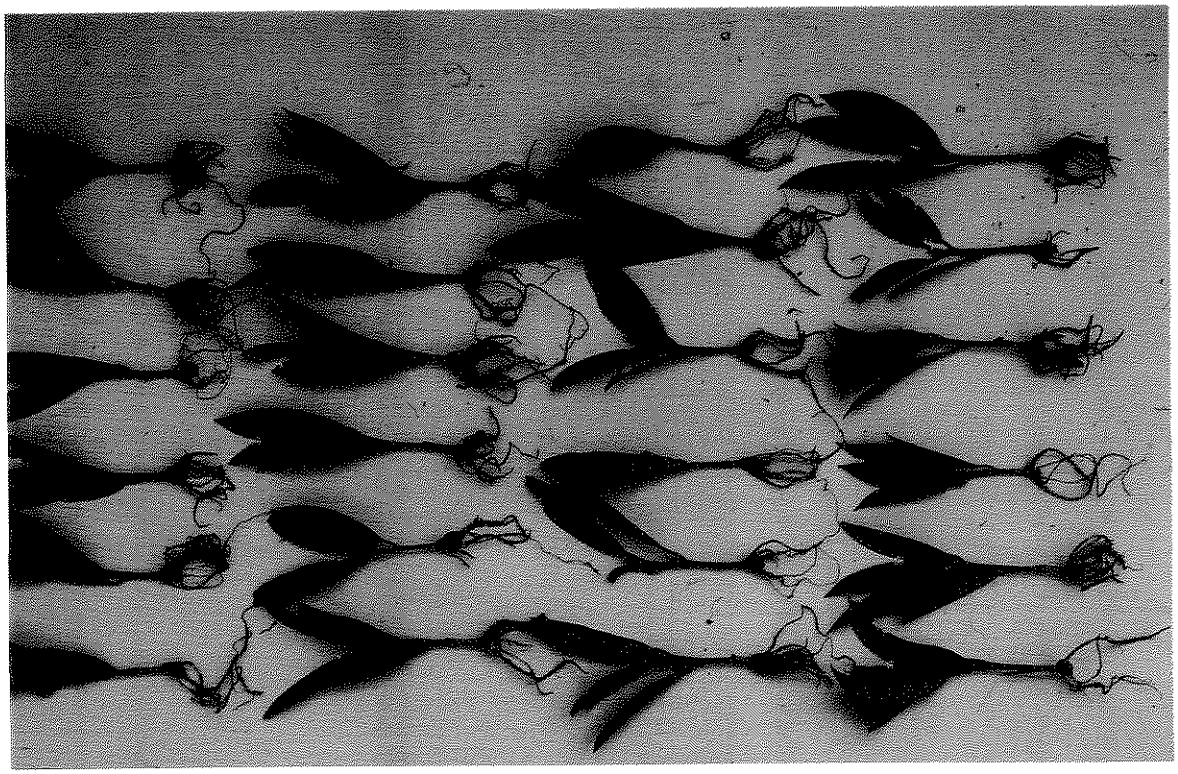
1500g

APPENDIX III Plate 8 *Prunus laurocerasus* 'Otto Luyken'

50:50 Peat:Bark



Rate suSCon Green g/m³	Nil	500g	1000g	1500g



50:50 Coir:Bark

(photographed 19 April 1994)

APPENDIX IV

Contract between HRI (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

1. TITLE OF PROJECT **Contract No: HNS15e**

VINE WEEVIL: EVALUATION OF SUSCON GREEN FOR USE DURING PROPAGATION OF HARDY NURSERY STOCK IN MODULES

2. BACKGROUND AND COMMERCIAL OBJECTIVE

Previous work by ADAS has shown clearly that suSCon Green gives excellent control of vine weevil for at least two seasons if correctly incorporated into growing media at rates of 750 g or 1000 g/m^3.

However, in phytotoxicity screening trials at HRI Efford, some species have shown a degree of sensitivity to the chemical in the form of either reduced top growth or root development.

All trial work to date has started with suSCon Green incorporation at the liner stage or for potting on plugs/liners into larger containers. Propagation by direct sticking of cuttings into various sized modules is increasing, and work has clearly demonstrated the need to protect the early stages of production against vine weevil. Plugs which did not have suSCon Green incorporated suffered vine weevil damage around the stems, even though they were potted on into media treated with suSCon at the recommended rate. Herbaceous and Alpine species were particularly susceptible in this situation. As yet, there is little information as to crop safety or efficacy of suSCon Green when used in the module stage. The possibility of using lower rates of suSCon Green to 'protect' modules also needs considering as a means of reducing the risk of phytotoxicity during propagation, without reducing efficacy.

Use of peat free media for propagation is increasing. Work funded through the HDC Project Nos HNS15a/15b/15c has shown that sensitivity to suSCon Green was greater and/or efficacy reduced in some media. Greatest phytotoxicity was seen in a coir based mix, the least in a peat:pine bark mix.

The HDC project HNS15b which was initially set up to monitor phytotoxicity in liner/final containers across a range of HONS and Herbaceous species was originally due to run for three years. However, it has now been decided that the funds originally allocated for the 3rd year of the project should be re-directed to work on efficacy and phytotoxicity during propagation. Therefore, to make the most effective use of resources and funding it is proposed that a single trial be designed to be jointly sponsored by HDC, Incitec and Fargro.

At present, suSCon Green only has label recommendations for use during potting. This work will enable a decision to be made by the Company as to whether to seek registration for use during propagation.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

To evaluate safety and efficacy of suSCon Green when incorporated in rooting media for propagation in modules.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

See HNS15b/15c.

6. DESCRIPTION OF THE WORK

TREATMENTS

PROPAGATION - HRI Efford

Rooting Media: 50% Peat:50% Pine Bark
50% Coir:50% Pine Bark

All rooting media to contain 0.5 kg/m^3 Osmocote mini granules (5-6 month)

Rate of suSCon Green: Nil
500g/m^3
1000/m^3
1500/m^3

Species/Module Size

	PG 273 (12 mls)	PG 150 (37 mls)	PG 77 (75 mls)	PG54 (105 mls)
Alpine Mossy Saxifrage	✓			
Heather *Erica carnea* 'Sunrise'	✓			
Evergreen *Azalea* 'Rosebud'		✓	✓	✓
Prunus laurocerasus 'Otto Luyken'				✓
~~Herbaceous - Sedum 'Autumn Joy'~~ Hypericum 'Hidcote'		✓	✓	✓

Changed in discussion with HDC, Thatcher and Fargro. All agreed.

-2-

Design : Randomised Block

Mossy Saxifrage/Heather/*Prunus*	*Azalea*/~~Herbaceous~~ Hypericum
2 media	2 media
x	x
4 rates suSCon	4 rates suSCon
—	x
8 treatments	3 module sizes
x	—
4 replicates	24 treatments
—	x
32 plots	3 replicates
—	—
	72 plots
	—

Plot size : ~~45~~ 50 recorded cuttings (Saxifrage, Azalea, Prunus ~~(Heather)~~, 30 for Hypericum.

Method : Nursery stock cuttings will be obtained from clonal stock beds at Efford. The alpine ~~and herbaceous~~ species will have to be bought in.

Cuttings will be rooted under netting enclosed intermittent mist on benches in a glasshouse compartment (J8).

Rooting hormone appropriate to the species will be used as standard.

ASSESSMENTS

1. Time taken for roots to come through the base of the cells
2. % Germination
3. Speed of rooting
4. 10 plugs/plot washed out to record root development
5. Photographs as appropriate

GROWING-ON - HRI EFFORD

10 plants/replicate to be potted-on into 90 mm pots and grown on in a well ventilated polythene roof/netting sided structure on drained sand beds.

Growing media :		100% Shamrock medium Peat	
	+	Osmocote Plus 12-14 Autumn	} rates according
		Magnesian Limestone	} to species
		suSCon Green at 750g/m^3	

Assessments : Spring 1995 (after spring flush of growth)

1. Size/Quality scores of top growth
2. Phytotoxicity symptoms present
3. % root volume over pot-ball
4. Photographs as appropriate

EFFICACY TESTING - ADAS

Only one plant subject is required for the efficacy testing, which needs to be a good host for vine weevil larvae. Material from the Efford trial would be sent to Wolverhampton by mid August 1994 at the latest. The efficacy trial would start immediately.

a. *Species proposed* : Evergreen *Azalea*

b. *Treatments* : As per propagation details for *Azalea*

viz :
2 rooting media
x
4 rates suSCon
x
3 module sizes
—
24 treatment combinations
—

c. *Replication* : 30 plugs/treatment

d. *Vine Weevil egg inoculation* : Minimum of 5 eggs/cell

This would need a total of 3600 eggs.

e. *Granule distribution* : 20 plugs/treatment will be used for counts on the number of suSCon granules per cell, to determine how even the mixing had been.

Based on an average of 1200 granules of suSCon per gramme the following would be expected:

	rate suSCon (g/m^3)		
	500	1000	1500
Cell size			
PG 150 (37 ml)	22	44	67
PG 77 (75 ml)	45	90	135
PG 54 (105 ml)	63	126	189

f. *Sciarid Fly* : Observations on a number of sciarid fly larvae in modules at assessment time would be made, plus a score of any damage by sciarids to roots.

g. *Assessments*

i. Counts of granules per cell as described above.
ii. Counts of surviving vine weevil larvae in December or January, depending on date of egg inoculation.

7. COMMENCEMENT DATE, DURATION AND REPORTING

Start date 01.06.94; duration 1 year.

Propagation (Efford) : June-~~August~~ February 1994/5

Efficacy testing (ADAS) : August-December 1994

Growing-on (Efford): Autumn 1994-late Spring 1995

REPORTING

A joint report would be prepared within 4 weeks of the completion of the assessments of the growing on part of the trial (Spring 1995).

Interim results will be communicated as available.

nb. The trial(s) may be viewed throughout by parties funding the work.

The results would be freely available for use by HDC, Incitec and Fargro.

8. STAFF RESPONSIBILITIES

Project Leaders: M Scott and J Buxton

9. LOCATION

HRI Efford and ADAS Wolverhampton

Efford will be responsible for all propagation and phytotoxicity assessments during this stage. The rooted plugs will then be passed on to ADAS who will inoculate with vine weevil eggs to test efficacy of the various treatments. A small proportion of the rooted plugs will be potted up at Efford and grown on to monitor any further phytotoxicity and efficacy of the treatments against natural infestations of vine weevil.

Contract No: HNS15e
Date: 12.10.94

TERMS AND CONDITIONS

The Council's standard terms and conditions of contract shall apply.

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Council

Signature.....

Position CHIEF EXECUTIVE

Date 12.10.94