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## CONTRACT REPORT

## Container Grown Nursery Stock: Investigation of Use of Controlled Release Fertilizers under Protection

**1991-1993**

**HDC HNS 43**

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## AUTHENTICATION

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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Date ....20/1/95.....

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Final Report July 1994

HDC HNS 43

# Container Grown Nursery Stock: Investigation of Use of Controlled Release Fertilizers Under Protection 1991-1993

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Commenced: August 1991

Completed: November 1993

Key words: Protected Container Nursery Stock, Formulations, Controlled Release Fertilizers, Shelf Life, Extended Release

# RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

## Application

A range of longer term Ficote TE and Osmocote Plus products were investigated for use in autumn potting of a range of species under protection over a two year period without supplementary feeding. The species included the sensitive *Azalea* 'Rose Greeley' and *Pieris* 'Forest Flame' and the more tolerant species *Elaeagnus pungens* 'Maculata'. Extended release products and rates have been identified which provide a balance of safety of use with sufficient nutrition to give good quality plants over a period of two years in the same pot.

## Summary

Nutrition of container nursery stock in the UK relies, in the main, on use of resin coated controlled release fertilizers (CRF). The 6-9 month CRFs, widely used in the 1970s, have generally been superseded by products with 12 to 18 month release patterns capable, in most cases, of providing sufficient nutrients to maintain quality over winter and on into a spring sales period from a single application in the base dressing at potting. Both Ficote and Osmocote have given good results provided the correct formulation and rate was matched with species and production method. MAFF funded screening trials between 1976-87 provided valuable information and guidelines on the use of these fertilizers, many of which were introduced as a result of increased specialism within the industry. Since then other products have become available, including those with trace elements incorporated and formulations with extended release patterns capable of providing nutrients over a two year period. While use of these very long term products may have a limited application for specialist use, they nonetheless could have potential for long term cropping, safer use under protection and where extended shelf life is required.

Protected cropping of hardy nursery stock is steadily increasing with an estimated 200 ha of plants now held under protection for all or part of their production cycle. In addition, many of the species grown under protection fall into the salt sensitive or slow growing categories which are easily stressed by high nutrient availability, the release of which can be increased by the higher temperatures occurring under protection.

Consequently Project HNS43 assessed the use of the range of Osmocote Plus and Ficote TE formulations available, including the 18 to 24 month products, for autumn potting of two species considered to be salt sensitive (*Azalea* 'Rose Greeley' and *Pieris* 'Forest Flame') and the more tolerant *Elaeagnus pungens* 'Maculata'. Rooted cuttings of all species, and micropropagated plugs of *Pieris*, were potted into 2 litre containers in mid August 1991 and grown on under a netting sided/polythene roof multibay structure on drained sand beds with capillary irrigation. The trial continued until October 1993, with plants held in the same container throughout to enable longevity of each fertilizer formulation to be monitored.

## Treatments

| | | *Azalea, Pieris* (salt sensitive) kg/m³ | | *Elaeagnus* (moderate) kg/m³ |
|---|---|---|---|---|
| | | Autumn potting | Spring potting | Autumn potting |
| 1 | Ficote 140 14:8:8 TE | 1 | 1 | 2 * |
| 2 | Ficote 140 14:8:8 TE | 2 * | 2 * | 3 |
| 3 | Ficote 140 14:8:8 TE | 3 | 3 | 4 |
| 4 | Ficote 180 14:8:8 TE | 2 | 2 | 3 * |
| 5 | Ficote 180 14:8:8 TE | 3 * | 3 * | 4 |
| 6 | Ficote 180 14:8:8 TE | 4 | 4 | 5 |
| 7 | Ficote 270 14:8:8 TE | 3 | 3 ** | 4 |
| 8 | Ficote 270 14:8:8 TE | 4 | 4 | 5 |
| 9 | Ficote 270 14:8:8 TE | 5 | 5 | 6 |
| 10 | Ficote 360 14:8:8 TE | 4 ** | 4 | 5 ** |
| 11 | Ficote 360 14:8:8 TE | 5 | 5 ** | 6 |
| 12 | Ficote 360 14:8:8 TE | 6 | 6 | 7 |
| 13 | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | 1 | 1 | 2 |
| 14 | Osmocote Plus, 8-9 months | 2 * | 2 * | 3 |
| 15 | Osmocote Plus, 8-9 months | 3 | 3 | 4 * |
| 16 | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | 2 | 2 * | 3 |
| 17 | Osmocote Plus, 12-14 months, Spring | 3 * | 3 * | 4 |
| 18 | Osmocote Plus, 12-14 months, Spring | 4 | 4 | 5 * |
| 19 | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | 3 * | 3 * | 4 |
| 20 | Osmocote Plus, 12-14 months, Autumn | 4 | 4 | 5 * |
| 21 | Osmocote Plus, 12-14 months, Autumn | 5 | 5 | 6 |
| 22 | Osmocote 16-18 months 16+8+9+3MgO | 4 * | 4 * | 7 |
| 23 | Osmocote 16-18 months | 5 | 5 | 8 * |
| 24 | Osmocote 16-18 months | 6 | 6 | 9 |

* 1991 recommended rates. Where a range of rates was given, the lower has been taken as the recommended rate since this trial used rooted cuttings potted direct into 2 litre containers.

** Recommendations for Ficote 270 and 360 TE came out after the start of the trial, and the lowest rate for each is at the higher end of the recommended range, especially when considering potting rooted cuttings direct into 2 litre containers.

The main results from the work can be summarised as follows:

## Establishment

*Azalea* **'Rose Greeley'** proved particularly sensitive to salt levels and establishment from the late summer potting was poor across all treatments. Consequently, this species was repotted from a later strike of cuttings in spring 1992, when 100% establishment was achieved in all but the highest rate of fertilizers. *Azalea* 'Blue Danube', used as guard plants, was less sensitive to nutrient levels and no problems were encountered in establishing this variety in the late summer potting across the range of fertilizers/rates used.

*Pieris* **'Forest Flame'** established and grew well over the first winter, but suffered severe scorch damage/death in the following spring, particularly in the higher rates of all Osmocote formulations. These effects gradually worsened over time, suggesting that irreversible root damage had occurred. The micropropagated *Pieris* plugs appeared more sensitive than the conventionally propagated cuttings.

The poor establishment of the salt sensitive species from the late summer potting was felt to be due to a number of factors. Firstly, the late potting meant that considerable reserves remained in the fertilizers, which would continue to release under the fluctuating temperatures under protection. Nutrients would have accumulated over the autumn/winter period as plants were on capillary sand beds with minimal leaching. (The routine of flushing pots through with plain water at intervals was not continued over the winter due to the danger of overwatering.) Secondly the cutting, as opposed to liner stage would have been more sensitive to accumulating nutrients, particularly as they would not have become fully established from the late potting prior to the winter.

*Elaeagnus pungens* **'Maculata'** established well regardless of type or rate of fertilizer. However, while early growth in most fertilizers was similar, that in Osmocote 16-18 month was poor and appeared to be related to the faster release of nutrients in this material. This particular formulation has now been replaced by an Osmocote Plus 16-18 month formulation.

## Growth

Overall the recommended rate of fertilizer for each formulation has produced good results within the specified longevity of each formulation. Osmocote Plus 8-9 months and Ficote 140 TE started to run out first, as monitored by foliage paling, and plants in these mixes would have required a top dressing overwinter plus liquid feeding in the second year to maintain growth and quality, particularly from the late summer potting. Osmocote Plus 12-14 and Ficote 180 TE provided nutrient reserves into the early part of the second season, when they too would have needed liquid feeding to maintain quality and growth. The Ficote 270 and 360 TE formulations

clearly demonstrated their ability to maintain plant growth and quality over two growing seasons, with Ficote 360 TE having sufficient reserves to hold quality over a further period for extended shelf-life.

With *Azalea* good results were achieved with 3-4 kg/m$^3$ of Ficote 270 TE and 4-5 kg/m$^3$ of Ficote 360 TE, with the 360 TE formulation providing additional shelf-life. Although problems were encountered with Osmocote 16-18 months for the late summer potted crops, this formulation produced good results over the 18 month period for the spring potted *Azalea* crop at 5-6 kg/m$^3$, after which foliage began to pale.

Leaf tip scorch was a problem with *Pieris* **'Forest Flame'** and increased with rate within each formulation. *Pieris* appears to have a low nutrient requirement with best growth and minimal leaf scorch 18 months after potting obtained in the lowest rate of Osmocote Plus 8-9 months and Ficote 140 TE (1 kg/m$^3$). However, these treatments then rapidly ran out of steam and would have required liquid feeding. The leaf tip scorching problem needs further investigation since it can also occur in plants which are showing starvation symptoms. The best results after two growing seasons were obtained in Ficote 270 TE (3 kg/m$^3$) and Ficote 360 TE (4 kg/m$^3$).

For *Elaeagnus pungens* **'Maculata'** good results were achieved after two seasons growth in the same container in Osmocote Plus 12-14 months Autumn (4 kg/m$^3$) and Ficote 180, 270 or 360 TE (5 kg/m$^3$). The extended release Ficote 270, and especially 360, would provide greater shelf-life potential at the equivalent rate. Improved shelf-life in the extended release formulations was obtained as rates increased; up to 6 kg/m$^3$ for Ficote 270 TE and 7 kg/m$^3$ for Ficote 360 TE.

## Summary

The trial has provided valuable information on the performance of various Ficote and Osmocote formulations under protected cropping conditions for a number of salt sensitive and tolerant species, particularly in respect of safety of use at different times of the year and longevity. Results with the Ficote 360 TE, in particular, have identified the potential of this extended release material to supply the total nutrient requirement of specialist plants grown under protection in the same container over two growing seasons. The trial also highlighted the care needed when handling salt sensitive species, especially rooted cuttings, with potting of these best done in the spring. Many other potting options exist and need testing, including seeing if the response to extended release fertilizers is the same if starting with established liners instead of rooted cuttings.

## Future Work

A new trial, HNS43a, under HDC, Levington Horticulture Ltd and Scotts UK Ltd sponsorship, will be assessing the use of this range of CRFs in the outdoor situation for a spring potted crop. Because of the potential response difference depending on geographical location, part of the trial will be conducted on a northern nursery site at Johnsons of Whixley.

## ACTION POINTS

- Rooted cuttings of salt sensitive species are best potted in the spring, as opposed to autumn, where nutrient accumulation overwinter can cause severe problems.

- Osmocote 8-9 month and Ficote 140 in general will require supplementary feeding after the first growing season.

- Osmocote 12-14 month and Ficote 180 can provide sufficient nutrient reserves to maintain quality over the winter period and into spring sales. When potting in the late summer/autumn the Osmocote Plus 12-14 months formulation should be used in preference to the Spring formulation.

- Where plants are grown in the same container over two growing seasons then the extended release Ficote 270 and 360 formulations have demonstrated the capability of supplying sufficient nutrients to give good quality plants over this period.

- The potential of the extended release formulations includes safer use under protection at rates which will provide adequate nutrition over an extended cropping period for salt sensitive species, together with improved shelf-life capabilities and potential for improving establishment following planting.

- Consider growing *Pieris* 'Forest Flame' in a very low rate of a shorter term fertilizer and liquid feed in the second year to reduce the risk of leaf tip scorch.

# EXPERIMENTAL SECTION

## INTRODUCTION

The investigation of plant response to controlled release fertilizers (CRFs) formed an important component of the Efford programme up until 1987, at which point MAFF funding was reduced and finally withdrawn. However, with UK container production based largely on the use of different CRFs and with the new range of products now available, including those with longer term release patterns, further investigation was commissioned through the HDC.

Production under protection has increased rapidly over the past five years with an estimated 200 ha of container nursery stock under protection for all or part of their production cycle. Protected plants grown for long periods of time in the same container include high value, slow growing species, which also tend to be salt sensitive and easily stressed by high nutrient availability. Any sudden release of nutrients due to high temperatures could be extremely damaging. The newer range of longer term Ficote TE and Osmocote Plus materials now available may prove to be safer options to use in this situation, while still providing sufficient nutrients to sustain quality growth over the season. The longest term products, Osmocote 16-18 months, Ficote 270 TE and Ficote 360 TE could also provide release well into the second year, avoiding the need for liquid feeding.

The range of longer term CRFs available in 1991, plus the Ficote 270 TE and 360 TE which were included in the trial under funding from Fisons plc prior to their market launch in 1992, were investigated for autumn potting of a range of species grown under a polythene roof/netting sided multi-bay structure with plants held for two years in the same container.

## OBJECTIVE

To compare the performance of the Ficote TE and Osmocote Plus range of controlled release fertilizers for salt sensitive and moderate vigour species under protection held in the same container for two years.

# MATERIALS AND METHODS

## Production System

Plants were grown under protection in a multispan net sided polythene tunnel on capillary sandbeds.

## Treatments

| | | *Azalea, Pieris* (salt sensitive) kg/m³ | | *Elaeagnus* (moderate) kg/m³ |
|---|---|---|---|---|
| | | Autumn potting | Spring potting | Autumn potting |
| 1 | Ficote 140 14:8:8 TE | 1 | 1 | 2 * |
| 2 | Ficote 140 14:8:8 TE | 2 * | 2 * | 3 |
| 3 | Ficote 140 14:8:8 TE | 3 | 3 | 4 |
| 4 | Ficote 180 14:8:8 TE | 2 | 2 | 3 * |
| 5 | Ficote 180 14:8:8 TE | 3 * | 3 * | 4 |
| 6 | Ficote 180 14:8:8 TE | 4 | 4 | 5 |
| 7 | Ficote 270 14:8:8 TE | 3 | 3 ** | 4 |
| 8 | Ficote 270 14:8:8 TE | 4 | 4 | 5 |
| 9 | Ficote 270 14:8:8 TE | 5 | 5 | 6 |
| 10 | Ficote 360 14:8:8 TE | 4 ** | 4 | 5 ** |
| 11 | Ficote 360 14:8:8 TE | 5 | 5 ** | 6 |
| 12 | Ficote 360 14:8:8 TE | 6 | 6 | 7 |
| 13 | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | 1 | 1 | 2 |
| 14 | Osmocote Plus, 8-9 months | 2 * | 2 * | 3 |
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| 19 | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | 3 * | 3 * | 4 |
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| 23 | Osmocote 16-18 months | 5 | 5 | 8 * |
| 24 | Osmocote 16-18 months | 6 | 6 | 9 |

* 1991 recommended rates. Where a range of rates was given, the lower has been taken as the recommended rate since this trial used rooted cuttings potted direct into 2 litre containers.

** Recommendations for Ficote 270 and 360 TE came out after the start of the trial, and the lowest rate for each is at the higher end of the recommended range.

## Species

*Azalea japonica* 'Rose Greeley'
*Pieris japonica* 'Forest Flame' - Micropropagated plugs
*Pieris japonica* 'Forest Flame' - Rooted cuttings
*Elaeagnus pungens* 'Maculata'

## Growing Medium

| | |
|---|---|
| Shamrock Medium Irish Peat | 100% |
| CRF as per treatment | |
| Magnesian limestone | 1 kg/m$^3$ |

Treatments 22, 23 and 24 (Osmocote 16-18 month): 300g/m$^3$ Fritted trace element WM255

## Pot Size

2 litre containers

## Start Material

The *Azalea*, *Elaeagnus* and one batch of *Pieris* were clonal cuttings from Efford stock beds rooted over the winter of 1990/91. The *Pieris* from micropropagated material was produced at Efford with well rooted plug plants used for potting-on.

## Start Date

*Autumn potting*: Plants were potted between 6 and 13 August 1991 and placed out on the beds on 5 and 6 September 1991.

*Spring potting*: The poor establishment of the *Azalea* 'Rose Greeley' led to this species being re-potted on 10 April 1992 using cuttings rooted over the winter of 1991/92.

## Design

Each species was set out in a randomised block layout with 3 replicates and 24 treatments fully randomised within each replicate (Appendix I, page 41).

Each plot comprised six recorded plants guarded by two plants on each end of the row.

## Records

A. **Growth Records:** April/May 1992
November 1992
April/May 1993
October 1993

Including, as appropriate, plant size score, foliage colour score, plant vigour score (based on strength and health of top growth), % plants dead, % root cover over pot ball, foliage scorch score on young or old growth, leaf drop score, flower score, quality score (based on above scores plus plant structure), flush stage score (based on how advanced the new growth was).

Plant scores were subjective, made by visual comparison against selected standards at each time of taking a record. Photographs of some of these 'standard' plants can be seen in Appendix V, page 68. The % root cover was a visual assessment of the amount of root covering the outside of the root ball. Examples of these may also be found in the above Appendix.

B. **Growing Media Analysis:** Samples analysed by ADAS, November 1992

C. **Growing Media Temperature Measurements:** These were recorded at 90 minute intervals throughout the trial using a Grant Squirrel Digital Logger. Daily means have been calculated and graphed in Appendix III, page 58.

D. **Photographs:** Photographs of trial layout, selected standards for growth record scores and treatment comparisons at end of trial were taken and can be seen in Appendix V, page 69.

## Statistical Analysis

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

# RESULTS

## *AZALEA JAPONICA* 'ROSE GREELEY'

### Autumn Potting Results

The *Azalea* 'Rose Greeley' potted in autumn 1991 established poorly, with a high number of deaths in some treatments by spring 1992 and plants of very poor quality in other treatments (Appendix II, page 42). In general it was the higher rates of all treatments in which plants suffered most. The *Azalea* was, therefore, repotted on 10 April 1992 using a new batch of rooted cuttings. These plants were cut back in spring 1993 to allow assessment of the new flush of growth in June.

In contrast, the *Azalea* 'Blue Danube', used for the guard plants, established satisfactorily across the different fertilizer treatments from the late summer potting.

### Spring Potting Results

These results and their statistical significance may be seen in Appendix II, tables 2 to 4, pages 43 to 45. The size and colour scores and % death have been presented graphically in Figures 1 and 2, pages 13 and 14.

***Ficote 140 TE***: *Azalea* in all rates of Ficote 140 TE grew well over the first summer and had produced large, vigorous plants of good colour by November 1992. Normally these plants would have been liquid fed in the second season but here they were left to monitor CRF longevity and by June 1993 plants were smaller and paler compared to the longer term CRF treatments. During the latter half of the summer plants started dying with losses of 8%, 17% and 33% in the low, medium and high rates respectively. The surviving plants in the lower rates were very small and of poorer quality by autumn 1993.

***Ficote 180 TE***: *Azalea* grown in the low rate of Ficote 180 (2 kg/m$^3$) was of a good size throughout the trial but somewhat paler in colour until the final record where the colour compared favourably to plants in the other treatments. Plants in the highest rate of Ficote 180 were smaller by comparison in November 1992 with a lower vigour score, suggesting this rate was too high. These plants remained comparatively small throughout the trial and had started paling by June 1993; 25% of the plants had died by the end of the trial. Plants in the medium rate were also small after the first summer, but their size had improved in June 1993, and they were of a reasonable colour in October 1993.

*Ficote 270 TE*: By November 1992 growth of *Azalea* in all rates of Ficote 270 was similar to that produced in the 140/180 TE mixes. The slightly paler colour in the lowest rate (3 kg/m$^3$) and poorer root development in the highest rate (5 kg/m$^3$) did not prove significant. By June 1993, 14 months after potting, growth overall appeared somewhat better in the 270 TE mixes, and while at this stage size differences did not prove significant, there was a significant improvement in colour at the two higher rates of Ficote 270 TE compared with plants in the low and medium rate 140/180 TE mixes. By October 1993, 18 months after potting, plants in the 270 TE mixes were significantly larger, with greater vigour in the new shoot growth than in the shorter term materials, though foliage had begun to pale. However, 33% of the plants in the highest rate (5 kg/m$^3$) had died by the end of the trial.

*Ficote 360 TE*: Results in the Ficote 360 TE were essentially similar to those in the 270 TE mixes over the 18 month duration of this crop, with good growth achieved up until June 1993 at all rates. A reduction in plant size in the highest rate (6 kg/m$^3$) observed by June 1993 and again in October 1993 did not prove significant, though by the end of the trial 25% of the plants had died in this treatment. Again while not significant plant size and colour appeared somewhat poorer in the lowest rate (4 kg/m$^3$) by October 1993. This effect was substantiated when plants were held beyond October 1993, with shoot vigour and colour holding better in the 5-6 kg/m$^3$ rate of 360 TE than in the 4 kg/m$^3$, confirming the potential of this product to maintain shelf-life over an extended period.

*Osmocote Plus 8-9 month*: Results in this formation were poor even over the first growing season. The 1 kg/m$^3$ rate produced plants of a reasonable size by November 1992, but their colour was significantly paler than other rates or mixes, and while colour improved as rate increased this was accompanied by a successive reduction in plant size and a loss of over 20% of the plants. By the end of the trial plant deaths in the highest rate (3 kg/m$^3$) had risen to 50%. Although a reasonable flush of growth was produced by June 1993, all but the highest rate produced significantly paler foliage than other Osmocote Plus formulations. Not surprisingly with this single season product, plant growth and quality had deteriorated significantly by October 1993.

*Osmocote Plus 12-14 months Spring*: Good growth was achieved over the first season at the 2-3 kg/m$^3$ rates, with 3 kg/m$^3$ producing the darkest foliage in the trial at this stage. An apparent check in growth at the highest rate (4 kg/m$^3$) was not significant by November 1992, but had become significant by June 1993. 10% plant losses were recorded over the first year in the higher rates, but this had increased to 58% in the 4 kg/m$^3$ rate by the end of the trial. While a reasonable flush of growth was produced in the 2-3 kg/m$^3$ mixes by June 1993, significant paling of foliage was occurring, particularly at the lower rate, compared with the longer term formulations. Overall quality was poor by October 1993.

*Osmocote Plus 12-14 months Autumn*: Results in this formulation were comparable to those in the Spring formulation over the first season, although foliage colour in the 3 kg/m$^3$ mix was significantly paler than the highest rate and the equivalent rate of the Spring formulation. No growth check was seen with the Autumn formulation at the higher rates, and by June 1993 plants in 4 kg/m$^3$ were significantly better in the Autumn compared with the Spring mix. However, the best quality plants were produced in 5 kg/m$^3$ where foliage colour was significantly darker, and on a par with the higher rates of the longer term formulation. By midsummer, though, even plants in this higher rate were beginning to pale and by October were paler and significantly smaller than the longer release materials. While plants established and grew satisfactorily over the first year, some loss of plants occurred over the final summer, with 25% of the deaths occurring in the lowest rate treatment (3 kg/m$^3$).

*Osmocote 16-18 months*: Plants in all rates were of good size and vigour with good root growth after the first summer, although the low rate (4 kg/m$^3$) was significantly paler than those at 6 kg/m$^3$ at this point. All plants grew well in spring 1993, though the low rate now had significantly paler foliage than both the two higher rates. By October 1993 the medium and high rates of Osmocote 16-18 months had produced the largest plants in the trial with the high rate (6 kg/m$^3$) also having a good colour. The plants were all of good quality in autumn 1993 and very few deaths were seen in this formulation.

# KEY

## Treatments

| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 kg/m$^3$ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 kg/m$^3$ |
| | H | Ficote 140 14:8:8 TE | @ | 3 kg/m$^3$ |
| | L | Ficote 180 14:8:8 TE | @ | 2 kg/m$^3$ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 kg/m$^3$ |
| | H | Ficote 180 14:8:8 TE | @ | 4 kg/m$^3$ |
| | L | Ficote 270 14:8:8 TE | @ | 3 kg/m$^3$ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 kg/m$^3$ |
| | H | Ficote 270 14:8:8 TE | @ | 5 kg/m$^3$ |
| | L | Ficote 360 14:8:8 TE | @ | 4 kg/m$^3$ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 kg/m$^3$ |
| | H | Ficote 360 14:8:8 TE | @ | 6 kg/m$^3$ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 kg/m$^3$ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 kg/m$^3$ |
| | H | Osmocote Plus, 8-9 months | @ | 3 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 kg/m$^3$ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 kg/m$^3$ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m$^3$ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 kg/m$^3$ |
| 16-18 | M | Osmocote 16-18 months | @ | 5 kg/m$^3$ |
| | H | Osmocote 16-18 months | @ | 6 kg/m$^3$ |

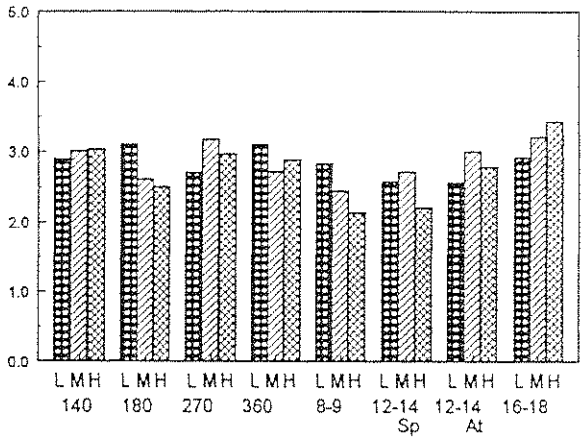
# *Azalea* 'Rose Greeley' Spring 1992 Potting

Figure 1

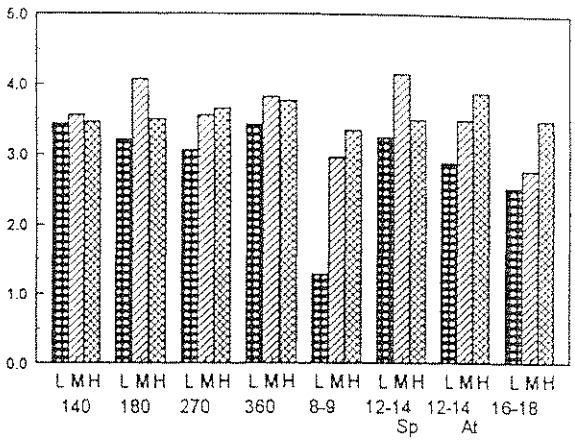
Mean Size Score
1-5,5=largest

Mean Colour Score
1-5, 5=Darkest green

November 1992




November 1992

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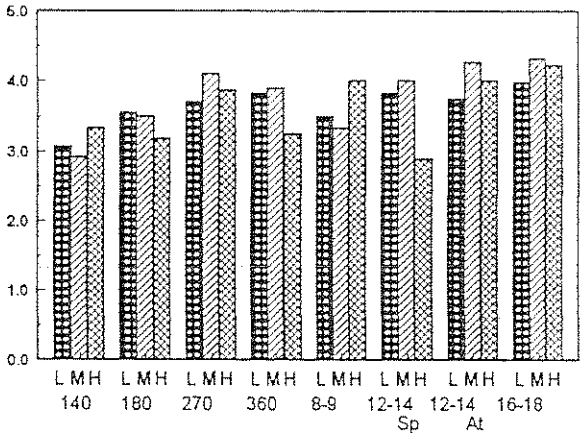


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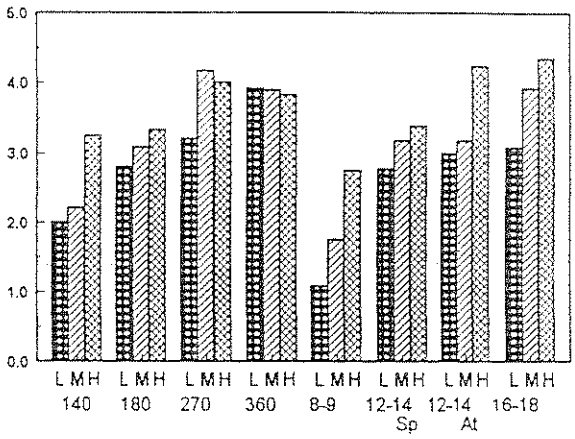
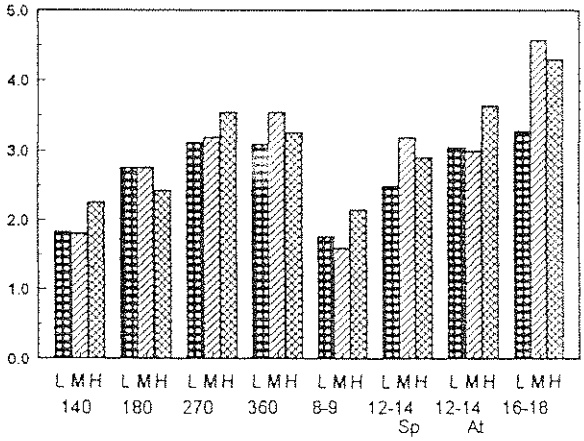



October 1993

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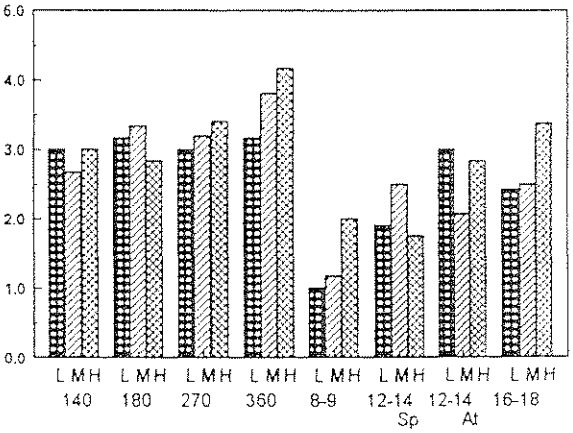


# KEY

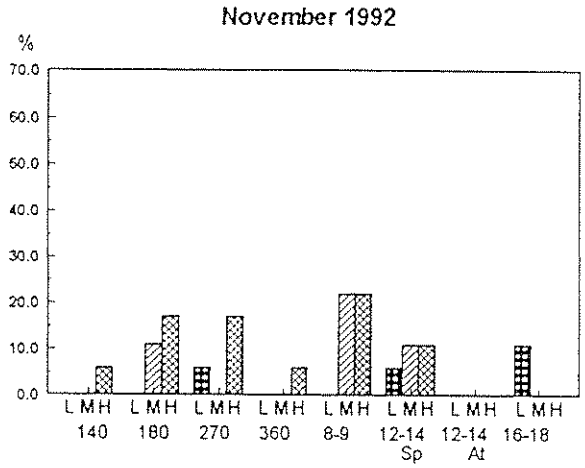
## Treatments

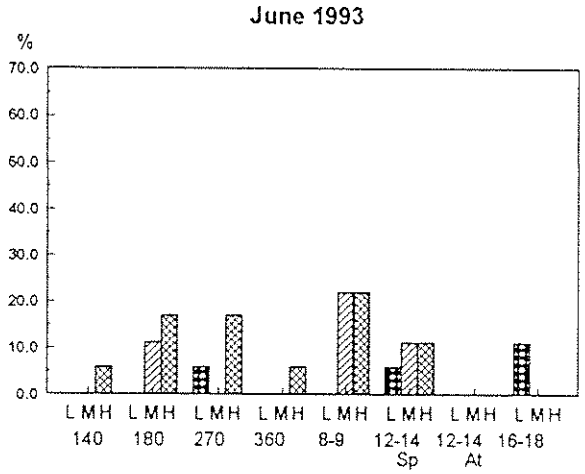
| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 kg/m$^3$ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 kg/m$^3$ |
| | H | Ficote 140 14:8:8 TE | @ | 3 kg/m$^3$ |
| | L | Ficote 180 14:8:8 TE | @ | 2 kg/m$^3$ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 kg/m$^3$ |
| | H | Ficote 180 14:8:8 TE | @ | 4 kg/m$^3$ |
| | L | Ficote 270 14:8:8 TE | @ | 3 kg/m$^3$ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 kg/m$^3$ |
| | H | Ficote 270 14:8:8 TE | @ | 5 kg/m$^3$ |
| | L | Ficote 360 14:8:8 TE | @ | 4 kg/m$^3$ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 kg/m$^3$ |
| | H | Ficote 360 14:8:8 TE | @ | 6 kg/m$^3$ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 kg/m$^3$ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 kg/m$^3$ |
| | H | Osmocote Plus, 8-9 months | @ | 3 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 kg/m$^3$ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 kg/m$^3$ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m$^3$ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 kg/m$^3$ |
| 16-18 | M | Osmocote 16-18 months | @ | 5 kg/m$^3$ |
| | H | Osmocote 16-18 months | @ | 6 kg/m$^3$ |

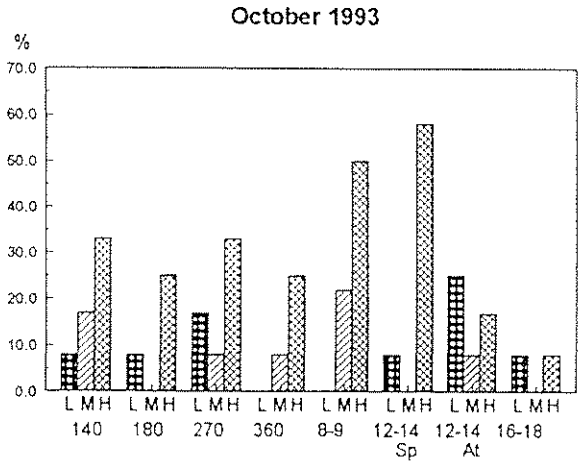
Figure 2

# *Azalea* 'Rose Greeley' Spring 1992 Potting

% Dead



**Summary:** ***Azalea*** **'Rose Greeley'**

In contrast to the late summer potted crop where plants failed to establish satisfactorily, regardless of treatment, no such problems were encountered with the spring potting which established well and grew away strongly. This variety of *Azalea* is considered to be particularly salt sensitive and relatively poor root development after the August potting, together with accumulation of nutrient levels on the capillary sand beds, were no doubt contributory factors to the problem.

With re-potting this crop was only taken over a period of 18 months. The best results overall, in terms of growth and foliage colour, were obtained in Ficote 360 TE at 5-6 kg/m$^3$, followed by Osmocote 16-18 months at 5-6 kg/m$^3$. Ficote 270 TE at 5 kg/m$^3$ also produced good results but had suffered greater losses over the second season. The better foliage colour in the Ficote 360 TE mixes became more apparent in plants held over after the trial had finished. Osmocote Plus 12-14 months Autumn had also produced good results at 5 kg/m$^3$ by the end of the trial, though foliage colour was paler by this time than the extended release materials. The recommended rates of the shorter term materials generally produced reasonable results over the first season, but thereafter would have required liquid feeding to maintain quality.

With the exception of Osmocote Plus 12-14 months Autumn and Osmocote 16-18 months, the higher rates of all other formulations caused unacceptably high plant losses. This did not manifest itself until the second summer, 14 months after potting, suggesting either a cumulative or carry over effect from the earlier stages of growth, though this was not always backed up by any significant reduction in root development in these treatments in the first growing season.

## *PIERIS JAPONICA* 'FOREST FLAME'

These results and their statistical significance can be found in Appendix II, tables 5-12, pages 46 to 53. The size and colour scores plus % deaths have been presented graphically in Figures 3 and 4 (rooted cuttings) and 5 and 6 (micropropagated plugs), pages 20 to 23.

### *Ficote 140 TE*

***Rooted cuttings***: All cuttings appeared to establish well over the first winter with the most vigorous plants by April 1992 in the lowest rate of 1 kg/m$^3$. Plants in the higher rates were significantly smaller with less root development and some leaf drop. However, as plants grew away in the spring leaf scorch and drop increased with a number of plants in the higher rates dying. These plant losses continued to occur over the following summer and winter periods with losses of 10 and 22% for the 2 and 3 kg/m$^3$ respectively by April 1993. No further losses occurred over the final season. The lowest rate continued to give good growth until April 1993, by which time foliage had started to pale and by October 1993 plants were very starved. The surviving plants in the highest rate (3 kg/m$^3$) were still of good size and foliage colour by the end of the trial, 26 months after potting, but had significantly less flowers than the lower rates.

***Micropropagated plugs***: Results were essentially similar to those observed with the rooted cuttings with the lowest rate of 1 kg/m$^3$ producing the best early growth, but with higher rates needed to provide sufficient nutrients for maintaining growth beyond the first year, which proved damaging. However, this micropropagated material proved considerably more sensitive to fertilizer rate than the rooted cuttings, with a greater degree of leaf scorch and drop and less root development by comparison. Again, while all plants appeared to establish over the first winter, plant deaths occurred in the higher rates of Ficote 140 TE as plants tried to grow away in the subsequent spring/summer period.

### *Ficote 180 TE*

***Rooted cuttings***: *Pieris* in the lowest rates of Ficote 180 TE (2 kg/m$^3$) established well, producing good plants by April 1992. Root development was also better at the lower rate at this stage, but all rates produced a better early root system than Ficote 140 TE. The highest rate of 4 kg/m$^3$ appeared excessive with significant reduction in top and root growth and vigour compared with plants in 2 kg/$^3$. While tip scorch and leaf drop increased as new growth occurred in the spring/summer of 1992, no plant deaths occurred until April 1993 where losses of 6, 17 and 33% were recorded as rate of fertilizer increased. By this time plants in the lower rates were falling behind, particularly the 2 kg/m$^3$ rate which had the poorest colour. At this point growth of the surviving plants in the highest rate (4 kg/m$^3$) improved and final size and colour by the end of the trial was still reasonable, though root growth was somewhat less than in the lower rates.

*Micropropagated plugs*: The pattern of results, while similar to that of the rooted cuttings was accentuated with this material, with a greater degree of leaf tip scorch and drop occurring as rate of fertilizer increased. Again plant losses were minimal over the first winter, but became severe over the first full growing season in the higher rates (33 and 67% respectively). Losses continued over the second winter in the highest rate to 78%. The best growth was produced in the lowest rate of 2 kg/m$^3$, but in contrast to the rooted cuttings foliage colour was maintained throughout the trial in all rates. Flowering was also less in the micropropagated material.

*Ficote 270 TE*

*Rooted cuttings*: While plants appeared to establish in all rates only those in the lowest (3 kg/m$^3$) grew satisfactorily, comparing favourably with the better treatments in other long term formulations throughout the trial. The higher rates proved excessive for this species with eventual losses of 44% rising to 61% at 5 kg/m$^3$. Prior to these losses both vigour and root development were poorer as rate increased, and while the surviving plants in the medium rate gradually caught up over the two year period, those in 5 kg/m$^3$ remained significantly smaller with markedly poorer root development than the lower rates of this formulation.

*Micropropagated plugs*: In contrast to the 140/180 TE formulations, effects of rate of fertilizer were less obvious with the micropropagated material compared to rooted cuttings, and losses were less severe with only 28% of the plants dying at 4 and 5 kg/m$^3$ compared with the 44 and 61% in the rooted cuttings. Tip scorch was, however, severe. In view of the potential sensitivity of micropropagated material to nutrient stress, as observed in the other formations, it was surprising that root development was apparently unaffected by increasing rates of Ficote 270 TE. Growth was initially slower in the highest rate of 5 kg/m$^3$, but excellent final plant quality, size, vigour and colour was achieved in all rates. Far less flower was produced on the micropropagated plants compared to the rooted cuttings.

*Ficote 360 TE*

*Rooted cuttings*: Both the 4 and 5 kg/m$^3$ had produced good plants over the first winter and growth and quality was maintained throughout 1992. However, by April 1993 33% of the plants in 5 kg/m$^3$ had died. The 6 kg/m$^3$ rate proved too high, with the loss of 78% of the plants by April 1993. This formulation at 4 kg/m$^3$ had produced some of the best quality plants by the end of the trial.

*Micropropagated plugs*: As with the 140/180 TE formulations results followed a similar pattern to the rooted cuttings with the lowest rate (4 kg/m$^3$) producing the best overall results in terms of growth and quality, with few losses. As with the cuttings the highest rate (6 kg/m$^3$) reduced vigour and root growth over the first year of the trial and by April 1993 67% of the plants had died. The surviving plants were of excellent quality which was maintained to the end of the trial.

*Osmocote Plus 8-9 months*

***Rooted cuttings***: Plants in the lowest rate (1 kg/m$^3$) established well and had produced good plants by April 1992. These plants had started to lose some of their vigour by November 1992 but were still a good size the following spring, and although foliage was somewhat paler than other treatments, it was still considered reasonable. Thereafter plant quality deteriorated rapidly as nutrient availability became limiting, though conversely flowering increased. Plant size, vigour and root development decreased as rate of fertilizer increased in the first year, with a corresponding increase in leaf scorch and drop, and losses of 67% were recorded in the 3 kg/m$^3$ rate over the summer of 1992. Losses of 28% had also occurred in the 2 kg/m$^3$ rate by spring 1993. The apparent improvement in plant size at 4 kg/m$^3$ by October 1993 reflects the vigour of the small number of surviving plants, although even here plant quality and colour was poor compared to the longer term materials.

***Micropropagated plugs***: As with the rooted cuttings the lowest rate of 1 kg/m$^3$ produced good results up until November 1992, but plants in higher rates had reduced vigour and root development and increased scorching of the older foliage leading to losses of 22% by November 1992. Foliage of all rates was starting to pale by November 1992 indicating limited nutrient availability.

*Osmocote Plus 12-14 months Spring*

***Rooted cuttings***: Overall vigour in this formulation was less than in the other longer term formulations included in the trial, and decreased significantly as rate increased. At the highest rate (4 kg/m$^3$) root development was also reduced and leaf scorch increased. By November 1992 levels of plant losses were 11, 28 and 67% for the 2, 3 and 4 kg/m$^3$ rates respectively and losses continued over time at the higher rates reaching 33 and 89% by the end of the trial. The apparent improvement in plant size at the highest rate by October 1993 reflects the vigour of growth of the small number of surviving plants. Even here, however, plant quality and colour was poor compared to the longer term materials.

***Micropropagated plugs***: In direct contrast to the rooted cuttings, this spring formulation of Osmocote Plus 12-14 months produced some of the best growth by November 1992, with relatively few plant losses. Plant colour began to pale by April 1993 compared with other long term treatments. While the 2 kg/m$^3$ rate gave good results up until November 1992, 3 kg/m$^3$ maintained growth, quality and colour for longer into the second season.

*Osmocote Plus 12-14 months Autumn*

*Rooted cuttings*: Plants appeared to establish satisfactorily, with the medium rate of 4 kg/m$^3$ producing the best vigour by April 1992. The highest rate of 5 kg/m$^3$ caused a significant reduction in vigour of growth and an increase in foliage scorch. However, shortly after the spring flush of growth leaf scorch and drop increased in all rates and was especially severe at the higher rate. Plant losses of 33 and 67% occurred in the low to high rate respectively. The problems were still obvious by spring 1993, with foliage scorch still occurring on all the surviving plants, though at this stage colour was reasonable. By October 1993 72% of the plants in the 4 and 5 kg/m$^3$ rates had died and those in the lowest rate (3 kg/m$^3$) were significantly smaller and paler than the equivalent rate of Ficote 270 TE.

*Micropropagated plugs*: Relatively poor results were obtained in this formulation for the micropropagated plugs following initial establishment and early growth. As previously leaf drop was more severe than with rooted cuttings and by April 1993 between 50-78% of the plants in the low to highest rate had died. Of the surviving plants top growth was significantly poorer than in equivalent rates of Osmocote Plus 12-14 months Spring formulation. Vigour was also reduced, especially at the highest rate (5 kg/m$^3$), and severe foliage scorch and plant losses of 83% occurred by the end of the trial. Even the lowest rate of 3 kg/m$^3$ had lost 61% of plants by October 1993, though colour of the surviving plants was good.

*Osmocote 16-18 months*

*Rooted cuttings*: The low rate of Osmocote 16-18 months produced good plants by April 1992, but plants at the higher rates had reduced vigour, with some scorching of the young foliage. Plant losses occurred at all rates over the summer of 1992; 11% at the lower rate (4 kg/m$^3$) but increasing to 61% and 67% in medium and high rates respectively by the autumn. The surviving plants in the low rate continued to look good, despite some leaf drop, but at the higher rates plants were small with a degree of tip scorch. All plants were very poor by April 1993 with high death and scorch and poor size and colour in the remaining plants. By autumn 1993 over 90% of the plants in the medium and high rates were dead, and death in the low rate had increased to 44%. Surviving plants in the high rate were very small, but of good colour, while in the lower rates plants were of a reasonable size, but had poor colour. Very few plants had produced flower bud.

*Micropropagated plugs*: Plant deaths in this formulation were severe with progressive losses of up to 100% at 5 kg/m$^3$. This occurred in the medium rate, though why this should produce more deaths than the high rate (61%) must be considered an anomaly. Losses of 50% also occurred in the low rate (4 kg/m$^3$). All rates gave poor vigour and root growth and scorch of the older leaves in spring 1992. Plants were small throughout the trial, but after initial paleness in spring 1992 plant colour was good. The surviving plants were of generally poor quality by the end of the trial.

KEY

## Treatments

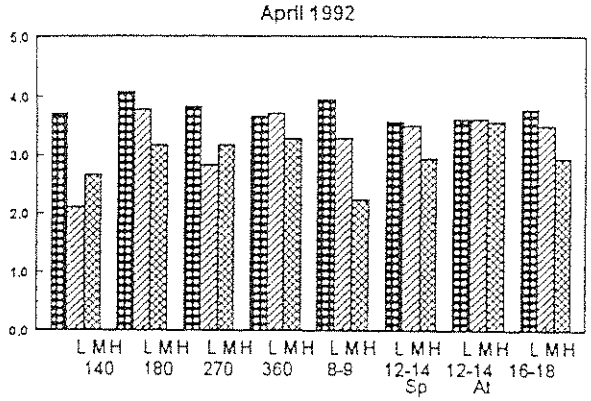
| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 kg/m$^3$ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 kg/m$^3$ |
| | H | Ficote 140 14:8:8 TE | @ | 3 kg/m$^3$ |
| | L | Ficote 180 14:8:8 TE | @ | 2 kg/m$^3$ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 kg/m$^3$ |
| | H | Ficote 180 14:8:8 TE | @ | 4 kg/m$^3$ |
| | L | Ficote 270 14:8:8 TE | @ | 3 kg/m$^3$ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 kg/m$^3$ |
| | H | Ficote 270 14:8:8 TE | @ | 5 kg/m$^3$ |
| | L | Ficote 360 14:8:8 TE | @ | 4 kg/m$^3$ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 kg/m$^3$ |
| | H | Ficote 360 14:8:8 TE | @ | 6 kg/m$^3$ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 kg/m$^3$ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 kg/m$^3$ |
| | H | Osmocote Plus, 8-9 months | @ | 3 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 kg/m$^3$ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 kg/m$^3$ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m$^3$ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 kg/m$^3$ |
| 16-18 | M | Osmocote 16-18 months | @ | 5 kg/m$^3$ |
| | H | Osmocote 16-18 months | @ | 6 kg/m$^3$ |

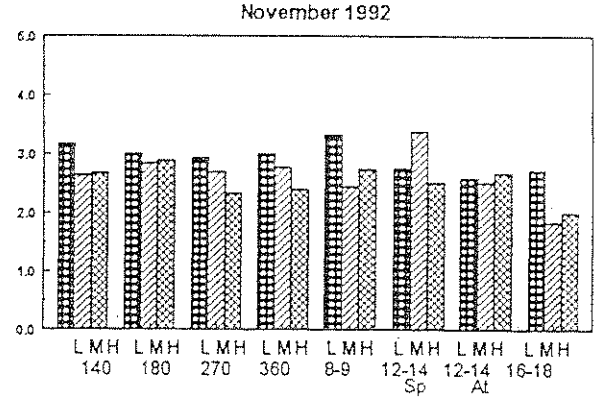
Figure 3

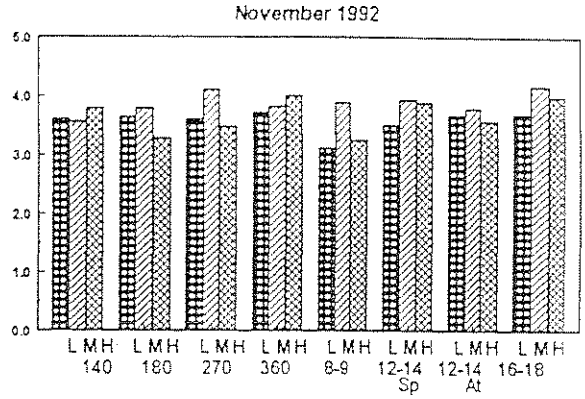
# *Pieris japonica* 'Forest Flame' Rooted Cuttings

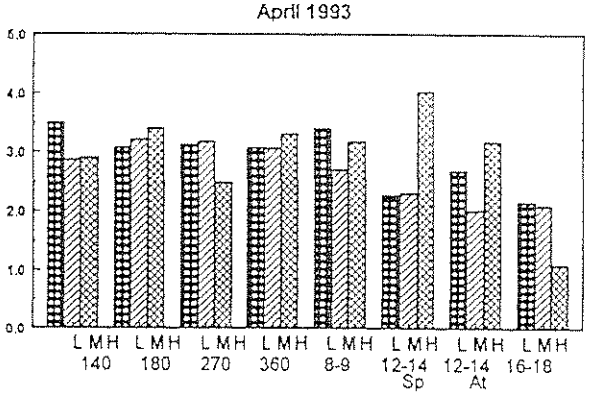
Mean Size Score
1 to 5, 5 = largest

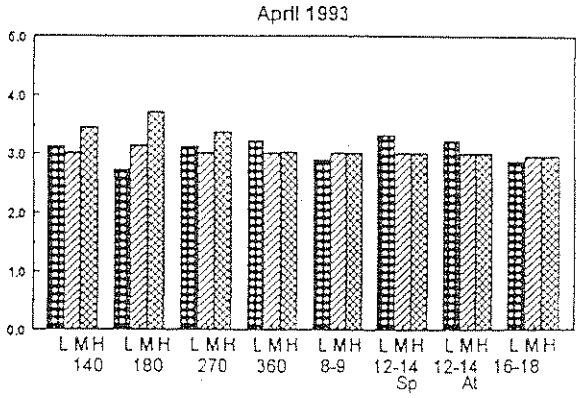
Mean Colour Score
1 to 5, 5 = darkest green

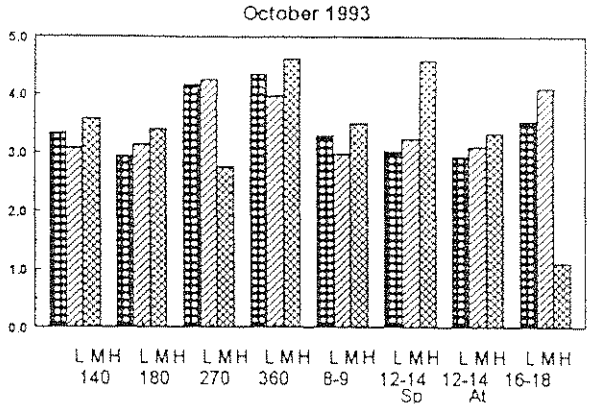


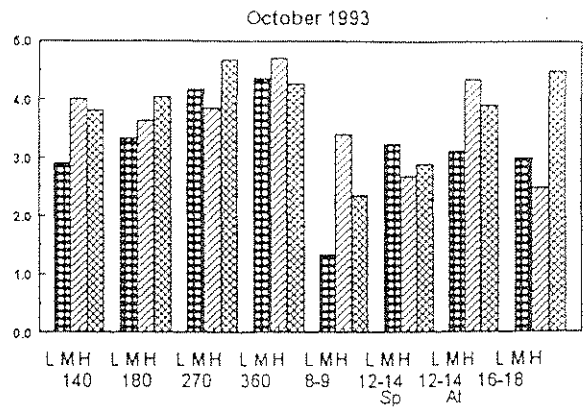



# KEY

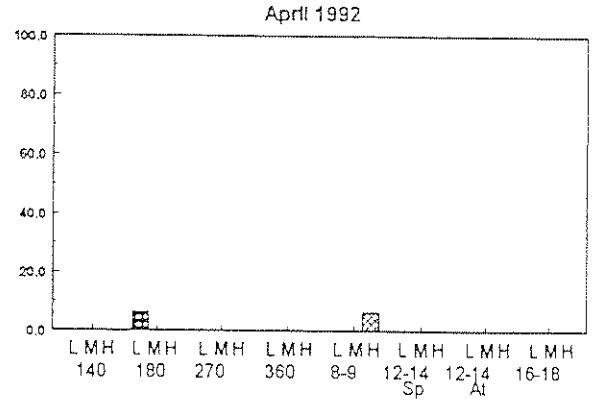
## Treatments

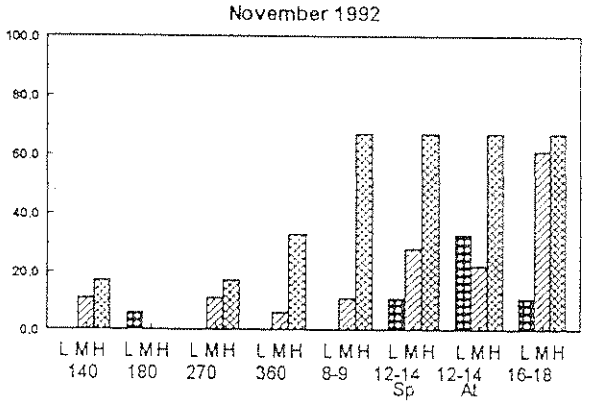
| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 kg/m$^3$ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 kg/m$^3$ |
| | H | Ficote 140 14:8:8 TE | @ | 3 kg/m$^3$ |
| | L | Ficote 180 14:8:8 TE | @ | 2 kg/m$^3$ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 kg/m$^3$ |
| | H | Ficote 180 14:8:8 TE | @ | 4 kg/m$^3$ |
| | L | Ficote 270 14:8:8 TE | @ | 3 kg/m$^3$ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 kg/m$^3$ |
| | H | Ficote 270 14:8:8 TE | @ | 5 kg/m$^3$ |
| | L | Ficote 360 14:8:8 TE | @ | 4 kg/m$^3$ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 kg/m$^3$ |
| | H | Ficote 360 14:8:8 TE | @ | 6 kg/m$^3$ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 kg/m$^3$ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 kg/m$^3$ |
| | H | Osmocote Plus, 8-9 months | @ | 3 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 kg/m$^3$ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 kg/m$^3$ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m$^3$ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 kg/m$^3$ |
| 16-18 | M | Osmocote 16-18 months | @ | 5 kg/m$^3$ |
| | H | Osmocote 16-18 months | @ | 6 kg/m$^3$ |

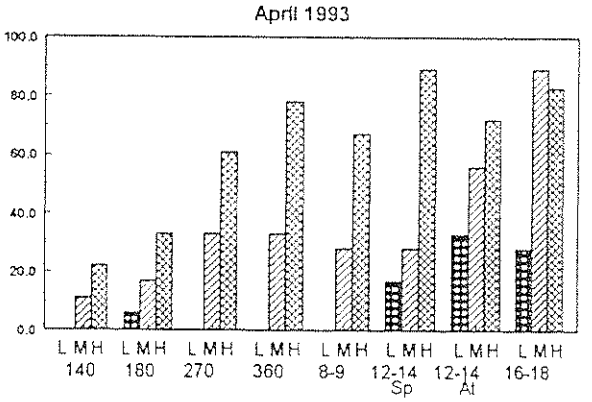
Figure 4

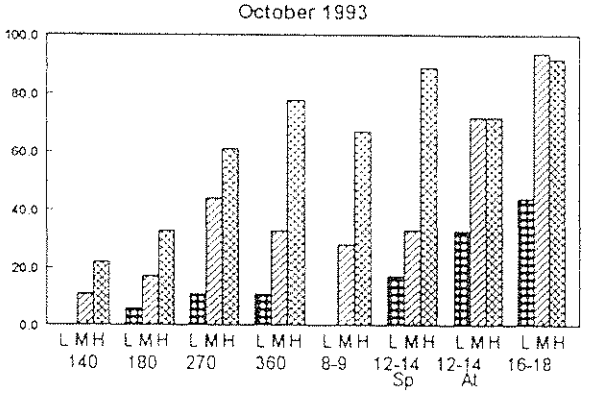
# *Pieris* 'Forest Flame' Rooted Cuttings

## % Dead



# KEY

## Treatments

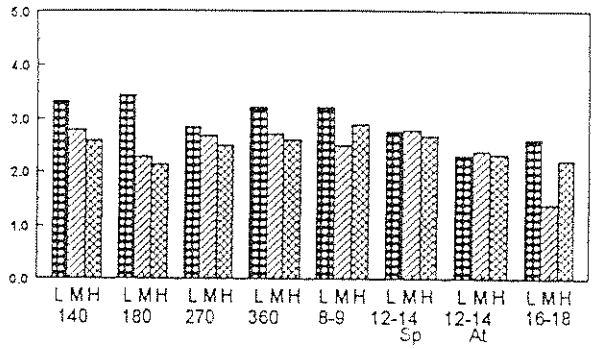
| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 kg/m$^3$ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 kg/m$^3$ |
| | H | Ficote 140 14:8:8 TE | @ | 3 kg/m$^3$ |
| | L | Ficote 180 14:8:8 TE | @ | 2 kg/m$^3$ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 kg/m$^3$ |
| | H | Ficote 180 14:8:8 TE | @ | 4 kg/m$^3$ |
| | L | Ficote 270 14:8:8 TE | @ | 3 kg/m$^3$ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 kg/m$^3$ |
| | H | Ficote 270 14:8:8 TE | @ | 5 kg/m$^3$ |
| | L | Ficote 360 14:8:8 TE | @ | 4 kg/m$^3$ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 kg/m$^3$ |
| | H | Ficote 360 14:8:8 TE | @ | 6 kg/m$^3$ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 kg/m$^3$ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 kg/m$^3$ |
| | H | Osmocote Plus, 8-9 months | @ | 3 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 kg/m$^3$ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 kg/m$^3$ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m$^3$ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 kg/m$^3$ |
| 16-18 | M | Osmocote 16-18 months | @ | 5 kg/m$^3$ |
| | H | Osmocote 16-18 months | @ | 6 kg/m$^3$ |

Figure 5

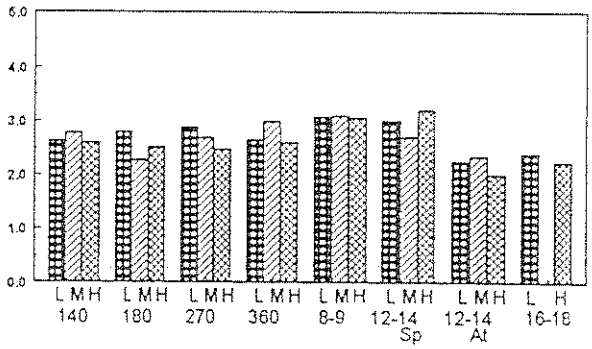
# *Pieris japonica* 'Forest flame' Plugs

## Mean Size Score

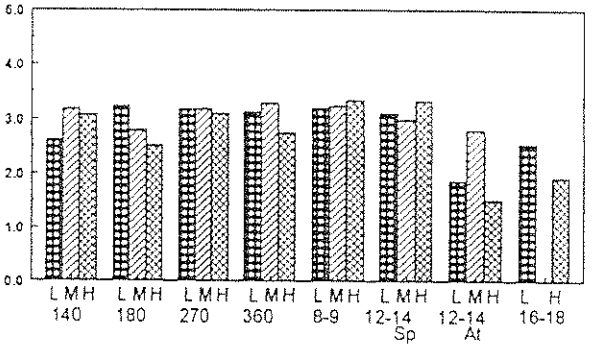
April 1992
1 to 5, 5 = largest



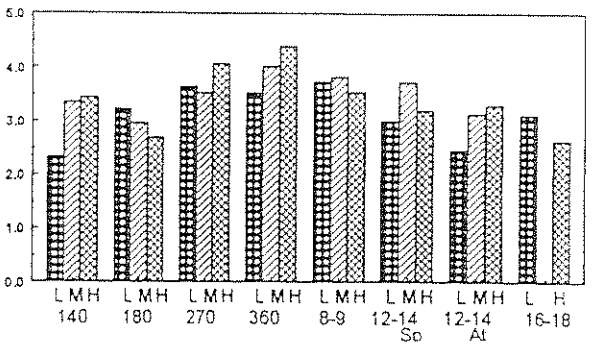

November 1992




April 1993

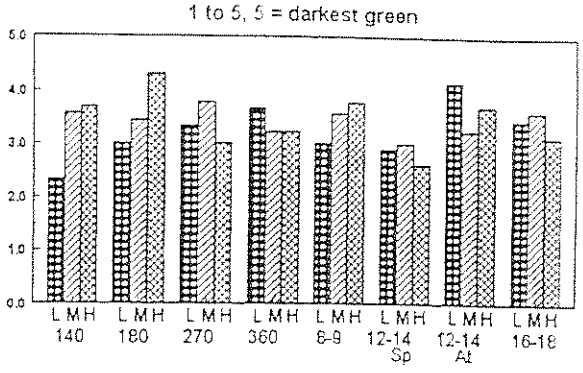



October 1993

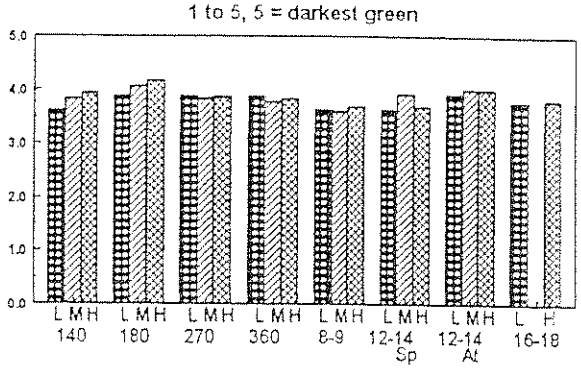



## Mean Colour Score

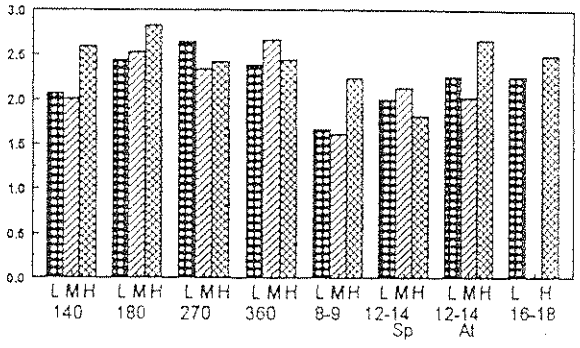
April 1992
1 to 5, 5 = darkest green



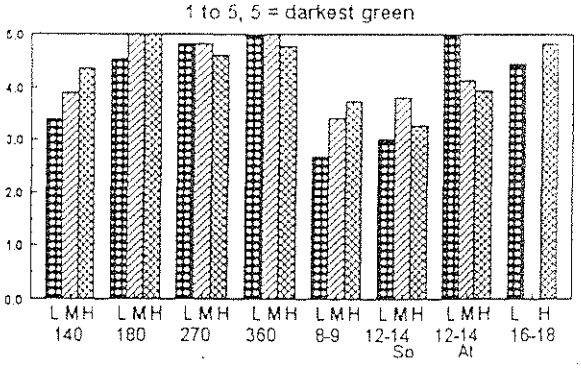

November 1992
1 to 5, 5 = darkest green




April 1993
1/3, 3 = darkest green




October 1993
1 to 5, 5 = darkest green



KEY

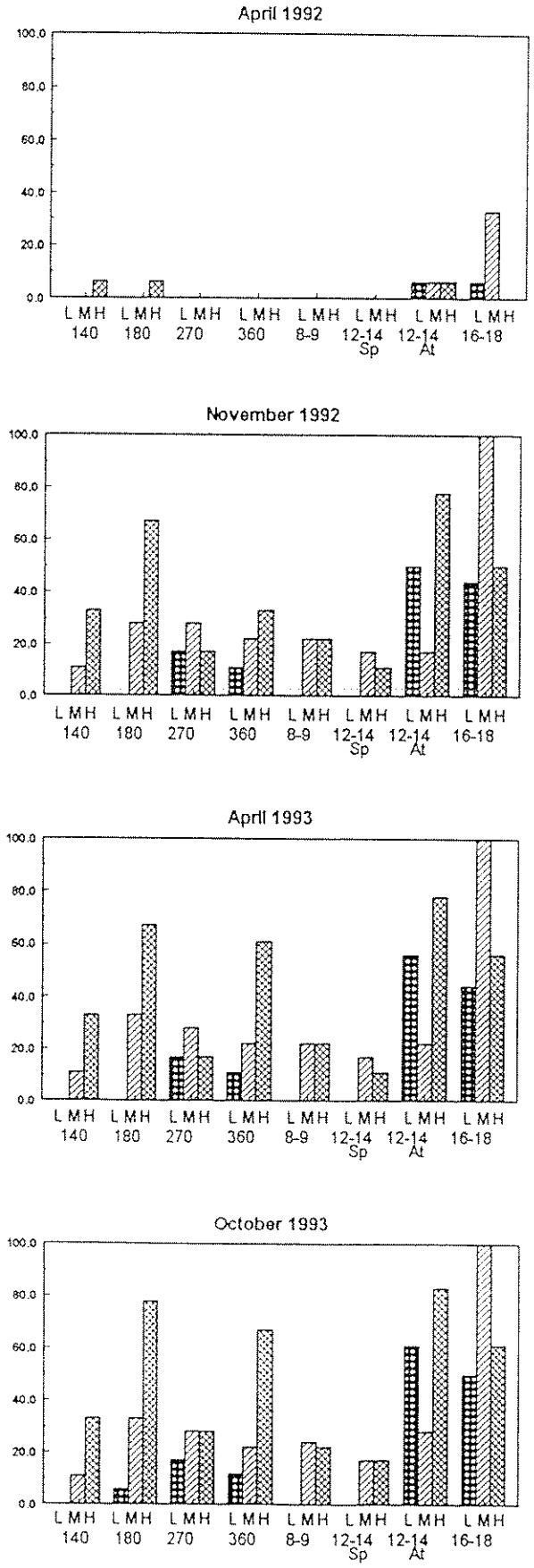
## Treatments

| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 kg/m$^3$ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 kg/m$^3$ |
| | H | Ficote 140 14:8:8 TE | @ | 3 kg/m$^3$ |
| | L | Ficote 180 14:8:8 TE | @ | 2 kg/m$^3$ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 kg/m$^3$ |
| | H | Ficote 180 14:8:8 TE | @ | 4 kg/m$^3$ |
| | L | Ficote 270 14:8:8 TE | @ | 3 kg/m$^3$ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 kg/m$^3$ |
| | H | Ficote 270 14:8:8 TE | @ | 5 kg/m$^3$ |
| | L | Ficote 360 14:8:8 TE | @ | 4 kg/m$^3$ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 kg/m$^3$ |
| | H | Ficote 360 14:8:8 TE | @ | 6 kg/m$^3$ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 kg/m$^3$ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 kg/m$^3$ |
| | H | Osmocote Plus, 8-9 months | @ | 3 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 kg/m$^3$ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 kg/m$^3$ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m$^3$ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 kg/m$^3$ |
| 16-18 | M | Osmocote 16-18 months | @ | 5 kg/m$^3$ |
| | H | Osmocote 16-18 months | @ | 6 kg/m$^3$ |

Figure 6

## *Pieris japonica* 'Forest Flame' Plugs

% Dead



## Summary: *Pieris japonica* 'Forest Flame'

Although plants appeared to establish satisfactorily over the first winter from the mid-late August potting, it became apparent that this was not the case when the new flush of growth occurred in the following spring, with leaf scorch, leaf drop and plant deaths occurring as rates of fertilizer within each formulation increased. Overall, greater damage occurred in the Osmocote Plus formulations than in corresponding rates of similar Ficote TE formulations, and also increased with the longer term formulations where higher rates had been used.

The best results over the two year period were obtained in the lower rates of Ficote TE mixes. Overall, Ficote 360 TE at 4 kg/m$^3$ produced the best results, closely followed by Ficote 270 TE at 3 kg/m$^3$. Ficote 180 TE at 2 kg/m$^3$ and 140 TE at 1 kg/m$^3$ gave good results up until November 1992, 15 months after potting, but thereafter plant vigour and colour became poorer by comparison with the 270/360 TE Ficote formulations.

The only safe Osmocote Plus treatment for this late summer potting was the 8-9 months formulation at the very low rate of 1 kg/m$^3$. This rate, however, was only able to maintain growth over the first season, after which time liquid feeding would have been necessary. In the early stages of the trial, though, this 1 kg/m$^3$ rate of Osmocote Plus 8-9 months produced some of the better quality plants.

The micropropagated plug material was, in general, more sensitive to nutrient stress than rooted cuttings, and the safest mixes were again the 1 kg/m$^3$ rate of either Osmocote Plus 8-9 months or Ficote 140 TE. In contrast to rooted cuttings, the mixes with micropropagated material did not appear to run out of steam so quickly.

The sensitivity of *Pieris* 'Forest Flame' to nutrient stress, and the conflicting demands of safety at potting plus extended release to maintain growth and quality is discussed further in the main Discussion.

*Elaeagnus pungens* 'Maculata'

Results and their statistical significance can be found in Appendix II, tables 13 to 16, pages 54 to 57. The size and colour scores and % death have been presented graphically in Figures 7 and 8, pages 27 and 28.

*Ficote 140 TE*: Plants established well in all rates and good growth was achieved over the first season, though by autumn 1992 the plants were showing signs of paling suggesting that the supply of nutrients was low. The apparent reduction in growth of the higher 4 kg/m$^3$ rate did not prove significant. By spring 1993 both size and colour of plants had picked up again, compared to the other treatments, but foliage paled rapidly over the summer and plants in the lower rates were of a smaller size and very pale by October 1993. However, plants in 4 kg/m$^3$ remained on a par with some of the longer term formulations with regard to size and colour by the end of the trial.

*Ficote 180 TE*: While plant size appeared smaller by comparison with the other treatments after the first winter, vigour was good and the middle rate of 4 kg/m$^3$ had produced good results by autumn 1992 and on to the following spring. Plant colour was paler in the 3 kg/m$^3$ rate but again this picked up over the winter period. The two lower rates appeared to run out over the second summer, with smaller, paler plants produced by the end of the trial compared with the longer term materials. The highest rate (5 kg/m$^3$) continued to maintain quality over the two year period.

*Ficote 270 TE*: Plants at all rates of Ficote 270 TE established well, producing good plants by spring 1992. Plants in the low rate (4 kg/m$^3$) were slightly paler in colour in the autumn of 1992, but recovered and continued to grow well in spring 1993. By the autumn of 1993 only the lowest rate of 4 kg/m$^3$ had started to pale with plants in the other rates maintaining a good growth and colour.

*Ficote 360 TE*: All treatments established well with little difference between rates by spring 1992, all producing good sized, vigorous plants at this stage and growth was maintained over the summer period and on to the following spring of 1993. By October 1993, 26 months after potting, the highest rate of 7 kg/m$^3$ had produced the best quality plants in the trial in respect of colour. While the other two rates produced good sized plants their foliage was paler than the highest rate.

*Osmocote Plus, 8-9 months*: Plants in the low rate of 2 kg/m$^3$ month grew well up until May 1993. Foliage then started paling over the summer of 1993 and not surprisingly with this short term formulation, plants were small and poor in colour by the autumn of 1993. Around 20% plant losses occurred in the higher rates over the first winter and this increased to 30% by the autumn of 1992. The remaining plants were good, only paling over the summer of the second year, leaving reasonable sized but pale plants by the autumn of 1993. The amount of flowers was particularly high in the 4 kg/m$^3$ rate.

*Osmocote Plus, 12-14 months Spring*: Plants in Osmocote Plus 12-14 months Spring established well, and while plants in the highest rate paled in November 1992 they recovered in the spring of 1993. The low and high rates were slower to flush in the spring of 1993. The lowest rate was the first to run out of nutrients, producing small, pale plants with a lower % root cover by October 1993. While plant size improved as rate increased, colour was significantly paler than the best treatment by October 1993.

*Osmocote Plus, 12-14 months Autumn*: All plants established well and produced good sized high quality plants by the autumn of 1992. An apparent trend for paler foliage compared to other formulations did not prove significant, and by May 1993 colour was similar to plants in other mixes. The two higher rates of 5 and 6 kg/m$^3$ maintained good growth and colour through to October 1993, but the lowest rate of 4 kg/m$^3$ appeared to be running out, plants in this mix having paler foliage.

*Osmocote 16-18 months*: In the spring after potting plants in Osmocote 16-18 months showed establishment problems with losses of between 22 to 39% in all rates. Deaths continued to occur until spring 1993, giving final losses of 61, 50 and 72% as rate increased. The surviving plants were small, of poor vigour and had poorer root growth. Plants in the low rate of Osmocote 16-18 month remained small throughout the trial, although the plant colour was good even after two years. Those in the higher rates appeared to recover slightly by autumn 1992, but were still small by comparison with other treatments throughout the second year.

# KEY

## Treatments

| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 2 kg/m³ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 3 kg/m³ |
| | H | Ficote 140 14:8:8 TE | @ | 4 kg/m³ |
| | L | Ficote 180 14:8:8 TE | @ | 3 kg/m³ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 4 kg/m³ |
| | H | Ficote 180 14:8:8 TE | @ | 5 kg/m³ |
| | L | Ficote 270 14:8:8 TE | @ | 4 kg/m³ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 5 kg/m³ |
| | H | Ficote 270 14:8:8 TE | @ | 6 kg/m³ |
| | L | Ficote 360 14:8:8 TE | @ | 5 kg/m³ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 6 kg/m³ |
| | H | Ficote 360 14:8:8 TE | @ | 7 kg/m³ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 2 kg/m³ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 3 kg/m³ |
| | H | Osmocote Plus, 8-9 months | @ | 4 kg/m³ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 3 kg/m³ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m³ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 5 kg/m³ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 4 kg/m³ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m³ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 6 kg/m³ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 5 kg/m³ |
| 16-18 | M | Osmocote 16-18 months | @ | 6 kg/m³ |
| | H | Osmocote 16-18 months | @ | 7 kg/m³ |

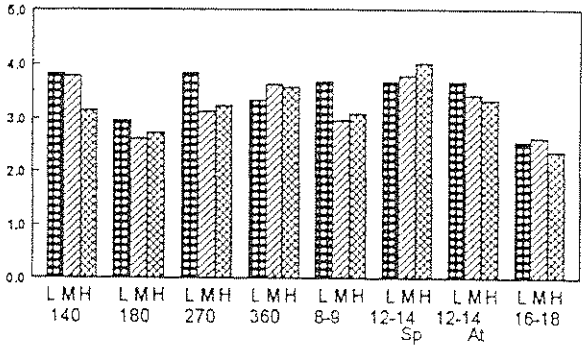
Figure 7

# *Elaeagnus pungens* 'Maculata'

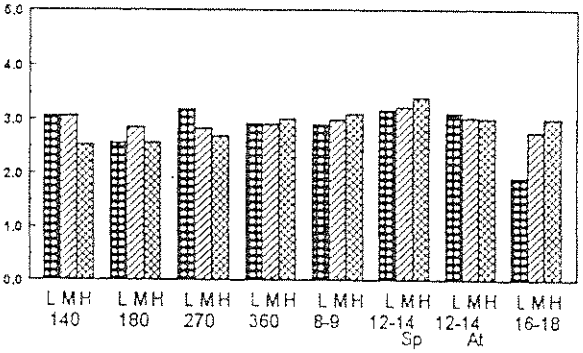
Mean Size Score

1 to 5, 5 = largest

May1992



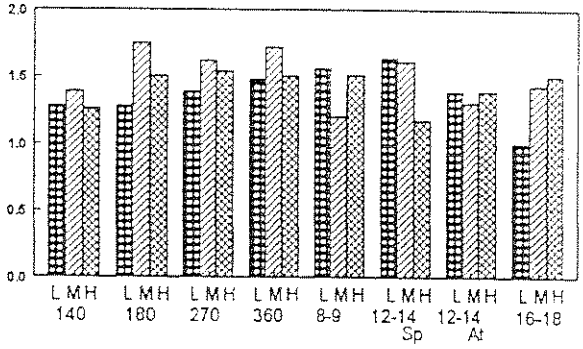

November 1992



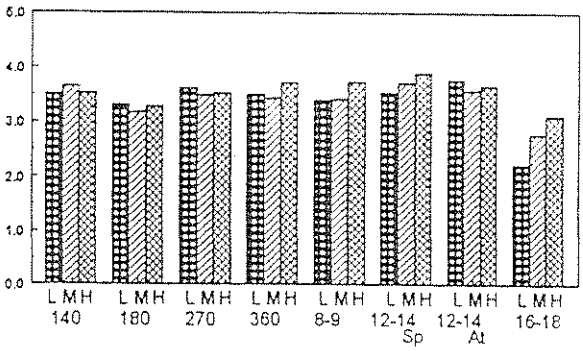

Mean Colour Score

November 1992

1/2, 2 = darkest green

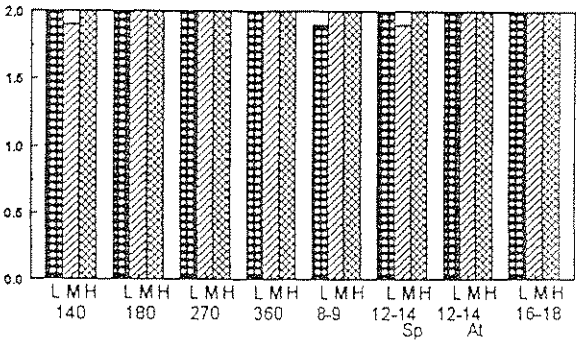



May 1993

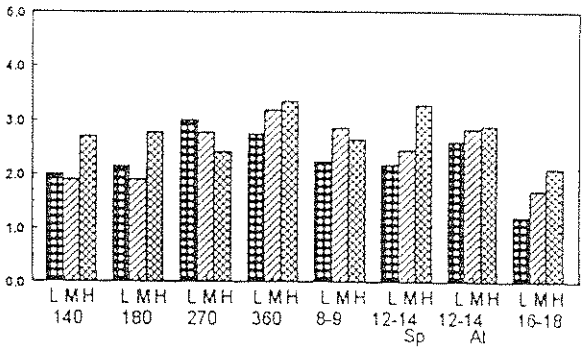



May 1993

1/2, 2 = darkest green

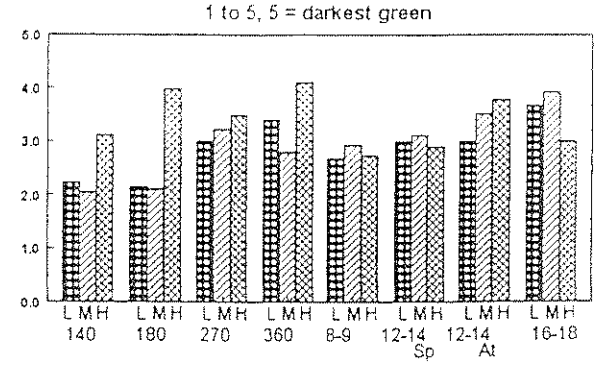



October 1993




October 1993

1 to 5, 5 = darkest green



KEY

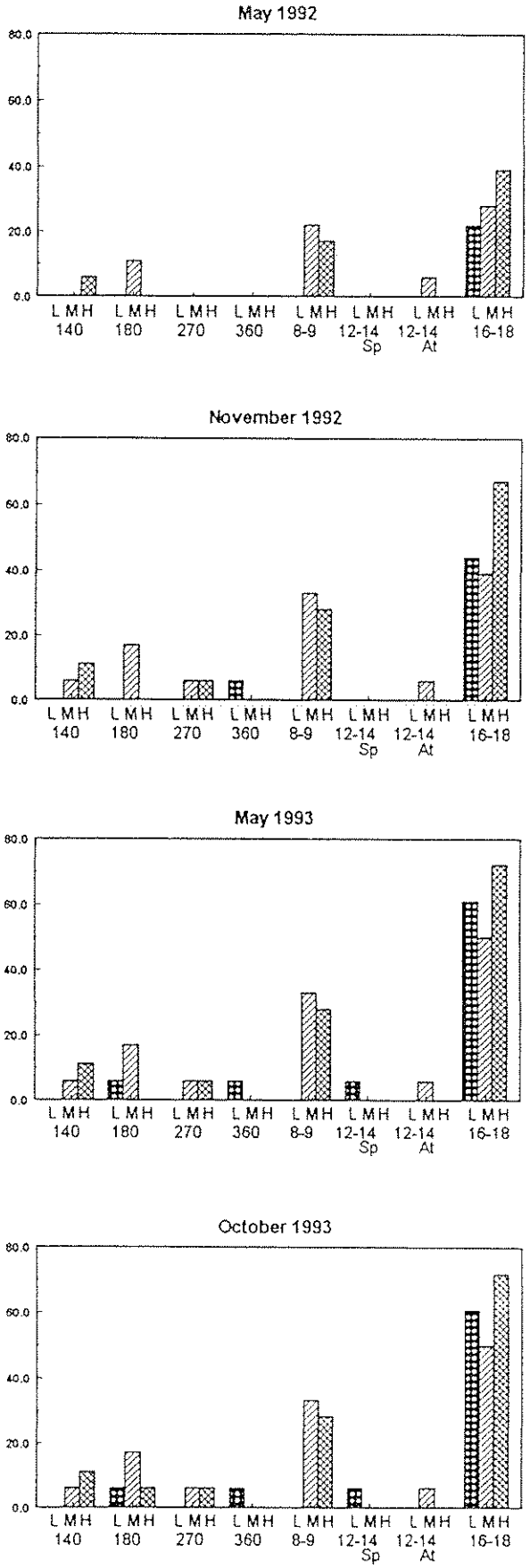
Treatments

| | | | | |
|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 2 kg/m$^3$ |
| 140 | M | Ficote 140 14:8:8 TE | @ | 3 kg/m$^3$ |
| | H | Ficote 140 14:8:8 TE | @ | 4 kg/m$^3$ |
| | L | Ficote 180 14:8:8 TE | @ | 3 kg/m$^3$ |
| 180 | M | Ficote 180 14:8:8 TE | @ | 4 kg/m$^3$ |
| | H | Ficote 180 14:8:8 TE | @ | 5 kg/m$^3$ |
| | L | Ficote 270 14:8:8 TE | @ | 4 kg/m$^3$ |
| 270 | M | Ficote 270 14:8:8 TE | @ | 5 kg/m$^3$ |
| | H | Ficote 270 14:8:8 TE | @ | 6 kg/m$^3$ |
| | L | Ficote 360 14:8:8 TE | @ | 5 kg/m$^3$ |
| 360 | M | Ficote 360 14:8:8 TE | @ | 6 kg/m$^3$ |
| | H | Ficote 360 14:8:8 TE | @ | 7 kg/m$^3$ |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 2 kg/m$^3$ |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 3 kg/m$^3$ |
| | H | Osmocote Plus, 8-9 months | @ | 4 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 3 kg/m$^3$ |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 4 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 5 kg/m$^3$ |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 4 kg/m$^3$ |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 5 kg/m$^3$ |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 6 kg/m$^3$ |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 5 kg/m$^3$ |
| 16-18 | M | Osmocote 16-18 months | @ | 6 kg/m$^3$ |
| | H | Osmocote 16-18 months | @ | 7 kg/m$^3$ |

Figure 8

# *Elaeagnus pungens* 'Maculata'

## % Dead



**Summary:** ***Elaeagnus pungens*'Maculata'**

The establishment and plant loss problem seen with the salt sensitive species was greatly reduced with *Elaeagnus pungens* 'Maculata', even though fertilizer rates were increased for this 'moderate' vigour species. The exception was with Osmocote 16-18 months where an unacceptably high proportion of plants either failed to establish or died during the first year. The surviving plants remained small and as a consequence maintained good colour. The only other formulation where high plant losses occurred was in the higher rates of the faster release Osmocote Plus 8-9 months (3-4 kg/m$^3$).

The best results at the end of the two year period were produced in the highest rate of Ficote 360 TE (7 kg/m$^3$). The trial plants were held *in situ* over the winter period after the trial had finished and the potential of this formulation to provide extended shelf-life became more evident over time. While quality of plants in other treatments deteriorated, those in the 7 kg/m$^3$ of Ficote 360 TE stood out, being able to be picked out at a distance by their continued vigour and good foliage colour.

Other formulations producing good results by the end of the trial included Osmocote Plus 12-14 months Autumn (4-5 kg/m$^3$), Ficote 270 TE (4-5 kg/m$^3$) and Ficote 180 TE (5 kg/m$^3$). While Ficote 180 and 270 TE formulations appeared to give similar results, perhaps questioning the need for the longer term material, observations after the completion of the trial indicated an increased shelf-life with 270 TE, especially at the higher rate of 6 kg/m$^3$.

## Growing Media Analysis

Full details of the analyses can be found in Appendix IV, tables 17-22, pages 62 to 67.

**At Potting** (Figure 9)

Although samples were taken at potting (6 August 1991), they were stored frozen until analysed in February 1992.

As rate of use increased with type of formulation so levels of available nutrients increased. In general, when comparing equivalent rates, nutrient release as expected was slower as the longevity of the material increased.

However, a major difference was observed between the Ficote and Osmocote formulations in this trial, with the latter appearing to release at a more rapid rate than the 'equivalent' formulation of Ficote. This was most pronounced in the Osmocote 16-18 months formulation, where highest levels of nutrients occurred and conductivity of between 200-350 $\mu$s (Index 5) were measured. Ammonium N and phosphorus levels were also considerably higher in the Osmocote mixes than those found in the Ficote mixes.

The results with *Elaeagnus* were similar to the pattern observed with *Azalea/Pieris*, except that with the increased rates of CRF used, nutrient levels were that much higher.

**November 1992** (figure 10 shows conductivity and nitrate N data)

These analyses were done on the fresh sample.

*Azalea* **'Rose Greeley'**

With the repotting of this species in spring 1992, the November sample relates to the nutrient status 7 months after potting. Not surprisingly, level of available nutrients was greater as longevity and rate of formulation increased. However, by November Ficote and Osmocote formulations of similar longevity had nutrient levels of the same order of magnitude. Phosphorus levels were still high, particularly in the extended release materials, in both Ficote and Osmocote mixes. Conductivities were also relatively high (Index 4-6) in Ficote 360 TE and Osmocote 16-18 months and the higher rate of Ficote 270 TE and Osmocote Plus 12-14 months Autumn.

*Pieris* 'Forest Flame'

***Rooted cuttings***: Levels of available nutrients still appeared to be in the 'satisfactory-high' range for all treatments, and were, in general, higher than those seen in the *Azalea* crop, despite the *Pieris* having been potted for 8 months longer. Conductivities were greatest in Ficote 270 and 360 TE at the higher rates, and the high rate of Osmocote 16-18 months, where levels between 900-1190 $\mu$s were recorded (Index 7-8). Ammonium N levels were also higher in these mixes. Phosphorus levels were high in both Ficote and Osmocote mixes by November with an Index of 7-9 recorded for all but mixes with the lower rates of shorter term products.

***Micropropagated plugs***: While a similar pattern was evident in relation to rates and formulation used, overall there were lower nutrient levels in mixes with this material than with the rooted cuttings.

# KEY

## Treatments

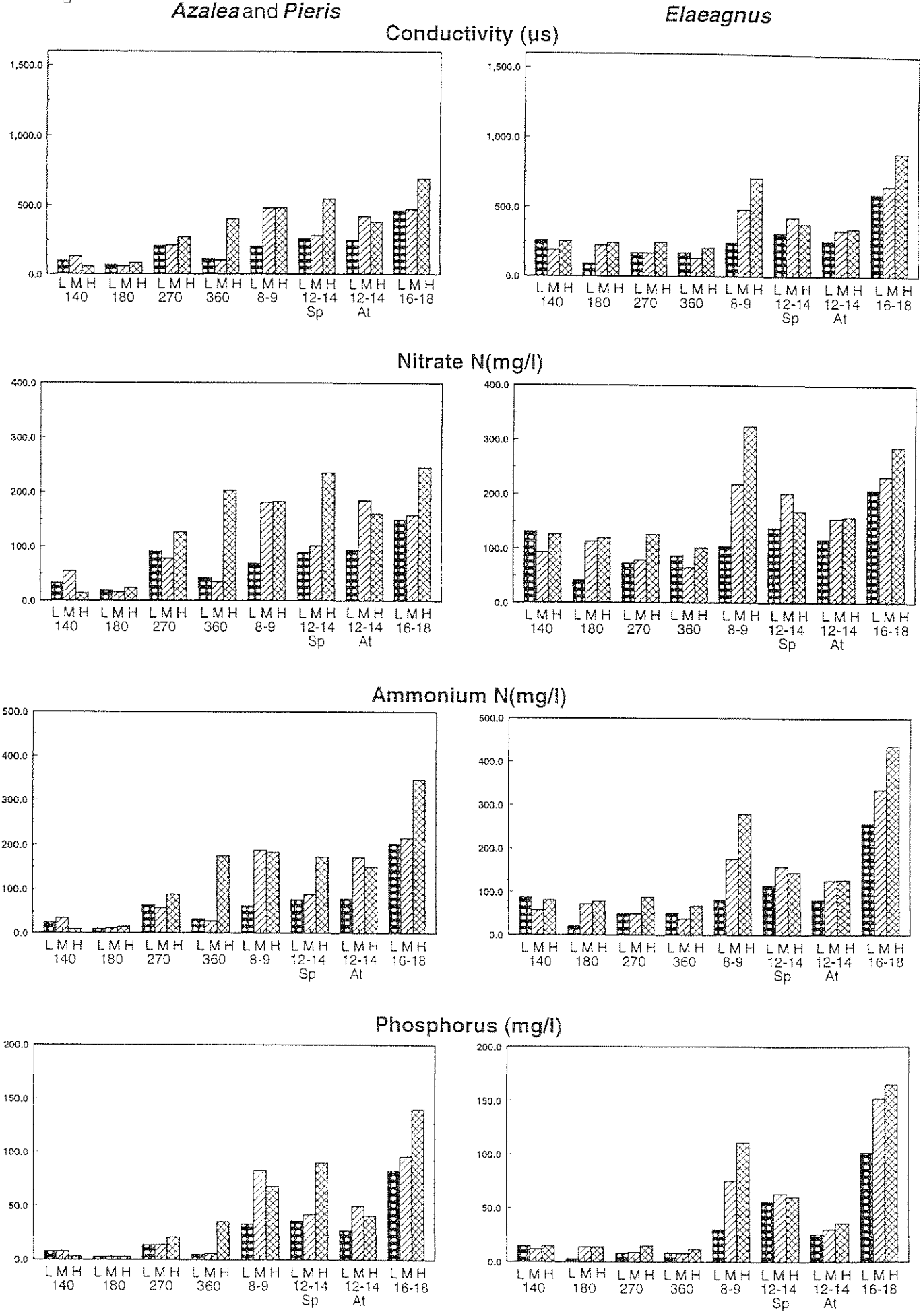
| | | | | *Azalea Pieris* kg/m³ | *Elaeagnus* |
|---|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 | 2 |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 | 3 |
| | H | Ficote 140 14:8:8 TE | @ | 3 | 4 |
| | L | Ficote 180 14:8:8 TE | @ | 2 | 3 |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 | 4 |
| | H | Ficote 180 14:8:8 TE | @ | 4 | 5 |
| | L | Ficote 270 14:8:8 TE | @ | 3 | 4 |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 | 5 |
| | H | Ficote 270 14:8:8 TE | @ | 5 | 6 |
| | L | Ficote 360 14:8:8 TE | @ | 4 | 5 |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 | 6 |
| | H | Ficote 360 14:8:8 TE | @ | 6 | 7 |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 | 2 |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 | 3 |
| | H | Osmocote Plus, 8-9 months | @ | 3 | 4 |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 | 3 |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 | 4 |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 | 5 |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 | 4 |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 | 5 |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 | 6 |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 | 7 |
| 16-18 | M | Osmocote 16-18 months | @ | 5 | 8 |
| | H | Osmocote 16-18 months | @ | 6 | 9 |

# Growing Media Analysis

## At Potting (6 August 1991)

*(samples frozen until analysed Febrary 1992)*

Figure 9

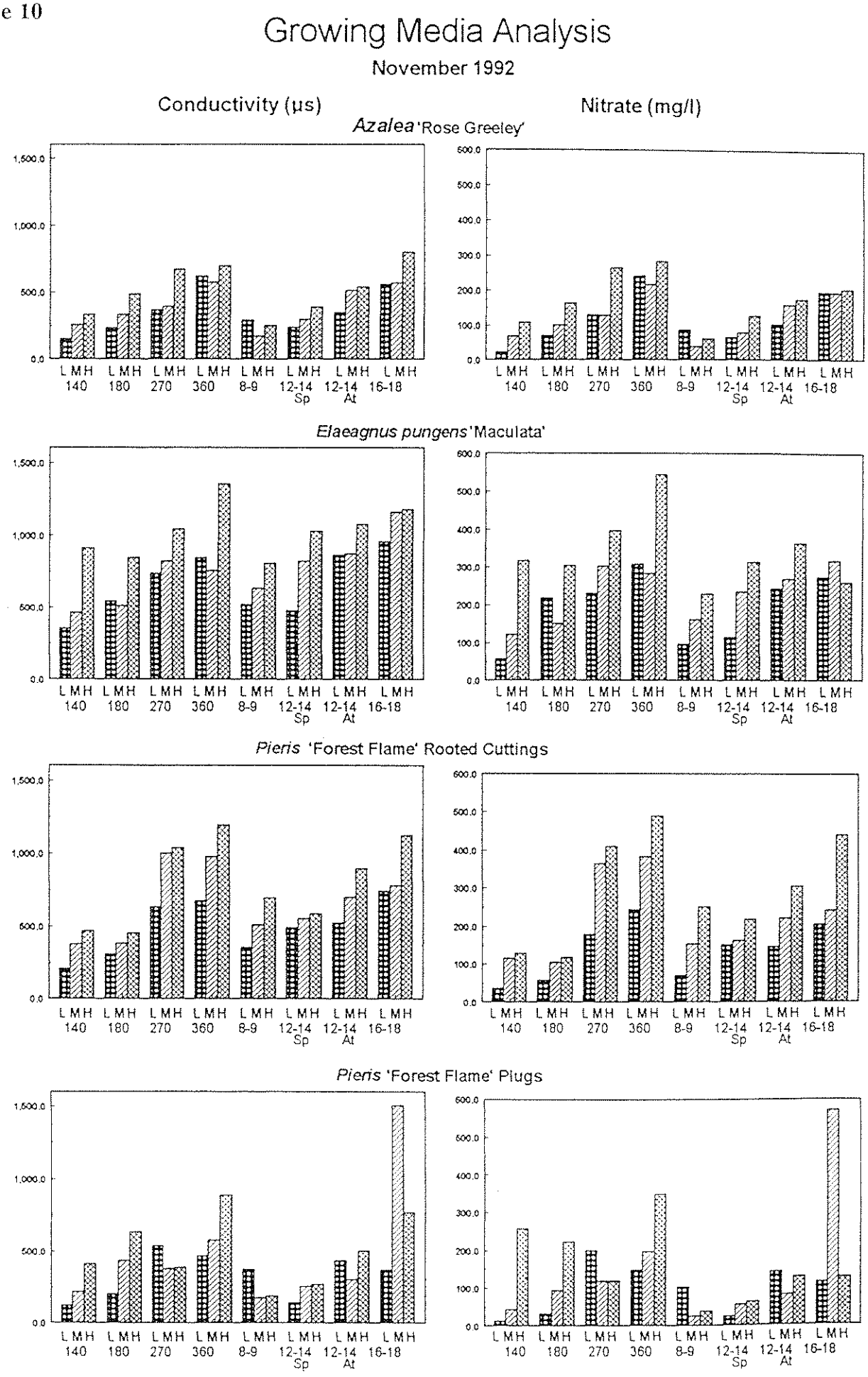


KEY

## Treatments

| | | | | *Azalea Pieris* kg/m³ | *Elaeagnus* kg/m³ |
|---|---|---|---|---|---|
| | L | Ficote 140 14:8:8 TE | @ | 1 | 2 |
| 140 | M | Ficote 140 14:8:8 TE | @ | 2 | 3 |
| | H | Ficote 140 14:8:8 TE | @ | 3 | 4 |
| | L | Ficote 180 14:8:8 TE | @ | 2 | 3 |
| 180 | M | Ficote 180 14:8:8 TE | @ | 3 | 4 |
| | H | Ficote 180 14:8:8 TE | @ | 4 | 5 |
| | L | Ficote 270 14:8:8 TE | @ | 3 | 4 |
| 270 | M | Ficote 270 14:8:8 TE | @ | 4 | 5 |
| | H | Ficote 270 14:8:8 TE | @ | 5 | 6 |
| | L | Ficote 360 14:8:8 TE | @ | 4 | 5 |
| 360 | M | Ficote 360 14:8:8 TE | @ | 5 | 6 |
| | H | Ficote 360 14:8:8 TE | @ | 6 | 7 |
| | L | Osmocote Plus, 8-9 months, 16+8+12+2MgO+traces | @ | 1 | 2 |
| 8-9 | M | Osmocote Plus, 8-9 months | @ | 2 | 3 |
| | H | Osmocote Plus, 8-9 months | @ | 3 | 4 |
| 12-14 | L | Osmocote Plus, 12-14 months, Spring 15+9+11+2MgO+traces | @ | 2 | 3 |
| Sp | M | Osmocote Plus, 12-14 months, Spring | @ | 3 | 4 |
| | H | Osmocote Plus, 12-14 months, Spring | @ | 4 | 5 |
| 12-14 | L | Osmocote Plus, 12-14 months, Autumn 15+8+11+2MgO+traces | @ | 3 | 4 |
| At | M | Osmocote Plus, 12-14 months, Autumn | @ | 4 | 5 |
| | H | Osmocote Plus, 12-14 months, Autumn | @ | 5 | 6 |
| | L | Osmocote 16-18 months 16+8+9+3MgO | @ | 4 | 7 |
| 16-18 | M | Osmocote 16-18 months | @ | 5 | 8 |
| | H | Osmocote 16-18 months | @ | 6 | 9 |

Figure 10


Growing Media Analysis
November 1992
Conductivity (µs)
Nitrate (mg/l)
Azalea 'Rose Greeley'
Elaeagnus pungens 'Maculata'
Pieris 'Forest Flame' Rooted Cuttings
Pieris 'Forest Flame' Plugs
L M H
140
180
270
360
8-9
12-14 Sp
12-14 At
16-18

## DISCUSSION

The objective of the trial was to compare a range of Ficote TE and Osmocote Plus products, including 18 to 24 months extended release formulations, for high value, salt sensitive species grown under protection and held in the same container over two growing seasons. Relatively slow growing species were used in order to monitor the longevity of the products, and for this reason no liquid feeding programme was applied in the second year, enabling the point at which the different products started to run out to be established.

The trial successfully highlighted the potential of the longer release formulations to maintain plants in good condition over an extended period, but also underlined problems that could occur from the use of CRFs for autumn potting of salt sensitive species, where rate and type of formulation must be balanced between safety of use and longevity over the required cropping period. *Azalea* and *Pieris*, both considered salt sensitive species, emphasised the problem of safety.

### *Establishment*

With *Azalea* **'Rose Greeley'** severe losses over the first few months of the trial suggested that damage might be associated with high nutrient levels, especially as damage increased with rate of fertilizer. However, plant establishment and vigour of growth was poor across the whole trial, regardless of rate or type of fertilizer, necessitating the re-potting of the crop the following spring. Several other factors could well have contributed to the poor establishment. Firstly, rooted cuttings, as opposed to established liners, were potted direct into 2 litre containers, and secondly, the late summer potting meant a limited period for root development, which by November 1991 was only covering around 10% of the pot ball. Thirdly, a capillary irrigation system on a drained sand bed was used which would have allowed nutrients to accumulate rather than leach out. While plants in full active growth would have been able to cope with this, as seen with the success of the spring potting, poorly established young plants with limited activity over winter, in mixes with a large proportion of the nutrient reserves remaining, could have problems. Flushing the pots through with water was done at intervals before the late autumn to reduce the risk of salt accumulation, but with diminishing water requirements over the winter period this was stopped since overwatering could have led to root damage. *Azalea* 'Rose Greeley' has been shown to be particularly salt sensitive in other trials, and for this reason was chosen as an indicator plant to monitor safety for the different CRF formulations. In the absence of any rate or formulation of fertilizer being safe for the autumn potting of rooted cuttings into the 2 litre containers it must be concluded that this variety would be better left for potting in the spring, where no such problems were encountered in the establishment and growing away. Whether well established liners would be safer to pot-on in the autumn would need further investigation.

In direct contrast, *Azalea* 'Blue Danube', used as guard plants around the main trial area, proved far less sensitive to the nutrient levels present, and no problems were encountered in establishing this variety from the late summer potting across the range of fertilizers/rates used.

With ***Pieris* 'Forest Flame'**, while plants appeared to establish satisfactorily over the first winter, they suffered severe foliage scorch in many treatments in the following spring when the new flush of growth tried to get away. Damage became greater as rates of fertilizer increased above manufacturers recommendations and was particularly severe in the higher rates of the Osmocote formulations, with most damage in Osmocote 16-18 months mixes. This links with the higher nitrate and ammonium N observed in these mixes at potting. These effects gradually increased over time suggesting that irreversible root damage had occurred. As with *Azalea* this may well have been associated with the accumulation of nutrients in the media over the winter period, and the late summer potted material not being sufficiently established to cope with this. The micropropagated *Pieris* plugs appeared more sensitive than the conventionally propagated cuttings at this time of year. Whether the young active micropropagated material would respond differently if potted in the spring needs further investigation.

The moderately vigorous ***Elaeagnus pungens* 'Maculata'** established well across all rates and formulations of CRF. However, while early growth appeared similar across most treatments, that in Osmocote 16-18 months was surprisingly poor. This result was confirmed by another potting in the second autumn. Media analysis suggested that this particular formulation was releasing nutrients faster than expected and this was confirmed in independent tests by the Company. This particular formulation has now been replaced by an Osmocote Plus 16-18 months formulation, which will be included in future trials.

*Growth*

Overall the recommended rate of fertilizer for each formulation produced satisfactory results within the specified longevity of each formulation, though there was some variation in response depending on species. Osmocote Plus 8-9 months and Ficote 140 TE started to run out first, as monitored by foliage paling, and plants in these mixes would have required a top dressing over winter and liquid feeding in the second year to maintain growth and quality, particularly from the late summer potting. Osmocote Plus 12-14 months and Ficote 180 TE provided nutrient reserves into the early part of the second season, when they too would have needed liquid feeding to maintain growth and quality further into the year. Overall, the Autumn formulation maintained growth for longer than the Spring formulation and was more suited for the late summer/autumn potting. The Ficote 270 and 360 TE formulations clearly demonstrated their ability to maintain plant growth and quality over two growing seasons, with Ficote 360 TE having sufficient reserves to provide a further shelf-life period.

For the late summer/autumn potted crop the Osmocote 8-9 and 12-14 month Spring formulations would not normally be considered for potting rooted cuttings of salt sensitive species, particularly for extended season cropping, unless liquid feeding programmes were in operation. Similarly Ficote 140 TE is no longer recommended for autumn/winter potting under protection for salt sensitive species, as it too can release nutrients rapidly if temperatures lift. If plants are considered 'very salt sensitive' then Ficote 180 as well as 140 TE is not now recommended for autumn/winter potting.

However, the main objective of this trial was to monitor the performance of the extended release materials for long term cropping of plants held in the same container over two growing seasons without liquid feeding.

For *Azalea* **'Rose Greeley'**, after the failure of the late summer potted crop, the re-potted spring crop grew away strongly. Observations on this species were over an 18 month period and best results overall in terms of plant size and colour were produced in Ficote 360 TE at 4-5 kg/m$^3$, followed by Osmocote 16-18 months which produced some of the largest, most vigorous plants in the trial from the spring potting, though colour was beginning to pale in comparison to the Ficote 360 TE formulation by the end of the second season. Nevertheless 5-6 kg/m$^3$ produced good results. The potential of Ficote 360 TE to maintain shelf-life over an extended period was seen in this variety after completion of the trial, when the improved foliage colour of plants in this mix became increasingly apparent. Ficote 270 TE at 3-4 kg/m$^3$ also produced good results. Results with Osmocote 12-14 months were also satisfactory but after 18 months colour in the spring formulations was paling rapidly. Why so many plants were lost over the second season remains unexplained. A few were lost to vine weevil activity, but this was not the cause of the majority of losses. By the second season it was anticipated that plant vigour would be able to cope with any remaining nutrient release, even where release was still relatively high in the extended release formulation. Disease activity may have had a part to play, especially as losses were greater when plants were under greater stress at the higher rates of fertilizer, and this would need further monitoring.

With *Pieris* **'Forest Flame** the best results over the two year period from the late summer potting were obtained in the lower rates of Ficote TE mixes. Overall Ficote 360 TE at 4 kg/m$^3$ produced the best results, closely followed by Ficote 270 TE at 3 kg/m$^3$. Leaf tip scorching was a problem with this variety of *Pieris* and this became more severe with increasing rate within each formulation. *Pieris* appears to have a low nutrient requirement and in the early stages of the trial the lowest rate of fertilizer in Osmocote Plus 8-9 months and Ficote 140 TE, both at 1 kg/m$^3$, produced excellent quality growth with minimal leaf scorch. However, liquid feeding would have been required after the first season to maintain growth and quality. The leaf tip scorching problem needs further investigation since it can also occur in plants showing starvation symptoms, especially as new growth tries to get away.

The greater sensitivity of the micropropagated plugs to nutrient stress was clearly demonstrated by their increased tip scorching early in the trial compared with the rooted cuttings. The safer option for this material would be to take it through a liner stage in low rates of fertilizer prior to potting-on.

The establishment and plant loss problem seen with the salt sensitive species was greatly reduced with the moderate vigour species ***Elaeagnus pungens* 'Maculata'**, even though fertilizer rates were increased for this species. By the end of the trial, two years after potting, Osmocote Plus 12-14 months Autumn (4-5 kg/m$^3$) and Ficote 180, 270 and 360 TE at 5 kg/m$^3$ had given good results. However, the extended release Ficote 270 and especially 360 TE would have provided greater shelf-life potential at equivalent rates. The potential for increased shelf-life with Ficote 360 TE at higher rates was demonstrated by plants which were held *in situ* over the winter period after the trial had finished. Plants in 7 kg/m$^3$ of Ficote 360 TE could be picked out at a distance by their vigour and foliage colour.

*Overall Summary*

The trial has provided valuable information on the performance of various Osmocote and Ficote formulations under protected cropping conditions for a number of salt sensitive and tolerant species, particularly in respect of safety of use at different times of the year and longevity. Results with Ficote 360 TE in particular have identified the potential of this extended release material to supply the total nutrient requirement of specialist plants grown under protection in the same container over two growing seasons.

Protected cropping is increasing, with latest estimates indicating that there is around 200 ha of nursery stock grown at some stage of its cycle under protection. An important category within protected cropping is the high value, salt sensitive and slow growing species which are likely to spend their whole life under protection. This makes the use of controlled release fertilizers more difficult in view of nutrient release increasing and continuing overwinter under the elevated temperatures, especially if considering autumn potting. In this particular trial rooted cuttings were potted in the late summer direct into 2 litre containers, making them more sensitive to nutrient release. A safer option would be to use well established liners at this time of year, but further observation would be needed to monitor longevity of the different CRF formulations, since less fresh mix would be included for the liner potting-on compared with the rooted cutting. An improved response could be expected if the liners themselves had been produced in a long term fertilizer to ensure a reserve of nutrients was taken over into the final potting for the longer schedules.

With salt sensitive species several options could be considered:

- Low rate of CRF (shorter term) plus liquid feeding.

- Extended release CRF formulations which have proved safer at higher rates, thus also providing the required longevity.

- Lower rates of extended release CRF plus liquid feeding.

However, for the very salt sensitive species the safest option is to delay potting-on until the spring, when plants in active growth can benefit from the CRF, as demonstrated clearly in the trial with *Azalea* 'Rose Greeley'.

Sensitivity to nutrients can vary widely between varieties within the same species, as shown with *Azalea* 'Blue Danube' which grew well from the autumn potting, compared with *Azalea* 'Rose Greeley' which failed at this time of year. Thus experience of species' degree of sensitivity to nutrients will still allow flexibility with potting schedules.

The extended release CRFs demonstrated their potential for maintaining quality growth over an 18 to 24 month period and provide a useful extension to the range of products available for specialist situations. These will depend on the cropping schedule, but are particularly pertinent where plants remain in the same container over two growing seasons. They also offer increased 'shelf-life', a factor becoming increasingly important in assuring customer confidence. The ability to maintain quality and plant activity after plants leave the nursery may well improve the early establishment and growth to the end user, thus improving customer satisfaction. Finally the longer term materials offer greater safety of use at rates required to maintain growth over extended periods when growing under protection, especially for salt sensitive species and for autumn potting.

Rates of fertilizer will vary with species and some of the best results in this trial have been at the upper ends of the manufacturers' recommendation, especially when considering extended 'shelf-life' as well as growth. The close collaboration of the CRF Companies involved ensures continual updating of recommendations as new information becomes available. Because of the range of factors which interact in choice of fertilizer and rate is not always possible to give a general recommendation. Cropping schedule, production systems, species, site and geographical location will need taking into account, and the rates which have given good results in this trial can only act as a guideline, together with manufacturers' recommendations and on site advice.

*Future Work*

A new trial, HNS43a, under HDC, Levington Horticulture Ltd and Scotts UK Ltd sponsorship, will be assessing the use of this range of CRFs in the outdoor situation for a spring potted crop. Because of the potential response difference depending on geographical location, part of the trial will be conducted on a northern nursery site at Johnsons of Whixley.

## CONCLUSIONS

The objective of this trial was to compare the performance of a range of Ficote TE and Osmocote Plus CRF formulations for salt sensitive species grown under protection and held in the same container over two growing seasons. The main trial was potted in late summer of 1991, using rooted cuttings potted direct into 2 litre containers, and was grown on capillary irrigated drained sand beds. The main results can be summarised as follows:

- The salt sensitive *Azalea* **'Rose Greeley'** established poorly and suffered severe losses over the winter following the late summer potting. Whilst most severe in the higher rates of fertilizer, losses across all treatments were unacceptable and the crop was re-potted with a later strike of cuttings the following spring. Establishment and growth following the spring potting was excellent.

- Late summer potted *Pieris* **'Forest Flame'** appeared to establish satisfactorily, but severe tip scorch and some death occurred the following spring when the new flush of growth tried to get away. Gradual loss of plants continued over the next 12 months suggesting irreversible root damage had occurred during the first winter. This was most noticeable in Osmocote mixes above recommended rates, but also occurred in Ficote mixes as rates increased, especially in the longer term materials. However, tip scorching was less severe in the lower (recommended) rates, with plants growing away satisfactorily.

- *Pieris* plants from micropropagated plugs appeared more sensitive to nutrients than those from rooted cuttings.

- The poorer results from the autumn potting of the salt sensitive species was attributed to nutrient accumulation overwinter, with plants at a particularly sensitive stage from potting rooted cuttings into 2 litre containers which had not fully established by the late autumn.

- Species considered to be particularly salt sensitive would benefit from going through the liner stage before potting-on and/or being left for spring potting.

- The moderately vigorous ***Elaeagnus pungens*** **'Maculata'** established and grew away well from the late summer potting.

- Overall the recommended rate of fertilizer for each CRF formulation produced good results within its specified longevity.

- Osmocote Plus 8-9 months and Ficote 140 TE started to run out first and would have required a top dressing and/or liquid feed to maintain quality and growth over the second winter period and on into the second growing season.

- Osmocote Plus 12-14 months and Ficote 180 TE provided sufficient nutrient reserves to maintain quality for spring markets. Thereafter they would have required liquid feeding if plants were taken on for a second year. Osmocote Plus 12-14 months Autumn maintained quality over a longer period than the Spring formulation and was more suited to the late summer potting.

- The Ficote 270 and 360 TE formulations clearly demonstrated their ability to maintain growth and quality over two growing seasons, with Ficote 360 TE having sufficient reserves to hold quality over a further period for extended shelf-life.

- Rate of extended release fertilizer used will vary according to time of year potting, production system and species, but satisfactory results were obtained within manufacturers' recommendations.

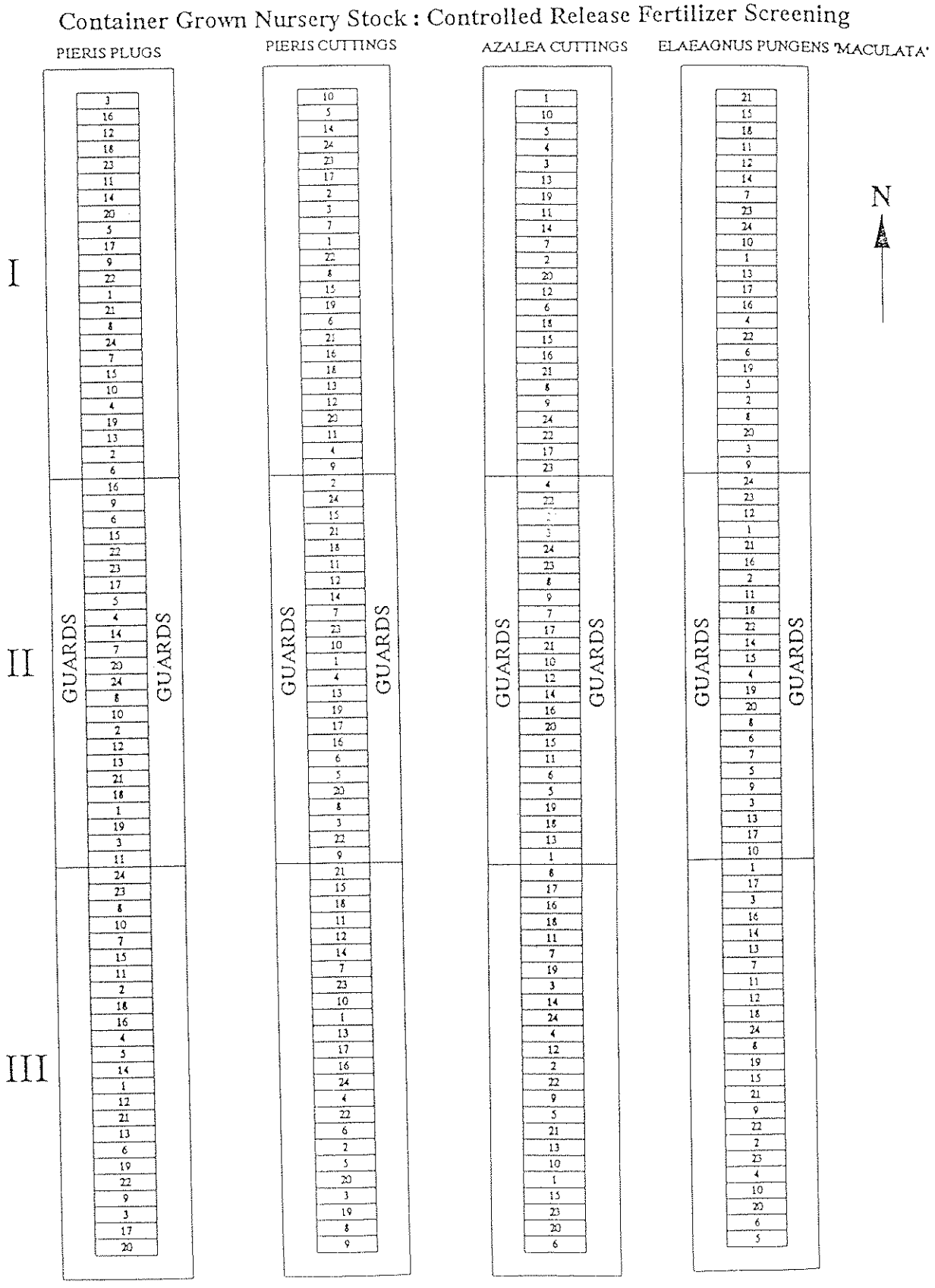
- Results in the Osmocote 16-18 months formulation were disappointing, with problems appearing to be associated with relatively fast release of nutrients. This formulation is no longer available, having been replaced with a 16-18 months Plus formulation.

- The tip scorching problem with *Pieris* 'Forest Flame' was reduced by growing in very low rates of short term CRF formulation (1 kg/m$^3$ Osmocote Plus 8-9 months and Ficote 140 TE). However, liquid feeding would have been required to maintain quality and growth into the second season.

- The potential for extended release formulation includes safer use at higher rates under protection, particularly when growing salt sensitive species; for long term cropping, especially where plants are held in the same container over two seasons; and for improving shelf-life.

## APPENDIX I

## Trial layout



# APPENDIX II

## Growth Records

Table 1 *Azalea* 'Rose Greeley' Autumn 1991 potting - May 1992

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Dry Weight (Per Plant) (g) | Vigour Score (1-5) 5=most vigorous | %Dead | % Root Cover |
|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 1.3 | 4.39 | 0 | 6.39 |
| 2 | Ficote 140 TE | 2 | 1.4 | 3.83 | 0 | 1.61 |
| 3 | Ficote 140 TE | 3 | 0.9 | 2.36 | 28 | 1.53 |
| 4 | Ficote 180 TE | 2 | 1.9 | 4.39 | 0 | 6.44 |
| 5 | Ficote 180 TE | 3 | 1.5 | 3.44 | 0 | 1.50 |
| 6 | Ficote 180 TE | 4 | 1.4 | 2.34 | 22 | 0.53 |
| 7 | Ficote 270 TE | 3 | 2.2 | 4.11 | 6 | 4.76 |
| 8 | Ficote 270 TE | 4 | 1.7 | 4.14 | 6 | 2.03 |
| 9 | Ficote 270 TE | 5 | 1.4 | 3.22 | 0 | 1.67 |
| 10 | Ficote 360 TE | 4 | 1.4 | 3.78 | 0 | 1.94 |
| 11 | Ficote 360 TE | 5 | 1.2 | 4.72 | 0 | 11.28 |
| 12 | Ficote 360 TE | 6 | 1.5 | 3.18 | 22 | 0.54 |
| 13 | Os. Plus 8-9 | 1 | 1.6 | 4.83 | 0 | 17.56 |
| 14 | Os. Plus 8-9 | 2 | 2.1 | 3.61 | 17 | 2.56 |
| 15 | Os. Plus 8-9 | 3 | 2.2 | 4.33 | 0 | 4.39 |
| 16 | Os. Plus 12-14 Sp. | 2 | 1.8 | 4.00 | 0 | 5.72 |
| 17 | Os. Plus 12-14 Sp. | 3 | 2.3 | 4.50 | 6 | 13.08 |
| 18 | Os. Plus 12-14 Sp. | 4 | 1.6 | 2.58 | 22 | 2.49 |
| 19 | Os. Plus 12-14 At. | 3 | 1.5 | 4.44 | 0 | 6.56 |
| 20 | Os. Plus 12-14 At. | 4 | 1.5 | 3.67 | 11 | 2.16 |
| 21 | Os. Plus 12-14 At. | 5 | 1.3 | 2.17 | 0 | 1.06 |
| 22 | Os. 16-18 | 4 | 2.1 | 4.70 | 6 | 12.34 |
| 23 | Os. 16-18 | 5 | 2.3 | 3.05 | 72 | 4.32 |
| 24 | Os. 16-18 | 6 | 1.8 | 3.86 | 11 | 3.42 |
| | *d.f. =45* | *SED* = ± | | *0.535* | | *2.554* |
| | | *LSD(5%)* = ± | | *1.080* | | *5.162* |

# APPENDIX II

## Growth Records

Table 2 *Azalea* 'Rose Greeley' Spring 1992 potting - November 1992

(figures are a mean of 18 plants less dead plants)

| Treatments | | | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | Vigour Score (1-5) 5=most vigorous | %Dead | %Root Cover |
|---|---|---|---|---|---|---|---|
| Code | Fertilizer | Rate ($kg/m^3$) | | | | | |
| 1 | Ficote 140 TE | 1 | 2.89 | 3.44 | 3.28 | 0 | 51.7 |
| 2 | Ficote 140 TE | 2 | 3.00 | 3.56 | 3.28 | 0 | 44.7 |
| 3 | Ficote 140 TE | 3 | 3.03 | 3.47 | 3.21 | 6 | 36.0 |
| 4 | Ficote 180 TE | 2 | 3.11 | 3.22 | 3.44 | 0 | 42.8 |
| 5 | Ficote 180 TE | 3 | 2.61 | 4.08 | 3.72 | 11 | 52.2 |
| 6 | Ficote 180 TE | 4 | 2.50 | 3.50 | 3.17 | 17 | 40.8 |
| 7 | Ficote 270 TE | 3 | 2.70 | 3.07 | 3.54 | 6 | 45.8 |
| 8 | Ficote 270 TE | 4 | 3.17 | 3.56 | 3.33 | 0 | 52.2 |
| 9 | Ficote 270 TE | 5 | 2.96 | 3.66 | 3.44 | 17 | 38.3 |
| 10 | Ficote 360 TE | 4 | 3.11 | 3.44 | 3.22 | 0 | 48.9 |
| 11 | Ficote 360 TE | 5 | 2.72 | 3.83 | 3.67 | 0 | 48.9 |
| 12 | Ficote 360 TE | 6 | 2.88 | 3.77 | 3.50 | 6 | 43.3 |
| 13 | Os. Plus 8-9 | 1 | 2.83 | 1.28 | 2.67 | 0 | 55.6 |
| 14 | Os. Plus 8-9 | 2 | 2.44 | 2.97 | 3.31 | 22 | 38.9 |
| 15 | Os. Plus 8-9 | 3 | 2.13 | 3.36 | 2.98 | 22 | 36.9 |
| 16 | Os. Plus 12-14 Sp. | 2 | 2.58 | 3.26 | 3.07 | 6 | 44.4 |
| 17 | Os. Plus 12-14 Sp. | 3 | 2.72 | 4.16 | 3.86 | 11 | 54.9 |
| 18 | Os. Plus 12-14 Sp. | 4 | 2.20 | 3.50 | 3.51 | 11 | 45.2 |
| 19 | Os. Plus 12-14 At. | 3 | 2.56 | 2.89 | 3.39 | 0 | 45.6 |
| 20 | Os. Plus 12-14 At. | 4 | 3.00 | 3.50 | 3.61 | 0 | 49.4 |
| 21 | Os. Plus 12-14 At. | 5 | 2.78 | 3.89 | 3.44 | 0 | 42.2 |
| 22 | Os. 16-18 | 4 | 2.93 | 2.54 | 3.50 | 11 | 53.7 |
| 23 | Os. 16-18 | 5 | 3.22 | 2.78 | 3.56 | 0 | 72.5 |
| 24 | Os. 16-18 | 6 | 3.44 | 3.50 | 3.56 | 0 | 53.9 |
| *d.f. = 46* | *SED = ±* | | *0.315* | *0.418* | *0.334* | | *7.25* |
| | *LSD(5%) = ±* | | *0.636* | *0.844* | *0.674* | | *14.65* |

# APPENDIX II

## Growth Records

Table 3 *Azalea* 'Rose Greeley' Spring 1992 potting - June 1993

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | %Dead |
|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 3.07 | 2.00 | 0 |
| 2 | Ficote 140 TE | 2 | 2.92 | 2.21 | 0 |
| 3 | Ficote 140 TE | 3 | 3.33 | 3.25 | 6 |
| 4 | Ficote 180 TE | 2 | 3.55 | 2.80 | 0 |
| 5 | Ficote 180 TE | 3 | 3.50 | 3.08 | 11 |
| 6 | Ficote 180 TE | 4 | 3.17 | 3.33 | 17 |
| 7 | Ficote 270 TE | 3 | 3.70 | 3.20 | 6 |
| 8 | Ficote 270 TE | 4 | 4.10 | 4.18 | 0 |
| 9 | Ficote 270 TE | 5 | 3.87 | 4.00 | 17 |
| 10 | Ficote 360 TE | 4 | 3.83 | 3.92 | 0 |
| 11 | Ficote 360 TE | 5 | 3.90 | 3.90 | 0 |
| 12 | Ficote 360 TE | 6 | 3.25 | 3.83 | 6 |
| 13 | Os. Plus 8-9 | 1 | 3.50 | 1.08 | 0 |
| 14 | Os. Plus 8-9 | 2 | 3.33 | 1.75 | 22 |
| 15 | Os. Plus 8-9 | 3 | 4.00 | 2.75 | 22 |
| 16 | Os. Plus 12-14 Sp. | 2 | 3.83 | 2.77 | 6 |
| 17 | Os. Plus 12-14 Sp. | 3 | 4.00 | 3.17 | 11 |
| 18 | Os. Plus 12-14 Sp. | 4 | 2.88 | 3.38 | 11 |
| 19 | Os. Plus 12-14 At. | 3 | 3.75 | 3.00 | 0 |
| 20 | Os. Plus 12-14 At. | 4 | 4.27 | 3.17 | 0 |
| 21 | Os. Plus 12-14 At. | 5 | 4.00 | 4.25 | 0 |
| 22 | Os. 16-18 | 4 | 3.98 | 3.08 | 11 |
| 23 | Os. 16-18 | 5 | 4.33 | 3.92 | 0 |
| 24 | Os. 16-18 | 6 | 4.23 | 4.35 | 0 |
| *d.f. =23* | *SED = ±* | | *0.453* | *0.384* | |
| | *LSD(5%) = ±* | | *0.936* | *0.794* | |

# APPENDIX II

## Growth Records

Table 4 *Azalea* 'Rose Greeley' Spring 1992 potting - October 1993

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate (kg/m$^3$) | Size Score (1-5) 5=largest | Colour score (1-5) 5=darkest green | %Dead | %Root Cover | Quality (1-5) 5=best quality |
|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 1.82 | 3.00 | 8 | 89.3 | 1.17 |
| 2 | Ficote 140 TE | 2 | 1.79 | 2.67 | 17 | 70.8 | 1.00 |
| 3 | Ficote 140 TE | 3 | 2.25 | 3.00 | 33 | 78.1 | 2.00 |
| 4 | Ficote 180 TE | 2 | 2.75 | 3.17 | 8 | 83.8 | 1.50 |
| 5 | Ficote 180 TE | 3 | 2.75 | 3.33 | 0 | 92.7 | 2.33 |
| 6 | Ficote 180 TE | 4 | 2.42 | 2.83 | 25 | 82.1 | 1.83 |
| 7 | Ficote 270 TE | 3 | 3.10 | 3.00 | 17 | 88.0 | 1.20 |
| 8 | Ficote 270 TE | 4 | 3.17 | 3.20 | 8 | 85.0 | 1.53 |
| 9 | Ficote 270 TE | 5 | 3.53 | 3.40 | 33 | 86.0 | 2.00 |
| 10 | Ficote 360 TE | 4 | 3.08 | 3.17 | 0 | 83.8 | 2.00 |
| 11 | Ficote 360 TE | 5 | 3.53 | 3.80 | 8 | 93.3 | 2.55 |
| 12 | Ficote 360 TE | 6 | 3.25 | 4.17 | 25 | 91.7 | 2.33 |
| 13 | Os. Plus 8-9 | 1 | 1.75 | 1.00 | 0 | 91.3 | 1.00 |
| 14 | Os. Plus 8-9 | 2 | 1.58 | 1.17 | 22 | 72.1 | 1.00 |
| 15 | Os. Plus 8-9 | 3 | 2.13 | 2.00 | 50 | 83.8 | 1.00 |
| 16 | Os. Plus 12-14 Sp. | 2 | 2.48 | 1.90 | 8 | 78.3 | 1.20 |
| 17 | Os. Plus 12-14 Sp. | 3 | 3.17 | 2.50 | 0 | 85.4 | 2.17 |
| 18 | Os. Plus 12-14 Sp. | 4 | 2.88 | 1.75 | 58 | 93.1 | 1.50 |
| 19 | Os. Plus 12-14 At. | 3 | 3.03 | 3.00 | 25 | 89.5 | 1.45 |
| 20 | Os. Plus 12-14 At. | 4 | 2.98 | 2.07 | 8 | 69.7 | 1.17 |
| 21 | Os. Plus 12-14 At. | 5 | 3.63 | 2.83 | 17 | 87.9 | 1.58 |
| 22 | Os. 16-18 | 4 | 3.27 | 2.43 | 8 | 86.5 | 1.73 |
| 23 | Os. 16-18 | 5 | 4.58 | 2.50 | 0 | 90.8 | 2.17 |
| 24 | Os. 16-18 | 6 | 4.30 | 3.37 | 8 | 84.7 | 2.43 |
| *d.f. = 23* | *SED = ±* | | *0.288* | *0.542* | | *8.19* | *0.494* |
| | *LSD(5%) = ±* | | *0.598* | *1.122* | | *16.95* | *1.022* |

# APPENDIX II

## Growth Records

Table 5 *Pieris japonica* 'Forest Flame' Rooted Cuttings - April 1992

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Vigour Score (1-5) 5=most vigorous | %Dead | %Root Cover | Scorch Score (on young growth) 0=no scorch 1=scorched | Leaf Drop Score 0=no drop 1=leaf drop | Flush Stage Score (1-5) 5=most advanced |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 3.72 | 4.61 | 0 | 12.56 | 0.17 | 0.22 | 4.06 |
| 2 | Ficote 140 TE | 2 | 2.11 | 4.00 | 0 | 3.61 | 0.06 | 0.72 | 4.39 |
| 3 | Ficote 140 TE | 3 | 2.67 | 3.94 | 0 | 5.33 | 0.00 | 0.83 | 3.39 |
| 4 | Ficote 180 TE | 2 | 4.08 | 4.66 | 6 | 19.67 | 0.17 | 0.41 | 3.91 |
| 5 | Ficote 180 TE | 3 | 3.78 | 4.22 | 0 | 15.39 | 0.11 | 0.78 | 4.11 |
| 6 | Ficote 180 TE | 4 | 3.17 | 3.67 | 0 | 10.22 | 0.06 | 0.67 | 3.44 |
| 7 | Ficote 270 TE | 3 | 3.83 | 4.11 | 0 | 11.50 | 0.22 | 0.94 | 4.50 |
| 8 | Ficote 270 TE | 4 | 2.83 | 3.00 | 0 | 6.50 | 0.00 | 1.00 | 4.28 |
| 9 | Ficote 270 TE | 5 | 3.17 | 3.67 | 0 | 6.22 | 0.11 | 1.00 | 4.50 |
| 10 | Ficote 360 TE | 4 | 3.67 | 4.06 | 0 | 12.50 | 0.22 | 0.83 | 4.17 |
| 11 | Ficote 360 TE | 5 | 3.72 | 4.00 | 0 | 10.72 | 0.00 | 0.72 | 4.28 |
| 12 | Ficote 360 TE | 6 | 3.28 | 3.28 | 0 | 6.11 | 0.28 | 0.94 | 4.39 |
| 13 | Os. Plus 8-9 | 1 | 3.94 | 4.33 | 0 | 10.39 | 0.17 | 0.67 | 4.67 |
| 14 | Os. Plus 8-9 | 2 | 3.28 | 3.28 | 0 | 5.67 | 0.06 | 1.00 | 4.72 |
| 15 | Os. Plus 8-9 | 3 | 2.24 | 2.47 | 6 | 1.64 | 0.41 | 1.00 | 3.77 |
| 16 | Os. Plus 12-14 Sp. | 2 | 3.56 | 3.56 | 0 | 8.44 | 0.17 | 0.83 | 4.83 |
| 17 | Os. Plus 12-14 Sp. | 3 | 3.50 | 3.06 | 0 | 7.00 | 0.00 | 1.00 | 4.44 |
| 18 | Os. Plus 12-14 Sp. | 4 | 2.94 | 2.67 | 0 | 4.94 | 0.39 | 0.94 | 4.00 |
| 19 | Os. Plus 12-14 At. | 3 | 3.61 | 3.56 | 0 | 10.61 | 0.11 | 1.00 | 4.83 |
| 20 | Os. Plus 12-14 At. | 4 | 3.61 | 4.17 | 0 | 12.28 | 0.17 | 0.89 | 4.44 |
| 21 | Os. Plus 12-14 At. | 5 | 3.56 | 3.17 | 0 | 8.06 | 0.33 | 0.94 | 4.22 |
| 22 | Os. 16-18 | 4 | 3.78 | 3.94 | 0 | 9.06 | 0.17 | 0.67 | 4.50 |
| 23 | Os. 16-18 | 5 | 3.50 | 3.28 | 0 | 3.44 | 0.28 | 0.94 | 4.61 |
| 24 | Os. 16-18 | 6 | 2.94 | 3.11 | 0 | 3.67 | 0.22 | 1.00 | 4.33 |
| | *d.f. = 46* | *SED = ±* | *0.352* | *0.372* | | *3.033* | *0.122* | *0.135* | *0.332* |
| | | *LSD(5%) = ±* | *0.710* | *0.752* | | *6.129* | *0.247* | *0.273* | *0.670* |

# APPENDIX II

## Growth Records

Table 6 *Pieris japonica* 'Forest Flame' Rooted Cuttings - November 1992

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | Vigour Score | %Dead | %Root | Scorch Score (on old growth) 5=most scorch | Leaf Drop Score 0=no drop 1=leaf drop | Flush Stage Score (1-5) 5=most advanced |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 3.17 | 3.61 | 3.06 | 0 | 14.72 | 0.94 | 0.94 | 1.17 |
| 2 | Ficote 140 TE | 2 | 2.64 | 3.56 | 3.19 | 11 | 14.58 | 1.17 | 0.67 | 1.92 |
| 3 | Ficote 140 TE | 3 | 2.67 | 3.78 | 3.33 | 17 | 14.17 | 1.00 | 0.67 | 2.11 |
| 4 | Ficote 180 TE | 2 | 3.00 | 3.63 | 3.21 | 6 | 21.00 | 1.00 | 0.94 | 1.52 |
| 5 | Ficote 180 TE | 3 | 2.83 | 3.78 | 3.72 | 0 | 16.11 | 1.06 | 0.78 | 1.78 |
| 6 | Ficote 180 TE | 4 | 2.89 | 3.28 | 3.11 | 0 | 14.44 | 1.06 | 0.72 | 1.56 |
| 7 | Ficote 270 TE | 3 | 2.94 | 3.60 | 3.42 | 0 | 18.06 | 1.06 | 0.89 | 1.62 |
| 8 | Ficote 270 TE | 4 | 2.68 | 4.10 | 3.03 | 11 | 11.06 | 1.24 | 0.80 | 1.54 |
| 9 | Ficote 270 TE | 5 | 2.32 | 3.48 | 2.70 | 17 | 15.28 | 1.17 | 0.69 | 1.44 |
| 10 | Ficote 360 TE | 4 | 3.00 | 3.72 | 3.39 | 0 | 15.83 | 1.06 | 0.72 | 1.78 |
| 11 | Ficote 360 TE | 5 | 2.77 | 3.82 | 3.37 | 6 | 18.00 | 1.12 | 0.83 | 1.68 |
| 12 | Ficote 360 TE | 6 | 2.39 | 4.00 | 3.00 | 33 | 11.81 | 1.50 | 0.94 | 1.31 |
| 13 | Os. Plus 8-9 | 1 | 3.33 | 3.11 | 3.39 | 0 | 19.72 | 1.00 | 0.83 | 2.17 |
| 14 | Os. Plus 8-9 | 2 | 2.44 | 3.88 | 2.89 | 11 | 10.03 | 1.00 | 0.63 | 1.64 |
| 15 | Os. Plus 8-9 | 3 | 2.74 | 3.24 | 3.26 | 67 | 13.02 | 0.95 | 0.79 | 2.73 |
| 16 | Os. Plus 12-14 Sp. | 2 | 2.76 | 3.50 | 2.94 | 11 | 10.89 | 1.71 | 0.89 | 1.30 |
| 17 | Os. Plus 12-14 Sp. | 3 | 3.37 | 3.93 | 3.11 | 28 | 16.08 | 1.00 | 0.83 | 1.81 |
| 18 | Os. Plus 12-14 Sp. | 4 | 2.50 | 3.89 | 2.94 | 67 | 6.78 | 1.11 | 0.89 | 1.72 |
| 19 | Os. Plus 12-14 At. | 3 | 2.58 | 3.67 | 2.79 | 33 | 12.50 | 1.38 | 0.44 | 1.86 |
| 20 | Os. Plus 12-14 At. | 4 | 2.50 | 3.78 | 3.28 | 22 | 11.39 | 1.14 | 0.92 | 1.36 |
| 21 | Os. Plus 12-14 At. | 5 | 2.67 | 3.58 | 3.00 | 67 | 14.17 | 1.33 | 0.92 | 1.75 |
| 22 | Os. 16-18 | 4 | 2.72 | 3.69 | 3.03 | 11 | 10.97 | 1.44 | 1.00 | 1.25 |
| 23 | Os. 16-18 | 5 | 1.83 | 4.17 | 2.28 | 61 | 6.94 | 2.39 | 0.89 | 1.11 |
| 24 | Os. 16-18 | 6 | 1.99 | 3.99 | 3.14 | 67 | 6.77 | 1.95 | 0.79 | 1.11 |
| | *d.f. = 43* | *SED = ±* | *0.328* | *0.365* | *0.290* | | *4.357* | *0.395* | *0.171* | *0.343* |
| | | *LSD(5%) = ±* | *0.662* | *0.737* | *0.587* | | *8.805* | *0.799* | *0.346* | *0.694* |

# APPENDIX II

## Growth Records

Table 7 *Pieris japonica* 'Forest Flame' Rooted Cuttings - April 1993

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | %Dead | Scorch Score (on young growth) (1-5) 5=most scorched | Flush Stage Score (1-5) 5 = most advanced |
|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 3.50 | 3.11 | 0 | 1.22 | 2.78 |
| 2 | Ficote 140 TE | 2 | 2.86 | 3.00 | 11 | 1.56 | 4.78 |
| 3 | Ficote 140 TE | 3 | 2.88 | 3.44 | 22 | 2.27 | 4.36 |
| 4 | Ficote 180 TE | 2 | 3.06 | 2.73 | 6 | 1.11 | 3.44 |
| 5 | Ficote 180 TE | 3 | 3.20 | 3.13 | 17 | 1.80 | 4.13 |
| 6 | Ficote 180 TE | 4 | 3.39 | 3.70 | 33 | 2.56 | 3.91 |
| 7 | Ficote 270 TE | 3 | 3.11 | 3.11 | 0 | 1.89 | 4.11 |
| 8 | Ficote 270 TE | 4 | 3.16 | 3.00 | 33 | 2.60 | 4.09 |
| 9 | Ficote 270 TE | 5 | 2.47 | 3.37 | 61 | 2.50 | 4.59 |
| 10 | Ficote 360 TE | 4 | 3.06 | 3.22 | 0 | 2.78 | 4.33 |
| 11 | Ficote 360 TE | 5 | 3.05 | 3.00 | 33 | 2.64 | 4.64 |
| 12 | Ficote 360 TE | 6 | 3.30 | 3.02 | 78 | 4.03 | 5.18 |
| 13 | Os. Plus 8-9 | 1 | 3.39 | 2.89 | 0 | 1.22 | 3.22 |
| 14 | Os. Plus 8-9 | 2 | 2.69 | 3.00 | 28 | 3.11 | 4.78 |
| 15 | Os. Plus 8-9 | 3 | 3.17 | 3.00 | 67 | 1.33 | 5.00 |
| 16 | Os. Plus 12-14 Sp. | 2 | 2.26 | 3.31 | 17 | 3.14 | 4.50 |
| 17 | Os. Plus 12-14 Sp. | 3 | 2.29 | 3.00 | 28 | 3.02 | 4.49 |
| 18 | Os. Plus 12-14 Sp. | 4 | 4.02 | 3.00 | 89 | 1.00 | 4.03 |
| 19 | Os. Plus 12-14 At. | 3 | 2.67 | 3.22 | 33 | 2.78 | 3.89 |
| 20 | Os. Plus 12-14 At. | 4 | 2.00 | 3.00 | 56 | 3.33 | 4.33 |
| 21 | Os. Plus 12-14 At. | 5 | 3.17 | 3.00 | 72 | 3.00 | 5.00 |
| 22 | Os. 16-18 | 4 | 2.15 | 2.87 | 28 | 3.20 | 4.43 |
| 23 | Os. 16-18 | 5 | 2.08 | 2.96 | 89 | 4.93 | 4.64 |
| 24 | Os. 16-18 | 6 | 1.08 | 2.96 | 83 | 3.93 | 4.64 |
| | *d.f. = 39* *SED* = ± | | *0.426* | *0.308* | | *0.765* | *0.559* |
| | *LSD(5%)* = ± | | *0.862* | *0.623* | | *1.546* | *1.129* |

# APPENDIX II

## Growth Records

Table 8 *Pieris japonica* 'Forest Flame' Rooted Cuttings - October 1993
(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | %Dead | %Root Cover | Tip Scorch Score (on old growth) (1-5) 5=most scorch | Flower (mean no. plants with flower per plot) | Quality (1-5) 5=best quality |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 3.33 | 2.89 | 0 | 64.4 | 4.44 | 5.00 | 1.78 |
| 2 | Ficote 140 TE | 2 | 3.08 | 4.00 | 11 | 48.4 | 3.50 | 4.33 | 2.56 |
| 3 | Ficote 140 TE | 3 | 3.59 | 3.80 | 22 | 37.0 | 2.07 | 2.00 | 3.69 |
| 4 | Ficote 180 TE | 2 | 2.94 | 3.33 | 6 | 60.5 | 3.76 | 4.67 | 2.53 |
| 5 | Ficote 180 TE | 3 | 3.14 | 3.61 | 17 | 55.5 | 3.62 | 2.33 | 2.94 |
| 6 | Ficote 180 TE | 4 | 3.40 | 4.02 | 33 | 42.6 | 3.22 | 3.00 | 2.63 |
| 7 | Ficote 270 TE | 3 | 4.18 | 4.16 | 11 | 57.8 | 2.93 | 4.33 | 2.96 |
| 8 | Ficote 270 TE | 4 | 4.25 | 3.83 | 44 | 54.8 | 2.87 | 2.33 | 3.50 |
| 9 | Ficote 270 TE | 5 | 2.76 | 4.66 | 61 | 29.8 | 3.20 | 1.53 | 2.24 |
| 10 | Ficote 360 TE | 4 | 4.36 | 4.36 | 11 | 62.1 | 3.64 | 3.00 | 3.73 |
| 11 | Ficote 360 TE | 5 | 3.98 | 4.70 | 33 | 50.4 | 3.16 | 2.67 | 2.97 |
| 12 | Ficote 360 TE | 6 | 4.62 | 4.26 | 78 | 40.0 | 4.03 | 1.14 | 3.70 |
| 13 | Os. Plus 8-9 | 1 | 3.28 | 1.33 | 0 | 70.3 | 3.00 | 5.67 | 1.56 |
| 14 | Os. Plus 8-9 | 2 | 2.97 | 3.39 | 28 | 33.3 | 2.44 | 1.33 | 2.44 |
| 15 | Os. Plus 8-9 | 3 | 3.50 | 2.33 | 67 | 61.2 | 3.00 | 1.00 | 2.00 |
| 16 | Os. Plus 12-14 Sp. | 2 | 3.03 | 3.23 | 17 | 39.7 | 2.51 | 1.67 | 1.74 |
| 17 | Os. Plus 12-14 Sp. | 3 | 3.24 | 2.67 | 33 | 48.1 | 3.27 | 1.67 | 1.71 |
| 18 | Os. Plus 12-14 Sp. | 4 | 4.58 | 2.88 | 89 | 66.3 | 4.07 | 0.83 | 1.03 |
| 19 | Os. Plus 12-14 At. | 3 | 2.94 | 3.11 | 33 | 44.4 | 3.56 | 2.33 | 1.44 |
| 20 | Os. Plus 12-14 At. | 4 | 3.11 | 4.33 | 72 | 48.3 | 3.00 | 0.33 | 3.67 |
| 21 | Os. Plus 12-14 At. | 5 | 3.33 | 3.89 | 72 | 40.0 | 3.89 | 0.33 | 1.67 |
| 22 | Os. 16-18 | 4 | 3.55 | 3.00 | 44 | 45.2 | 4.70 | 0.67 | 1.00 |
| 23 | Os. 16-18 | 5 | 4.10 | 2.49 | 94 | 61.6 | 4.93 | 0.72 | 2.93 |
| 24 | Os. 16-18 | 6 | 1.10 | 4.48 | 92 | 6.7 | 2.94 | 0.00 | 2.93 |
| | *d.f. = 39* | *SED = ±* | *0.622* | *0.667* | | *11.95* | *0.905* | *1.137* | *0.652* |
| | | *LSD(5%) = ±* | *1.256* | *1.347* | | *24.15* | *1.829* | *2.298* | *1.317* |

# APPENDIX II

## Growth Records

Table 9 *Pieris japonica* 'Forest Flame' Plugs - April 1992

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | Vigour Score (1-5) 5=most vigorous | %Dead | %Root Cover | Scorch Score (on old growth) 0=no scorch 1=scorched | Leaf Drop Score (mean no. plants per plot with drop) | Flush Stage Score (1-5) 5=most advanced |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 3.33 | 2.33 | 4.06 | 0 | 6.61 | 0.83 | 2.00 | 4.22 |
| 2 | Ficote 140 TE | 2 | 2.78 | 3.56 | 3.28 | 0 | 5.06 | 0.94 | 4.67 | 4.44 |
| 3 | Ficote 140 TE | 3 | 2.58 | 3.68 | 2.77 | 6 | 3.93 | 0.83 | 4.67 | 3.74 |
| 4 | Ficote 180 TE | 2 | 3.44 | 3.00 | 4.00 | 0 | 6.83 | 0.61 | 3.00 | 4.11 |
| 5 | Ficote 180 TE | 3 | 2.28 | 3.44 | 3.17 | 0 | 2.89 | 0.56 | 5.33 | 3.61 |
| 6 | Ficote 180 TE | 4 | 2.14 | 4.31 | 2.52 | 6 | 1.27 | 0.60 | 5.33 | 3.43 |
| 7 | Ficote 270 TE | 3 | 2.83 | 3.33 | 3.39 | 0 | 2.89 | 0.50 | 4.67 | 3.67 |
| 8 | Ficote 270 TE | 4 | 2.67 | 3.78 | 3.39 | 0 | 2.83 | 0.94 | 4.33 | 4.11 |
| 9 | Ficote 270 TE | 5 | 2.50 | 3.00 | 3.22 | 0 | 1.83 | 0.67 | 5.67 | 3.78 |
| 10 | Ficote 360 TE | 4 | 3.22 | 3.67 | 3.72 | 0 | 4.56 | 0.72 | 4.33 | 4.17 |
| 11 | Ficote 360 TE | 5 | 2.72 | 3.22 | 3.56 | 0 | 3.61 | 0.78 | 3.67 | 3.83 |
| 12 | Ficote 360 TE | 6 | 2.61 | 3.22 | 2.72 | 0 | 1.44 | 0.78 | 5.00 | 3.94 |
| 13 | Os. Plus 8-9 | 1 | 3.22 | 3.00 | 3.33 | 0 | 5.22 | 0.56 | 5.67 | 3.22 |
| 14 | Os. Plus 8-9 | 2 | 2.50 | 3.56 | 2.89 | 0 | 2.00 | 0.78 | 5.00 | 3.50 |
| 15 | Os. Plus 8-9 | 3 | 2.89 | 3.78 | 3.00 | 0 | 3.50 | 0.72 | 4.67 | 4.22 |
| 16 | Os. Plus 12-14 Sp. | 2 | 2.76 | 2.89 | 3.67 | 0 | 5.67 | 0.61 | 3.67 | 3.67 |
| 17 | Os. Plus 12-14 Sp. | 3 | 2.78 | 3.00 | 3.28 | 0 | 4.17 | 0.50 | 4.67 | 3.72 |
| 18 | Os. Plus 12-14 Sp. | 4 | 2.67 | 2.61 | 3.39 | 0 | 3.61 | 0.61 | 4.33 | 3.61 |
| 19 | Os. Plus 12-14 At. | 3 | 2.32 | 4.16 | 2.74 | 6 | 3.20 | 0.59 | 4.67 | 4.14 |
| 20 | Os. Plus 12-14 At. | 4 | 2.39 | 3.23 | 3.69 | 6 | 3.31 | 0.36 | 2.67 | 4.14 |
| 21 | Os. Plus 12-14 At. | 5 | 2.33 | 3.71 | 2.51 | 6 | 2.66 | 1.00 | 5.67 | 4.28 |
| 22 | Os. 16-18 | 4 | 2.62 | 3.44 | 2.88 | 6 | 1.97 | 0.82 | 4.67 | 3.87 |
| 23 | Os. 16-18 | 5 | 1.40 | 3.60 | 1.40 | 33 | 0.93 | 0.93 | 4.00 | 2.20 |
| 24 | Os. 16-18 | 6 | 2.22 | 3.11 | 2.39 | 0 | 1.67 | 0.78 | 4.33 | 3.11 |
| | *d.f. = 46* | *SED = ±* | *0.413* | *0.427* | *0.413* | | *1.511* | *0.166* | *0.868* | *0.447* |
| | | *LSD(5%) = ±* | *0.834* | *0.863* | *0.835* | | *3.054* | *0.336* | *1.754* | *0.903* |

# APPENDIX II

## Growth Records

Table 10 *Pieris japonica* 'Forest Flame' Plugs - November 1992

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | Vigour Score (1-5) 5=most vigorous | %Dead | %Root Cover | Scorch Score (on old growth) (1to5) 5=most scorch | Leaf Drop (mean no. plants per plot with drop) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 2.62 | 3.61 | 3.50 | 0 | 17.78 | 1.06 | 0.00 |
| 2 | Ficote 140 TE | 2 | 2.76 | 3.82 | 3.48 | 11 | 13.43 | 1.06 | 0.33 |
| 3 | Ficote 140 TE | 3 | 2.58 | 3.93 | 3.64 | 33 | 20.78 | 1.00 | 1.00 |
| 4 | Ficote 180 TE | 2 | 2.78 | 3.89 | 3.61 | 0 | 14.22 | 1.11 | 0.33 |
| 5 | Ficote 180 TE | 3 | 2.27 | 4.07 | 3.13 | 28 | 8.62 | 1.18 | 1.33 |
| 6 | Ficote 180 TE | 4 | 2.50 | 4.17 | 3.50 | 67 | 7.00 | 1.00 | 0.67 |
| 7 | Ficote 270 TE | 3 | 2.88 | 3.88 | 3.33 | 17 | 9.72 | 1.08 | 0.67 |
| 8 | Ficote 270 TE | 4 | 2.68 | 3.83 | 3.45 | 28 | 10.58 | 1.00 | 0.00 |
| 9 | Ficote 270 TE | 5 | 2.46 | 3.87 | 3.08 | 17 | 12.89 | 1.00 | 0.00 |
| 10 | Ficote 360 TE | 4 | 2.64 | 3.89 | 3.53 | 11 | 13.06 | 1.08 | 0.33 |
| 11 | Ficote 360 TE | 5 | 2.98 | 3.77 | 3.32 | 22 | 12.56 | 1.11 | 0.33 |
| 12 | Ficote 360 TE | 6 | 2.58 | 3.83 | 2.75 | 33 | 6.58 | 1.58 | 1.00 |
| 13 | Os. Plus 8-9 | 1 | 3.06 | 3.63 | 3.37 | 0 | 17.39 | 1.06 | 2.00 |
| 14 | Os. Plus 8-9 | 2 | 3.08 | 3.60 | 3.59 | 22 | 14.94 | 1.07 | 0.67 |
| 15 | Os. Plus 8-9 | 3 | 3.05 | 3.68 | 3.37 | 22 | 21.00 | 0.92 | 0.00 |
| 16 | Os. Plus 12-14 Sp. | 2 | 2.99 | 3.63 | 3.29 | 0 | 16.78 | 1.07 | 0.33 |
| 17 | Os. Plus 12-14 Sp. | 3 | 2.70 | 3.91 | 3.52 | 17 | 20.21 | 1.00 | 0.33 |
| 18 | Os. Plus 12-14 Sp. | 4 | 3.19 | 3.69 | 3.33 | 11 | 14.69 | 1.11 | 0.67 |
| 19 | Os. Plus 12-14 At. | 3 | 2.25 | 3.92 | 2.67 | 50 | 4.83 | 1.61 | 2.00 |
| 20 | Os. Plus 12-14 At. | 4 | 2.33 | 4.00 | 3.44 | 17 | 8.78 | 1.06 | 0.67 |
| 21 | Os. Plus 12-14 At. | 5 | 2.00 | 4.00 | 3.00 | 78 | 5.83 | 1.33 | 0.00 |
| 22 | Os. 16-18 | 4 | 2.39 | 3.78 | 3.33 | 44 | 6.47 | 1.58 | 1.33 |
| 23 | Os. 16-18 | 5 | - | - | - | 100 | - | - | - |
| 24 | Os. 16-18 | 6 | 2.24 | 3.81 | 3.14 | 50 | 6.74 | 1.47 | 1.45 |
| | *d.f. = 43* | *SED = ±* | *0.291* | *0.196* | *0.329* | | *5.966* | *0.180* | *0.659* |
| | | *LSD(5%) = ±* | *0.588* | *0.395* | *0.666* | | *12.057* | *0.364* | *1.332* |

# APPENDIX II

## Growth Records

Table 11 *Pieris japonica* 'Forest Flame' Plugs - April 1993

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate (kg/m$^3$) | Size Score (1-5) 5=largest | Colour Score (1-3) 3=darkest green | %Dead | Scorch Score (on old growth) 0=no scorch 1=scorch |
|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 2.61 | 2.06 | 0 | 0.00 |
| 2 | Ficote 140 TE | 2 | 3.17 | 2.00 | 11 | 0.06 |
| 3 | Ficote 140 TE | 3 | 3.06 | 2.59 | 33 | 0.07 |
| 4 | Ficote 180 TE | 2 | 3.22 | 2.44 | 0 | 0.06 |
| 5 | Ficote 180 TE | 3 | 2.78 | 2.53 | 33 | 0.22 |
| 6 | Ficote 180 TE | 4 | 2.50 | 2.83 | 67 | 0.17 |
| 7 | Ficote 270 TE | 3 | 3.18 | 2.64 | 17 | 0.00 |
| 8 | Ficote 270 TE | 4 | 3.17 | 2.33 | 28 | 0.08 |
| 9 | Ficote 270 TE | 5 | 3.09 | 2.42 | 17 | 0.13 |
| 10 | Ficote 360 TE | 4 | 3.12 | 2.39 | 11 | 0.20 |
| 11 | Ficote 360 TE | 5 | 3.28 | 2.67 | 22 | 0.00 |
| 12 | Ficote 360 TE | 6 | 2.72 | 2.44 | 61 | 0.28 |
| 13 | Os. Plus 8-9 | 1 | 3.20 | 1.66 | 0 | 0.06 |
| 14 | Os. Plus 8-9 | 2 | 3.22 | 1.61 | 22 | 0.06 |
| 15 | Os. Plus 8-9 | 3 | 3.33 | 2.23 | 22 | 0.13 |
| 16 | Os. Plus 12-14 Sp. | 2 | 3.11 | 2.00 | 0 | 0.11 |
| 17 | Os. Plus 12-14 Sp. | 3 | 2.98 | 2.13 | 17 | 0.12 |
| 18 | Os. Plus 12-14 Sp. | 4 | 3.31 | 1.81 | 11 | 0.11 |
| 19 | Os. Plus 12-14 At. | 3 | 1.86 | 2.25 | 56 | 0.92 |
| 20 | Os. Plus 12-14 At. | 4 | 2.79 | 2.02 | 22 | 0.00 |
| 21 | Os. Plus 12-14 At. | 5 | 1.50 | 2.67 | 78 | 0.50 |
| 22 | Os. 16-18 | 4 | 2.53 | 2.25 | 44 | 0.31 |
| 23 | Os. 16-18 | 5 | - | - | 100 | - |
| 24 | Os. 16-18 | 6 | 1.90 | 2.49 | 56 | 0.51 |
| *d.f. =43* | *SED = ±* | | *0.463* | *0.338* | | *0.177* |
| | *LSD(5%) = ±* | | *0.935* | *0.683* | | *0.358* |

# APPENDIX II

## Growth Records

Table 12 *Pieris japonica* 'Forest Flame' Plugs - October 1993

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate (kg/m³) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | %Dead | %Root Cover | Tip Scorch Score (on old growth) (1-5) 5=most tip scorch | Flower 0=no flower 1=flowering | Quality (1-5) 5=best quality |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 2.33 | 3.39 | 0 | 71.9 | 3.11 | 0.00 | 3.33 |
| 2 | Ficote 140 TE | 2 | 3.33 | 3.89 | 11 | 66.6 | 4.00 | 0.17 | 2.78 |
| 3 | Ficote 140 TE | 3 | 3.43 | 4.36 | 33 | 54.1 | 3.89 | 0.19 | 2.07 |
| 4 | Ficote 180 TE | 2 | 3.21 | 4.53 | 6 | 75.2 | 4.42 | 0.12 | 2.69 |
| 5 | Ficote 180 TE | 3 | 2.94 | 5.00 | 33 | 35.8 | 3.66 | 0.15 | 2.59 |
| 6 | Ficote 180 TE | 4 | 2.67 | 5.00 | 78 | 35.0 | 3.33 | 0.17 | 2.00 |
| 7 | Ficote 270 TE | 3 | 3.64 | 4.83 | 17 | 53.3 | 3.88 | 0.00 | 2.59 |
| 8 | Ficote 270 TE | 4 | 3.52 | 4.83 | 28 | 69.4 | 4.57 | 0.00 | 2.70 |
| 9 | Ficote 270 TE | 5 | 4.06 | 4.61 | 28 | 67.9 | 3.67 | 0.31 | 2.50 |
| 10 | Ficote 360 TE | 4 | 3.52 | 5.00 | 12 | 56.1 | 4.20 | 0.15 | 2.37 |
| 11 | Ficote 360 TE | 5 | 4.02 | 5.00 | 22 | 72.5 | 3.53 | 0.33 | 2.80 |
| 12 | Ficote 360 TE | 6 | 4.39 | 4.78 | 67 | 58.3 | 3.22 | 0.00 | 2.78 |
| 13 | Os. Plus 8-9 | 1 | 3.72 | 2.67 | 0 | 67.8 | 2.56 | 0.33 | 2.67 |
| 14 | Os. Plus 8-9 | 2 | 3.82 | 3.40 | 24 | 75.3 | 3.31 | 0.31 | 2.73 |
| 15 | Os. Plus 8-9 | 3 | 3.53 | 3.73 | 22 | 63.8 | 3.23 | 0.38 | 2.23 |
| 16 | Os. Plus 12-14 Sp. | 2 | 3.00 | 3.00 | 0 | 61.8 | 3.56 | 0.33 | 1.78 |
| 17 | Os. Plus 12-14 Sp. | 3 | 3.72 | 3.80 | 17 | 58.2 | 3.49 | 0.52 | 2.64 |
| 18 | Os. Plus 12-14 Sp. | 4 | 3.19 | 3.26 | 17 | 62.5 | 3.36 | 0.19 | 2.27 |
| 19 | Os. Plus 12-14 At. | 3 | 2.44 | 5.00 | 61 | 8.8 | 3.78 | 0.56 | 1.00 |
| 20 | Os. Plus 12-14 At. | 4 | 3.13 | 4.13 | 28 | 54.8 | 3.36 | 0.24 | 2.42 |
| 21 | Os. Plus 12-14 At. | 5 | 3.28 | 3.93 | 83 | 42.8 | 3.02 | 0.21 | 1.96 |
| 22 | Os. 16-18 | 4 | 3.11 | 4.44 | 50 | 59.0 | 3.89 | 0.19 | 1.94 |
| 23 | Os. 16-18 | 5 | - | - | 100 | - | - | - | - |
| 24 | Os. 16-18 | 6 | 2.63 | 4.83 | 61 | 38.5 | 3.31 | 0.76 | 1.42 |
| | *d.f. = 42* *SED = ±* | | *0.475* | *0.600* | | *12.69* | *0.533* | *0.298* | *0.547* |
| | *LSD(5%) = ±* | | *0.960* | *1.213* | | *25.65* | *1.078* | *0.603* | *1.106* |

# APPENDIX II

## Growth Records

Table 13 *Elaeagnus pungens* 'Maculata' - May 1992

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate (kg/m³) | Size Score (1-5) 5=largest | Vigour Score (1-5) 5=most vigorous | %Dead | % Root Cover |
|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 2 | 3.83 | 4.89 | 0 | 7.56 |
| 2 | Ficote 140 TE | 3 | 3.78 | 4.61 | 0 | 8.33 |
| 3 | Ficote 140 TE | 4 | 3.14 | 4.27 | 6 | 5.69 |
| 4 | Ficote 180 TE | 3 | 2.94 | 4.17 | 0 | 5.22 |
| 5 | Ficote 180 TE | 4 | 2.61 | 4.08 | 11 | 4.81 |
| 6 | Ficote 180 TE | 5 | 2.72 | 4.39 | 0 | 7.28 |
| 7 | Ficote 270 TE | 4 | 3.83 | 4.89 | 0 | 8.00 |
| 8 | Ficote 270 TE | 5 | 3.11 | 4.28 | 0 | 8.11 |
| 9 | Ficote 270 TE | 6 | 3.22 | 4.28 | 0 | 6.22 |
| 10 | Ficote 360 TE | 5 | 3.33 | 4.39 | 0 | 7.17 |
| 11 | Ficote 360 TE | 6 | 3.61 | 4.61 | 0 | 7.89 |
| 12 | Ficote 360 TE | 7 | 3.56 | 4.39 | 0 | 7.44 |
| 13 | Os. Plus 8-9 | 2 | 3.67 | 4.61 | 0 | 8.44 |
| 14 | Os. Plus 8-9 | 3 | 2.94 | 3.39 | 22 | 5.17 |
| 15 | Os. Plus 8-9 | 4 | 3.07 | 4.30 | 17 | 6.71 |
| 16 | Os. Plus 12-14 Sp. | 3 | 3.67 | 4.61 | 0 | 9.22 |
| 17 | Os. Plus 12-14 Sp. | 4 | 3.78 | 4.89 | 0 | 7.50 |
| 18 | Os. Plus 12-14 Sp. | 5 | 4.00 | 4.78 | 0 | 12.11 |
| 19 | Os. Plus 12-14 At. | 4 | 3.67 | 4.61 | 0 | 7.78 |
| 20 | Os. Plus 12-14 At. | 5 | 3.41 | 4.47 | 6 | 7.78 |
| 21 | Os. Plus 12-14 At. | 6 | 3.33 | 4.72 | 0 | 7.56 |
| 22 | Os. 16-18 | 7 | 2.55 | 3.23 | 22 | 3.43 |
| 23 | Os. 16-18 | 8 | 2.62 | 3.54 | 28 | 5.29 |
| 24 | Os. 16-18 | 9 | 2.36 | 2.69 | 39 | 2.61 |
| | *d.f. =46* | *SED = ±* | *0.405* | *0.484* | | *1.336* |
| | | *LSD(5%) = ±* | *0.819* | *0.978* | | *2.700* |

# APPENDIX IV

## Media Analyses - Available

## November 1992

Table 19 *Azalea* 'Rose Greeley' - Mean over 3 Replicates

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | pH | P (mg/l) | K (mg/l) | Mg (mg/l) | Cond. ($\mu s$) | $NO_3$ (mg/l) | $NH_4$ (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 4.6 | 19 (4) | 37 (1) | 26 (4) | 150 (0) | 22 (1) | 10 (0) |
| 2 | Ficote 140 TE | 2 | 4.4 | 49 (6) | 78 (2) | 45 (5) | 254 (1) | 68 (3) | 37 (1) |
| 3 | Ficote 140 TE | 3 | 4.4 | 58 (7) | 111 (3) | 56 (6) | 333 (2) | 107 (4) | 53 (2) |
| 4 | Ficote 180 TE | 2 | 4.6 | 40 (5) | 74 (2) | 35 (4) | 233 (1) | 69 (3) | 36 (1) |
| 5 | Ficote 180 TE | 3 | 4.5 | 65 (7) | 114 (3) | 54 (6) | 330 (2) | 100 (4) | 54 (2) |
| 6 | Ficote 180 TE | 4 | 4.4 | 107 (9) | 193 (4) | 73 (6) | 485 (3) | 163 (5) | 98 (2) |
| 7 | Ficote 270 TE | 3 | 4.6 | 65 (7) | 116 (3) | 51 (6) | 370 (2) | 129 (4) | 81 (2) |
| 8 | Ficote 270 TE | 4 | 4.6 | 77 (8) | 130 (3) | 53 (6) | 391 (2) | 127 (4) | 92 (2) |
| 9 | Ficote 270 TE | 5 | 4.4 | 138 (9) | 251 (5) | 85 (6) | 672 (5) | 264 (6) | 190 (4) |
| 10 | Ficote 360 TE | 4 | 4.6 | 106 (9) | 215 (4) | 72 (6) | 621 (5) | 241 (6) | 179 (4) |
| 11 | Ficote 360 TE | 5 | 4.5 | 108 (9) | 207 (4) | 74 (6) | 572 (4) | 215 (6) | 154 (4) |
| 12 | Ficote 360 TE | 6 | 4.5 | 125 (9) | 249 (4) | 81 (6) | 699 (5) | 282 (6) | 203 (5) |
| 13 | Os. Plus 8-9 | 1 | 4.5 | 49 (6) | 92 (2) | 39 (5) | 289 (1) | 85 (4) | 62 (2) |
| 14 | Os. Plus 8-9 | 2 | 4.4 | 32 (5) | 71 (2) | 23 (3) | 171 (1) | 38 (2) | 19 (0) |
| 15 | Os. Plus 8-9 | 3 | 4.4 | 51 (6) | 121 (3) | 34 (4) | 247 (1) | 60 (3) | 36 (1) |
| 16 | Os. Plus 12-14 Sp. | 2 | 4.6 | 56 (7) | 109 (3) | 32 (4) | 240 (1) | 64 (3) | 41 (1) |
| 17 | Os. Plus 12-14 Sp. | 3 | 4.8 | 63 (7) | 139 (3) | 34 (4) | 293 (1) | 77 (3) | 40 (1) |
| 18 | Os. Plus 12-14 Sp. | 4 | 4.4 | 85 (8) | 182 (4) | 52 (6) | 387 (2) | 125 (4) | 80 (2) |
| 19 | Os. Plus 12-14 At. | 3 | 4.5 | 71 (7) | 161 (3) | 42 (5) | 348 (2) | 101 (4) | 74 (2) |
| 20 | Os. Plus 12-14 At. | 4 | 4.6 | 115 (9) | 249 (4) | 49 (5) | 509 (4) | 157 (5) | 133 (3) |
| 21 | Os. Plus 12-14 At. | 5 | 4.3 | 127 (9) | 283 (5) | 48 (5) | 535 (4) | 172 (5) | 150 (3) |
| 22 | Os. 16-18 | 4 | 4.7 | 140 (9) | 211 (4) | 41 (5) | 559 (4) | 194 (5) | 210 (5) |
| 23 | Os. 16-18 | 5 | 4.7 | 134 (9) | 226 (4) | 39 (5) | 567 (4) | 191 (5) | 173 (4) |
| 24 | Os. 16-18 | 6 | 4.6 | 190 (9) | 355 (5) | 55 (6) | 797 (6) | 201 (6) | 215 (5) |

# APPENDIX IV

## Media Analyses - Available

## November 1992

Table 20 *Pieris japonica* 'Forest Flame' Rooted Cuttings - Mean over 3 Replicates

| Treatments | | | pH | P (mg/l) | K (mg/l) | Mg (mg/l) | Cond. ($\mu$s) | $NO_3$ (mg/l) | $NH_4$ (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| Code | Fertilizer | Rate ($kg/m^3$) | | | | | | | |
| 1 | Ficote 140 TE | 1 | 4.7 | 12 (3) | 23 (0) | 38 (5) | 208 (1) | 36 (2) | 7 (0) |
| 2 | Ficote 140 TE | 2 | 4.6 | 49 (6) | 67 (2) | 98 (7) | 380 (2) | 115 (4) | 10 (0) |
| 3 | Ficote 140 TE | 3 | 4.7 | 76 (8) | 103 (3) | 110 (7) | 470 (3) | 128 (4) | 26 (1) |
| 4 | Ficote 180 TE | 2 | 4.9 | 30 (5) | 45 (1) | 70 (6) | 309 (2) | 58 (3) | 14 (0) |
| 5 | Ficote 180 TE | 3 | 4.7 | 56 (7) | 77 (2) | 95 (7) | 382 (2) | 105 (4) | 23 (1) |
| 6 | Ficote 180 TE | 4 | 4.8 | 63 (7) | 89 (2) | 112 (7) | 456 (3) | 117 (4) | 18 (0) |
| 7 | Ficote 270 TE | 3 | 4.9 | 77 (8) | 149 (3) | 125 (7) | 632 (5) | 178 (5) | 75 (2) |
| 8 | Ficote 270 TE | 4 | 4.6 | 164 (9) | 282 (5) | 221 (9) | 999 (7) | 364 (7) | 147 (3) |
| 9 | Ficote 270 TE | 5 | 4.5 | 169 (9) | 296 (5) | 240 (9) | 1037 (7) | 408 (7) | 183 (4) |
| 10 | Ficote 360 TE | 4 | 4.6 | 91 (8) | 159 (3) | 149 (7) | 677 (5) | 243 (6) | 89 (2) |
| 11 | Ficote 360 TE | 5 | 4.9 | 150 (9) | 275 (5) | 206 (9) | 976 (7) | 381 (7) | 161 (4) |
| 12 | Ficote 360 TE | 6 | 4.7 | 192 (9) | 387 (5) | 229 (9) | 1191 (8) | 487 (7) | 249 (5) |
| 13 | Os. Plus 8-9 | 1 | 4.9 | 37 (5) | 49 (1) | 103 (7) | 355 (2) | 71 (3) | 7 (0) |
| 14 | Os. Plus 8-9 | 2 | 4.7 | 78 (8) | 106 (3) | 229 (9) | 510 (4) | 153 (5) | 9 (0) |
| 15 | Os. Plus 8-9 | 3 | 4.4 | 122 (9) | 228 (4) | 206 (9) | 692 (5) | 250 (6) | 27 (1) |
| 16 | Os. Plus 12-14 Sp. | 2 | 4.7 | 80 (8) | 130 (3) | 136 (7) | 490 (3) | 152 (5) | 21 (1) |
| 17 | Os. Plus 12-14 Sp. | 3 | 4.5 | 91 (8) | 138 (3) | 140 (7) | 552 (4) | 162 (5) | 24 (1) |
| 18 | Os. Plus 12-14 Sp. | 4 | 4.6 | 138 (9) | 205 (4) | 159 (8) | 586 (4) | 217 (6) | 34 (1) |
| 19 | Os. Plus 12-14 At. | 3 | 4.5 | 96 (8) | 152 (3) | 130 (7) | 523 (4) | 146 (5) | 32 (1) |
| 20 | Os. Plus 12-14 At. | 4 | 4.6 | 144 (9) | 225 (4) | 190 (8) | 697 (5) | 222 (6) | 57 (2) |
| 21 | Os. Plus 12-14 At. | 5 | 4.7 | 194 (9) | 353 (5) | 215 (9) | 899 (6) | 304 (7) | 152 (4) |
| 22 | Os. 16-18 | 4 | 4.5 | 163 (9) | 238 (4) | 152 (8) | 742 (6) | 205 (6) | 79 (2) |
| 23 | Os. 16-18 | 5 | 4.5 | 205 (9) | 214 (4) | 170 (8) | 778 (6) | 242 (6) | 151 (4) |
| 24 | Os. 16-18 | 6 | 4.7 | 240 (9) | 402 (6) | 248 (9) | 1125 (8) | 440 (7) | 300 (5) |

# APPENDIX IV

## Media Analyses - Available

## November 1992

Table 21 *Pieris* Plugs - Mean over 3 Replicates

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | pH | P (mg/l) | K (mg/l) | Mg (mg/l) | Cond. ($\mu s$) | $NO_3$ (mg/l) | $NH_4$ (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 5.2 | 7 (1) | 9 (0) | 20 (3) | 124 (0) | 12 (0) | 7 (0) |
| 2 | Ficote 140 TE | 2 | 4.7 | 23 (4) | 33 (1) | 43 (5) | 219 (1) | 43 (3) | 12 (0) |
| 3 | Ficote 140 TE | 3 | 4.7 | 69 (7) | 113 (3) | 97 (7) | 411 (0) | 257 (6) | 35 (1) |
| 4 | Ficote 180 TE | 2 | 4.5 | 28 (4) | 34 (1) | 37 (5) | 202 (1) | 32 (2) | 10 (0) |
| 5 | Ficote 180 TE | 3 | 4.7 | 78 (8) | 124 (3) | 98 (7) | 435 (3) | 93 (4) | 39 (1) |
| 6 | Ficote 180 TE | 4 | 4.5 | 119 (9) | 202 (4) | 121 (7) | 629 (5) | 222 (6) | 88 (2) |
| 7 | Ficote 270 TE | 3 | 4.7 | 76 (8) | 129 (4) | 115 (7) | 538 (4) | 199 (5) | 80 (2) |
| 8 | Ficote 270 TE | 4 | 4.5 | 56 (7) | 87 (2) | 72 (6) | 379 (2) | 118 (4) | 55 (2) |
| 9 | Ficote 270 TE | 5 | 4.5 | 66 (7) | 101 (3) | 61 (6) | 386 (2) | 119 (4) | 64 (2) |
| 10 | Ficote 360 TE | 4 | 4.7 | 61 (7) | 100 (2) | 98 (7) | 466 (3) | 148 (5) | 68 (2) |
| 11 | Ficote 360 TE | 5 | 4.7 | 77 (8) | 143 (3) | 107 (7) | 573 (4) | 195 (5) | 106 (3) |
| 12 | Ficote 360 TE | 6 | 4.7 | 139 (9) | 281 (5) | 174 (8) | 883 (6) | 348 (7) | 183 (4) |
| 13 | Os. Plus 8-9 | 1 | 4.8 | 60 (7) | 112 (3) | 76 (6) | 373 (2) | 102 (4) | 47 (1) |
| 14 | Os. Plus 8-9 | 2 | 5.1 | 18 (3) | 20 (0) | 32 (4) | 173 (1) | 24 (1) | 5 (0) |
| 15 | Os. Plus 8-9 | 3 | 4.9 | 22 (4) | 36 (1) | 29 (4) | 190 (1) | 37 (2) | 10 (0) |
| 16 | Os. Plus 12-14 Sp. | 2 | 4.7 | 15 (3) | 22 (0) | 26 (4) | 142 (0) | 24 (1) | 7 (0) |
| 17 | Os. Plus 12-14 Sp. | 3 | 5.0 | 40 (5) | 57 (2) | 53 (6) | 255 (1) | 56 (3) | 17 (0) |
| 18 | Os. Plus 12-14 Sp. | 4 | 5.0 | 43 (6) | 56 (2) | 67 (6) | 269 (1) | 62 (3) | 16 (0) |
| 19 | Os. Plus 12-14 At. | 3 | 4.5 | 59 (7) | 145 (3) | 89 (7) | 435 (3) | 141 (5) | 54 (2) |
| 20 | Os. Plus 12-14 At. | 4 | 4.6 | 45 (6) | 80 (2) | 66 (6) | 304 (2) | 81 (4) | 21 (1) |
| 21 | Os. Plus 12-14 At. | 5 | 4.8 | 74 (7) | 130 (3) | 110 (7) | 498 (3) | 127 (4) | 37 (1) |
| 22 | Os. 16-18 | 4 | 4.5 | 72 (7) | 81 (2) | 54 (6) | 368 (2) | 113 (4) | 75 (2) |
| 23 | Os. 16-18 | 5 | 4.8 | 335 (9) | 553 (6) | 277 (9) | 1505 (9) | 570 (7) | 475 (5) |
| 24 | Os. 16-18 | 6 | 4.9 | 143 (9) | 235 (4) | 152 (8) | 762 (6) | 126 (4) | 179 (4) |

# APPENDIX IV

## Media Analyses - Available

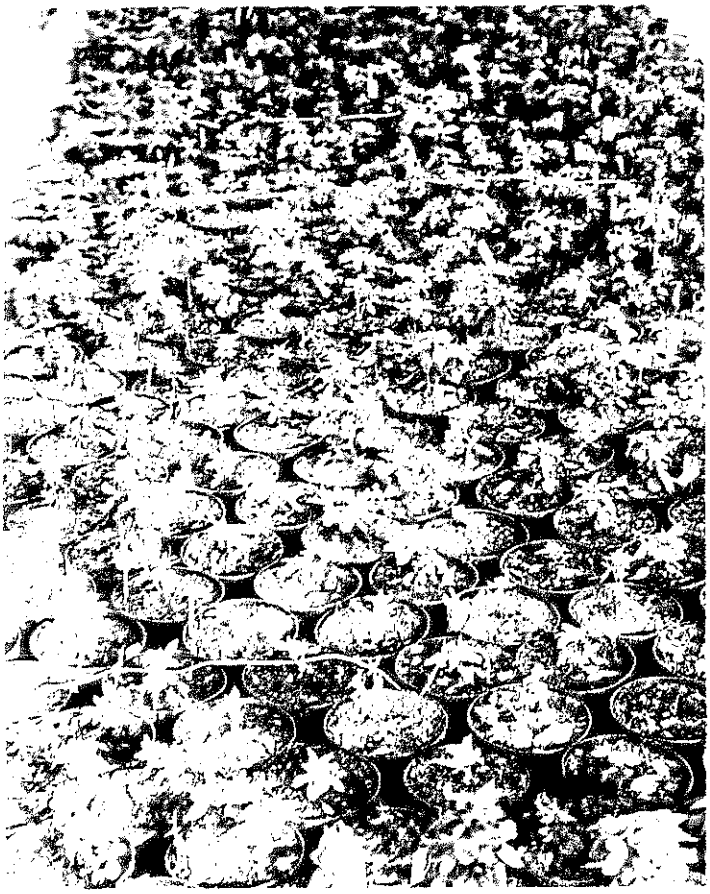
## November 1992

Table 22 *Elaeagnus pungens* 'Maculata' - Mean over 3 Replicates

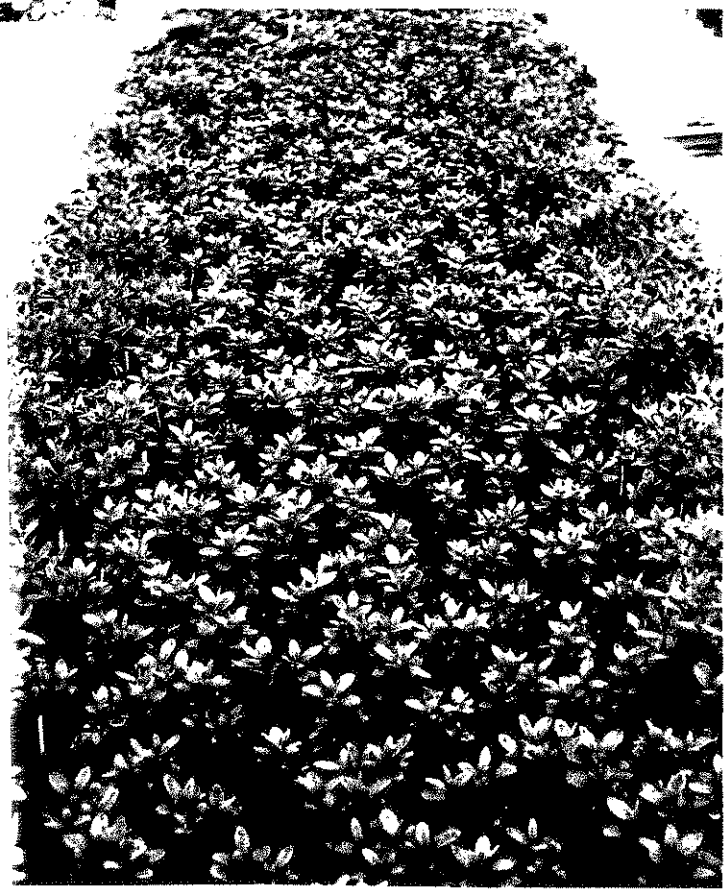
| Code | Treatments Fertilizer | Rate ($kg/m^3$) | pH | P (mg/l) | K (mg/l) | Mg (mg/l) | Cond. ($\mu s$) | $NO_3$ (mg/l) | $NH_4$ (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 2 | 4.6 | 47 (6) | 61 (2) | 106 (7) | 356 (2) | 57 (3) | 16 (0) |
| 2 | Ficote 140 TE | 3 | 4.4 | 65 (7) | 99 (2) | 131 (7) | 464 (3) | 121 (4) | 33 (1) |
| 3 | Ficote 140 TE | 4 | 4.6 | 138 (9) | 238 (4) | 241 (9) | 910 (7) | 318 (7) | 127 (3) |
| 4 | Ficote 180 TE | 3 | 4.6 | 109 (9) | 179 (4) | 171 (8) | 544 (4) | 219 (6) | 93 (2) |
| 5 | Ficote 180 TE | 4 | 4.7 | 72 (7) | 114 (3) | 121 (7) | 509 (4) | 150 (5) | 36 (1) |
| 6 | Ficote 180 TE | 5 | 4.7 | 487 (9) | 287 (5) | 197 (8) | 844 (6) | 305 (7) | 142 (3) |
| 7 | Ficote 270 TE | 4 | 4.5 | 113 (9) | 223 (4) | 197 (8) | 734 (6) | 231 (6) | 91 (2) |
| 8 | Ficote 270 TE | 5 | 4.6 | 118 (9) | 219 (4) | 193 (8) | 821 (6) | 303 (7) | 139 (3) |
| 9 | Ficote 270 TE | 6 | 4.4 | 168 (9) | 333 (5) | 225 (9) | 1044 (7) | 397 (7) | 214 (5) |
| 10 | Ficote 360 TE | 5 | 4.5 | 147 (9) | 263 (5) | 177 (8) | 844 (6) | 308 (7) | 165 (4) |
| 11 | Ficote 360 TE | 6 | 4.4 | 121 (9) | 216 (4) | 179 (8) | 757 (6) | 283 (6) | 125 (3) |
| 12 | Ficote 360 TE | 7 | 4.5 | 195 (9) | 440 (6) | 309 (9) | 1351 (9) | 544 (7) | 249 (5) |
| 13 | Os. Plus 8-9 | 2 | 4.8 | 90 (8) | 108 (3) | 176 (8) | 518 (4) | 96 (4) | 27 (1) |
| 14 | Os. Plus 8-9 | 3 | 4.6 | 124 (9) | 215 (4) | 163 (8) | 634 (5) | 160 (5) | 74 (2) |
| 15 | Os. Plus 8-9 | 4 | 4.5 | 163 (9) | 278 (5) | 214 (9) | 806 (6) | 229 (6) | 105 (3) |
| 16 | Os. Plus 12-14 Sp. | 3 | 4.6 | 98 (8) | 136 (3) | 141 (7) | 477 (3) | 114 (4) | 30 (1) |
| 17 | Os. Plus 12-14 Sp. | 4 | 4.9 | 178 (9) | 290 (5) | 226 (9) | 819 (6) | 234 (6) | 120 (3) |
| 18 | Os. Plus 12-14 Sp. | 5 | 4.8 | 216 (9) | 413 (6) | 254 (9) | 1027 (7) | 313 (7) | 171 (4) |
| 19 | Os. Plus 12-14 At. | 4 | 4.6 | 196 (9) | 293 (5) | 256 (9) | 864 (6) | 244 (6) | 110 (3) |
| 20 | Os. Plus 12-14 At. | 5 | 4.8 | 178 (9) | 330 (5) | 222 (9) | 875 (6) | 269 (6) | 154 (4) |
| 21 | Os. Plus 12-14 At. | 6 | 4.6 | 209 (9) | 470 (6) | 217 (9) | 1077 (7) | 364 (7) | 255 (5) |
| 22 | Os. 16-18 | 7 | 4.5 | 233 (9) | 331 (5) | 185 (8) | 957 (7) | 274 (6) | 264 (5) |
| 23 | Os. 16-18 | 8 | 4.4 | 262 (9) | 359 (5) | 198 (8) | 1161 (8) | 317 (7) | 258 (5) |
| 24 | Os. 16-18 | 9 | 4.4 | 267 (9) | 422 (6) | 216 (9) | 1178 (8) | 260 (6) | 342 (5) |

## APPENDIX V

Plate 1 *Azalea* 'Rose Greeley'



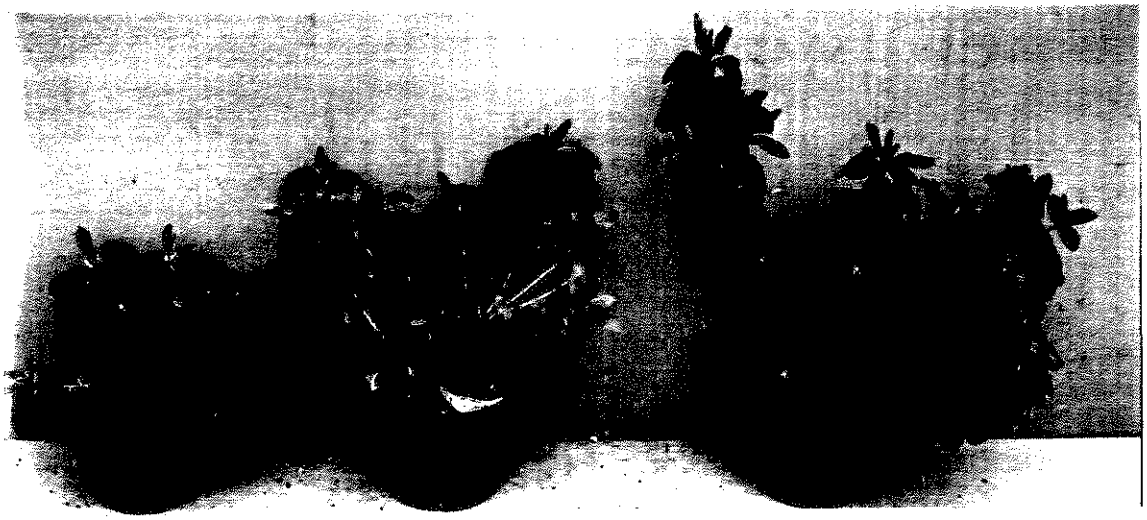
Plants showed poor establishment after initial potting in late summer 1991
(Photographed Jan. 1992)



Improved establishment following potting in spring 1992
(Photographed June 1992)

## APPENDIX V

Plate 2 *Azalea* 'Rose Greeley' - Growth Scores



1 3 5

November 1992 Size Scores

5 4 3 2 1

June 1993 Size Scores

5 4 3 2 1

October 1993 Size Scores

## APPENDIX V

Plate 3 *Azalea* 'Rose Greeley' - Treatment Effects, August 1993

Ficote 140 TE 3 kg/m³ | Ficote 180 TE 3 kg/m³ | Ficote 270 TE 5 kg/m³ | Ficote 360 TE 4 kg/m³

3 kg/m³ | 4 kg/m³ | 5 kg/m³

Ficote 270 TE

4 kg/m³ | 5 kg/m³ | 6 kg/m³

Ficote 360 TE

APPENDIX V

Plate 4 *Azalea* 'Rose Greeley' - Treatment Effects, August 1993

Os + 8-9m 3 kg/m³ | Os + 12-14 Sp 4 kg/m³ | Os + 12-14 A 5 kg/m³ | Os 16-18m 6 kg/m³

3 kg/m³ | 4 kg/m³ | 5 kg/m³

Osmocote Plus 12-14 months Autumn

4 kg/m³ | 5 kg/m³ | 6 kg/m³

Osmocote 16-18 months

APPENDIX V

Plate 5 *Pieris* 'Forest Flame' - Rooted Cuttings

Severe scorch/death in higher rates of fertilizer in spring 1992

5 4 3 2 1

April 1992 Size Scores

1 2 3 4 5

December 1992 Size Scores

## APPENDIX V

Plate 6 *Pieris* 'Forest Flame' - Growth Scores

Rooted Cuttings

5 4 3 2 1

April 1993 Size Score

5 4 3 2 1

October 1993 Size Scores

Micropropagated Plugs

5 4 3 2 1

April 1992 Size Score

## APPENDIX V

Plate 7 *Pieris* 'Forest Flame' - Growth Scores

Micropropagated Plugs

1 2 3 4 5

November 1992 Size Scores

5 4 3 2 1

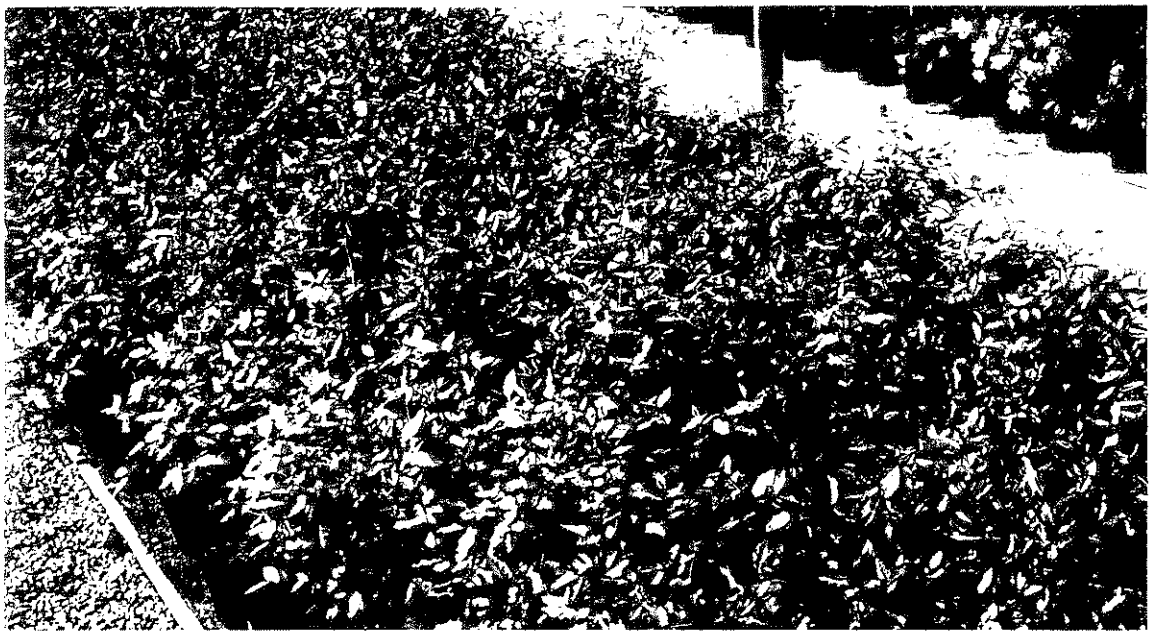
April 1993 Size Scores

5 4 3 2 1

October 1993 Size Scores

## APPENDIX V

Plate 8 *Elaeagnus pungens* 'Maculata'



General view of bed (May 1993)

5 4 3 2 1

May 1992 Size Score

1 2 3 4 5

November 1992 Size Scores

## APPENDIX V

Plate 9 *Elaeagnus pungens* 'Maculata'

5 4 3 2 1

May 1993 Size Scores

1 2

Colour Scores

5 4 3 2 1

October 1993 Size Scores

APPENDIX V

Plate 10 *Elaeagnus pungens* 'Maculata' - Treatment Effects, August 1993

Ficote 140 TE 3 kg/m³ | Ficote 180 TE 4 kg/m³ | Ficote 270 TE 4 kg/m³ | Ficote 360 TE 7 kg/m³

4 kg/m³ | 5 kg/m³ | 6 kg/m³

Ficote 270 TE

5 kg/m³ | 6 kg/m³ | 7 kg/m³

Ficote 360 TE

APPENDIX V

Plate 11 *Elaeagnus pungens* 'Maculata' - Treatment Effects, August 1993

Os + 8-9m 4 kg/m³ | Os + 12-14 Sp 4 kg/m³ | Os + 12-14 A 5 kg/m³ | Os 16-18 m 7 kg/m³

4 kg/m³ | 5 kg/m³ | 6 kg/m³

Osmocote Plus 12-14 months Autumn

## APPENDIX VI

## HRI Efford Meteorological Data

Table 23 Rainfall mm

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 | **98.0** | **6.2** | **45.2** | **74.7** | **45.7** | **61.6** | **86.2** | **35.8** | **120.7** | **169.3** | | |
| 1992 | **21.7** | **28.6** | **51.6** | **70.4** | **19.6** | **32.2** | **63.1** | **88.1** | **78.9** | **81.5** | **145.3** | **81.2** |
| 1991 | 88.5 | 29.3 | 77.9 | 42.3 | 4.0 | 113.0 | 63.3 | 12.3 | **48.6** | **63.0** | **49.2** | **33.4** |
| 1990 | 112.7 | 166.5 | 6.4 | 43.9 | 11.2 | 55.3 | 12.2 | 23.1 | 28.9 | 98.6 | 53.6 | 62.3 |
| 1989 | 30.6 | 69.8 | 74.8 | 71.7 | 13.7 | 34.6 | 22.5 | 23.6 | 37.3 | 91.0 | 56.6 | 242.4 |
| 1988 | 170.9 | 47.3 | 82.0 | 39.5 | 27.9 | 34.3 | 71.8 | 63.6 | 41.6 | 98.4 | 20.7 | 20.8 |
| 1987 | 15.8 | 60.4 | 89.4 | 69.1 | 19.3 | 54.4 | 61.4 | 16.4 | 37.7 | 195.6 | 78.3 | 43.2 |
| 1986 | 109.9 | 11.3 | 61.3 | 58.9 | 74.3 | 25.3 | 46.6 | 87.6 | 33.9 | 79.2 | 114.6 | 102.6 |
| 1985 | 69.5 | 47.0 | 51.6 | 43.8 | 44.6 | 61.1 | 37.8 | 88.2 | 24.3 | 32.4 | 53.4 | 88.0 |
| 1984 | 120.5 | 36.1 | 81.3 | 0.3 | 86.4 | 18.6 | 12.0 | 18.7 | 62.1 | 94.6 | 127.9 | 96.2 |
| 1983 | 68.1 | 25.9 | 36.9 | 86.0 | 77.3 | 47.8 | 7.1 | 32.7 | 66.3 | 57.2 | 40.9 | 82.0 |
| 1982 | 45.6 | 47.1 | 88.4 | 21.4 | 44.6 | 87.6 | 38.2 | 56.4 | 60.5 | 195.0 | 111.2 | 85.3 |
| *11/12 yr mean* | 79.3 | 48.0 | 62.2 | 51.8 | 39.1 | 52.2 | 43.5 | 45.5 | 53.4 | 104.7 | 77.4 | 85.2 |
| *40 yr mean* | 81.2 | 52.9 | 59.5 | 44.9 | 47.0 | 54.8 | 47.6 | 58.0 | 70.0 | 82.8 | 83.5 | 85.1 |

NB: Bold figures in body of table relate to the period of the trial.

## APPENDIX VI

## HRI Efford Meteorological Data

Table 24 Mean Daily Sunshine Hours

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 | **1.1** | **2.3** | **4.6** | **4.5** | **6.70** | **8.3** | **6.0** | **8.2** | **4.5** | **4.3** | | |
| 1992 | **2.4** | **2.1** | **2.02** | **5.5** | **9.25** | **8.25** | **5.4** | **5.2** | **4.7** | **4.2** | **2.0** | **1.7** |
| 1991 | 2.20 | 2.76 | 3.55 | 5.80 | 5.81 | 5.20 | 7.2 | 8.6 | **6.1** | **3.0** | **2.2** | **1.7** |
| 1990 | 1.52 | 3.24 | 5.15 | 8.13 | 9.63 | 4.60 | 10.18 | 8.64 | 6.34 | 3.52 | 3.02 | 1.95 |
| 1989 | 2.21 | 3.66 | 3.04 | 5.65 | 10.57 | 9.25 | 9.75 | 9.31 | 4.80 | 3.56 | 3.62 | 1.14 |
| 1988 | 1.97 | 4.58 | 3.39 | 6.49 | 8.02 | 6.10 | 6.65 | 5.91 | 3.84 | 3.46 | 3.46 | 1.48 |
| 1987 | 2.13 | 2.96 | 3.94 | 6.68 | 7.77 | 5.79 | 7.15 | 6.47 | 4.97 | 3.54 | 2.10 | 1.42 |
| 1986 | 2.03 | 2.74 | 3.57 | 5.57 | 5.85 | 7.22 | 6.16 | 5.65 | 5.64 | 3.37 | 2.75 | 2.05 |
| 1985 | 2.48 | 2.99 | 4.25 | 5.66 | 6.88 | 6.04 | 7.86 | 6.45 | 5.36 | 4.07 | 2.75 | 1.19 |
| 1984 | 2.80 | 2.92 | 2.92 | 8.22 | 4.93 | 9.86 | 8.92 | 6.84 | 4.03 | 2.89 | 2.21 | 1.87 |
| 1983 | 1.86 | 3.67 | 3.56 | 5.42 | 5.56 | 6.60 | 9.17 | 8.48 | 3.87 | 3.66 | 1.88 | 2.10 |
| 1982 | 1.85 | 1.83 | 5.20 | 6.70 | 7.31 | 7.10 | 6.62 | 5.79 | 5.19 | 2.95 | 2.43 | 1.70 |
| *11/12 yr mean* | 2.05 | 2.98 | 3.77 | 6.19 | 7.36 | 7.03 | 7.59 | 7.13 | 4.95 | 3.54 | 2.58 | 1.66 |
| *40 yr mean* | 1.95 | 2.80 | 4.1 | 5.96 | 7.19 | 7.30 | 7.30 | 6.80 | 5.38 | 3.79 | 2.54 | 1.74 |

NB. Bold figures in body of table relate to the period of the trial.

## APPENDIX VI

## HRI Efford Meteorological Data

Table 25 Mean Maximum Temperature °C

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 | **9.8** | **7.8** | **10.4** | **13.2** | **16.5** | **19.5** | **19.1** | **19.6** | **17.1** | **13.0** | | |
| 1992 | **7.2** | **9.0** | **10.9** | **12.7** | **18.7** | **20.6** | **20.1** | **19.5** | **17.6** | **12.9** | **12.3** | **8.2** |
| 1991 | 7.3 | 5.1 | 11.0 | 12.2 | 15.5 | 15.5 | 20.5 | 21.0 | **20.0** | **14.0** | **10.9** | **8.5** |
| 1990 | 10.4 | 11.2 | 11.8 | 13.6 | 18.4 | 16.9 | 21.9 | 22.7 | 19.1 | 16.1 | 10.8 | 7.9 |
| 1989 | 9.9 | 10.0 | 11.5 | 10.8 | 19.3 | 20.2 | 23.9 | 21.6 | 19.5 | 16.5 | 11.5 | 9.5 |
| 1988 | 9.1 | 8.9 | 10.2 | 12.7 | 16.7 | 18.8 | 17.5 | 19.1 | 17.7 | 15.1 | 10.6 | 10.7 |
| 1987 | 3.9 | 7.4 | 8.1 | 13.4 | 15.2 | 16.6 | 20.5 | 20.4 | 18.1 | 14.7 | 10.5 | 8.3 |
| 1986 | 7.8 | 2.2 | 8.3 | 9.9 | 13.7 | 20.0 | 19.4 | 17.9 | 15.9 | 15.4 | 12.3 | 10.0 |
| 1985 | 4.2 | 5.8 | 8.4 | 12.7 | 15.8 | 17.2 | 20.5 | 18.1 | 18.4 | 14.9 | 8.3 | 9.8 |
| 1984 | 8.5 | 7.7 | 8.6 | 13.7 | 14.4 | 19.5 | 22.0 | 22.0 | 18.0 | 15.0 | 12.1 | 9.8 |
| 1983 | 9.6 | 5.4 | 9.6 | 10.8 | 13.8 | 18.3 | 24.4 | 22.7 | 17.8 | 14.5 | 11.0 | 9.7 |
| 1982 | 7.1 | 8.0 | 10.0 | 13.5 | 15.9 | 19.0 | 21.2 | 19.6 | 18.8 | 14.0 | 11.7 | 6.6 |
| *11/12 yr mean* | 7.9 | 7.4 | 9.9 | 12.4 | 16.2 | 18.5 | 20.9 | 20.4 | 18.2 | 14.7 | 11.1 | 9.0 |
| *40 yr mean* | 7.3 | 7.3 | 9.8 | 11.9 | 15.7 | 18.4 | 20.4 | 20.3 | 18.3 | 14.9 | 10.9 | 8.6 |

NB. Bold figures in body of table relate to the period of the trial.

## APPENDIX VI

## HRI Efford Meteorological Data

Table 26 Mean Minimum Temperature °C

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 | **5.1** | **3.3** | **3.8** | **6.5** | **8.8** | **11.4** | **12.4** | **11.3** | **10.0** | **7.0** | | |
| 1992 | **1.7** | **2.8** | **5.3** | **5.6** | **9.2** | **10.8** | **13.5** | **13.4** | **12.0** | **5.4** | **6.2** | **2.7** |
| 1991 | 3.1 | 0.5 | 5.4 | 4.8 | 7.0 | 9.4 | 12.9 | 12.8 | **11.5** | **8.1** | **4.8** | **4.0** |
| 1990 | 5.5 | 6.3 | 5.6 | 4.3 | 8.6 | 10.8 | 12.6 | 13.5 | 9.7 | 10.3 | 5.8 | 3.3 |
| 1989 | 4.3 | 3.3 | 5.1 | 3.9 | 9.4 | 10.9 | 14.3 | 13.0 | 12.0 | 10.0 | 5.6 | 4.3 |
| 1988 | 4.0 | 2.5 | 4.5 | 4.8 | 8.8 | 10.7 | 12.4 | 11.9 | 10.3 | 7.6 | 3.0 | 5.3 |
| 1987 | 0.6 | 1.7 | 1.9 | 6.1 | 7.0 | 9.7 | 12.4 | 11.9 | 11.9 | 8.4 | 4.8 | 4.5 |
| 1986 | 1.8 | 2.2 | 2.2 | 2.9 | 7.8 | 10.5 | 12.4 | 11.5 | 7.6 | 8.8 | 5.9 | 4.2 |
| 1985 | 1.3 | 0.2 | 1.5 | 4.5 | 7.3 | 9.2 | 11.9 | 12.5 | 11.1 | 8.7 | 2.2 | 5.5 |
| 1984 | 2.7 | 2.1 | 2.3 | 3.7 | 6.7 | 10.3 | 11.6 | 13.3 | 11.2 | 9.3 | 6.6 | 3.2 |
| 1983 | 5.1 | 0.6 | 3.4 | 4.2 | 7.7 | 11.3 | 14.9 | 13.1 | 11.4 | 8.4 | 5.9 | 3.8 |
| 1982 | 2.1 | 2.9 | 2.7 | 4.5 | 7.4 | 12.3 | 13.1 | 12.6 | 10.9 | 8.3 | 7.2 | 2.6 |
| *11/12 yr mean* | 3.1 | 2.4 | 3.6 | 4.7 | 8.0 | 10.6 | 12.9 | 12.6 | 10.8 | 8.4 | 5.3 | 3.9 |
| *40 yr mean* | 2.2 | 1.8 | 3.3 | 4.4 | 7.4 | 10.3 | 12.3 | 12.2 | 10.7 | 8.2 | 4.8 | 3.3 |

NB. Bold figures in body of table relate to the period of the trial.

# APPENDIX VII Contract

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

1. TITLE OF PROJECT

Contract No: HNS43
Contract date: 20.12.93

CONTAINER GROWN NURSERY STOCK: INVESTIGATION OF USE OF CONTROLLED RELEASE FERTILIZERS UNDER PROTECTION

2. BACKGROUND AND COMMERCIAL OBJECTIVE

With UK container production based largely on the use of controlled release fertilizers (CRF) it is important to evaluate the use of different products/formulations available over season, under different growing conditions and across the range of species response groups grown. Investigation of plant response to CRF's formed an important component of the Efford programme up until 1987 when MAFF funding was reduced and finally withdrawn. Since then further developments in CRF formulations have occurred and need to be investigated, including the new range of Ficote TE and Osmocote Plus materials, and in particular for high value/sensitive species grown under protection where information on their use is limited. Production under protection has increased rapidly over the past 5 years with an estimated 200 ha of container HNS under protection for all or part of their production cycle. The principal species grown under protection for long periods of time include high value, slow growing species which also tend to be salt sensitive and easily stressed by high nutrient availability. Sudden release of nutrients due to high temperatures can be extremely damaging. Consequently the longer term release formulations of CRF are seen as a safer option for use under protection, while still providing sufficient nutrients to sustain quality growth over the season. The development of even longer term formulations such as Ficote TE 270 and 360 may offer the opportunity of a 2 year release material for species kept in the same container over that period of time, thus avoiding the need for liquid feeding in the second season. Fisons plc are willing to sponsor the inclusion of the Ficote TE 270 and 360 in the work prior to their market launch in 1992.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

There is potential for reduced labour input if a formulation of fertilizer can provide both safety of use early on in the crop life and sustain growth over the required period without the need for liquid feeding. Matching the 'best' formulation for the growing conditions and species involved will offer the opportunity for improving and maintaining quality not only during production but also have a carry-over effect into shelf-life.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

To compare the performance of the Ficote TE and Osmocote Plus range of CRF's across a representative range of HNS species under protection.

# APPENDIX VII

## 5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

Would follow-on from the MAFF funded RESEARCH programme ~~of CRF screening~~ at Efford between 1976-1987. This earlier work was outdoors and the newer range of CRF formulations were not available. This work builds on the preliminary results which were obtained in the earlier HDC-funded work on controlled release fertiliser screening (part of HNS28).

## 6. DESCRIPTION OF THE WORK

Liners or plugs of *Pieris* 'Forest Flame', and liners of *Azalea* 'Rose Greeley' and *Elaeagnus pungens* 'Maculata' would be potted on into 3 litre containers in either autumn 1991 or Spring 1992 and grown on drained sand beds with capillary irrigation under a multibay polynet structure.

*Growing media* : 100% Irish medium sphagnum peat

*Base dressings* : CRF as appropriate plus Magnesian lime at 1.0 kg/m$^3$. The mixes with Osmocote 16-18 month incorporated will also need the addition of 0.3 kg/m$^3$ Fritted trace element WM 255.

*Fertilizer treatments* : (Rates discussed with each fertilizer company)

| | | Pieris, Azalea kg/m$^3$ | Elaeagnus kg/m$^3$ |
|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 2 * |
| 2 | Ficote 140 TE | 2 | 3 |
| 3 | Ficote 140 TE | 3 | 4 |
| 4 | Ficote 180 TE | 2 | 3 * |
| 5 | Ficote 180 TE | 3 | 4 |
| 6 | Ficote 180 TE | 4 | 5 |
| 7 | Ficote 270 TE | 3 | 4 * |
| 8 | Ficote 270 TE | 4 | 5 |
| 9 | Ficote 270 TE | 5 | 6 |
| 10 | Ficote 360 TE | 4 | 5 * |
| 11 | Ficote 360 TE | 5 | 6 |
| 12 | Ficote 360 TE | 6 | 7 |
| 13 | Osmocote Plus, 8-9 month | 1 | 2 |
| 14 | Osmocote Plus, 8-9 month | 2 * | 3 |
| 15 | Osmocote Plus, 8-9 month | 3 | 4 * |
| 16 | Osmocote Plus, 12-14 month, Spring | 2 | 3 |
| 17 | Osmocote Plus, 12-14 month, Spring | 3 * | 4 |
| 18 | Osmocote Plus, 12-14 month, Spring | 4 | 5 * |
| 19 | Osmocote Plus, 12-14 month, Autumn | 3 * | 4 |
| 20 | Osmocote Plus, 12-14 month, Autumn | 4 | 5 * |
| 21 | Osmocote Plus, 12-14 month, Autumn | 5 | 6 |
| 22 | Osmocote 16-18 month | 4 * | 7 |
| 23 | Osmocote 16-18 month | 5 | 8 * |
| 24 | Osmocote 16-18 month | 6 | 9 |

* Manufacturer's recommended rate. (Ficote TE 270 and 360 recommendations not yet known)

# APPENDIX VII

*Design* : Randomised block with three replicates within each species.

*Assessments* :

1. Visual score of growth and quality Spring and autumn in 1992 and 1993.
2. Growing media analysis at potting and September 1992. (Analyses to be done by ADAS)
3. Growing media temperature measurements. Temperature data loggers set up to monitor throughout the trial.

The data will be analyzed to provide information on the effect of the rate of application and formulation of fertilizer for each species relative to growth and quality produced and the underlying causes of the responses observed. Conclusions will also be drawn on the useful longevity of different CRF's for different types of production schedule.

## 7. COMMENCEMENT DATE AND DURATION

Start date 01.08.91; duration 2½ years. The experimental work will be completed by October/November 1993 and the final report will be produced by March 1994.

## 8. STAFF RESPONSIBILITIES

Project Leader: Miss M Scott
Other staff: Mr B Burbridge and Dr Liz Davies

## 9. LOCATION

Efford

## APPENDIX VII

Contract No: HNS43

### 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.....

Date.....

# APPENDIX II

## Growth Records

Table 14 *Elaeagnus pungens* 'Maculata' - November 1992

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-2) 2=darkest green | Vigour Score (1-5) 5=most vigorous | %Dead | % Root Cover |
|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 2 | 3.06 | 1.28 | 3.17 | 0 | 19.72 |
| 2 | Ficote 140 TE | 3 | 3.06 | 1.39 | 2.90 | 6 | 22.28 |
| 3 | Ficote 140 TE | 4 | 2.51 | 1.26 | 3.27 | 11 | 15.56 |
| 4 | Ficote 180 TE | 3 | 2.56 | 1.28 | 2.94 | 0 | 15.94 |
| 5 | Ficote 180 TE | 4 | 2.83 | 1.75 | 3.11 | 17 | 15.83 |
| 6 | Ficote 180 TE | 5 | 2.56 | 1.50 | 2.72 | 0 | 11.61 |
| 7 | Ficote 270 TE | 4 | 3.17 | 1.39 | 3.56 | 0 | 21.11 |
| 8 | Ficote 270 TE | 5 | 2.82 | 1.62 | 3.24 | 6 | 17.00 |
| 9 | Ficote 270 TE | 6 | 2.68 | 1.54 | 3.37 | 6 | 15.83 |
| 10 | Ficote 360 TE | 5 | 2.91 | 1.48 | 2.86 | 6 | 13.68 |
| 11 | Ficote 360 TE | 6 | 2.89 | 1.72 | 3.06 | 0 | 14.17 |
| 12 | Ficote 360 TE | 7 | 3.00 | 1.50 | 3.50 | 0 | 15.56 |
| 13 | Os. Plus 8-9 | 2 | 2.89 | 1.56 | 3.33 | 0 | 15.39 |
| 14 | Os. Plus 8-9 | 3 | 2.98 | 1.20 | 3.49 | 33 | 20.09 |
| 15 | Os. Plus 8-9 | 4 | 3.09 | 1.51 | 2.93 | 28 | 11.78 |
| 16 | Os. Plus 12-14 Sp. | 3 | 3.16 | 1.64 | 3.66 | 0 | 15.72 |
| 17 | Os. Plus 12-14 Sp. | 4 | 3.22 | 1.61 | 3.61 | 0 | 18.89 |
| 18 | Os. Plus 12-14 Sp. | 5 | 3.39 | 1.17 | 3.67 | 0 | 19.44 |
| 19 | Os. Plus 12-14 At. | 4 | 3.11 | 1.39 | 3.23 | 0 | 13.50 |
| 20 | Os. Plus 12-14 At. | 5 | 3.01 | 1.30 | 3.27 | 6 | 17.56 |
| 21 | Os. Plus 12-14 At. | 6 | 3.00 | 1.39 | 3.22 | 0 | 14.44 |
| 22 | Os. 16-18 | 7 | 1.92 | 1.00 | 2.08 | 44 | 7.08 |
| 23 | Os. 16-18 | 8 | 2.75 | 1.43 | 2.90 | 39 | 14.50 |
| 24 | Os. 16-18 | 9 | 3.00 | 1.50 | 3.42 | 67 | 22.50 |
| *d.f.* = 45 | *SED* = ± | | *0.355* | *0.210* | *0.377* | | *4.514* |
| | *LSD(5%)* = ± | | *0.717* | *0.425* | *0.762* | | *9.122* |

# APPENDIX II

## Growth Records

Table 15 *Elaeagnus pungens* 'Maculata' - May 1993

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-2) 2=darkest green | %Dead | Flush Score (1-5) 5=most advanced flush |
|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 2 | 3.50 | 2.0 | 0 | 3.22 |
| 2 | Ficote 140 TE | 3 | 3.64 | 1.9 | 6 | 3.96 |
| 3 | Ficote 140 TE | 4 | 3.53 | 2.0 | 11 | 4.40 |
| 4 | Ficote 180 TE | 3 | 3.31 | 2.0 | 6 | 3.93 |
| 5 | Ficote 180 TE | 4 | 3.17 | 2.0 | 17 | 3.89 |
| 6 | Ficote 180 TE | 5 | 3.28 | 2.0 | 0 | 4.33 |
| 7 | Ficote 270 TE | 4 | 3.61 | 2.0 | 0 | 3.67 |
| 8 | Ficote 270 TE | 5 | 3.48 | 2.0 | 6 | 4.29 |
| 9 | Ficote 270 TE | 6 | 3.52 | 2.0 | 6 | 3.60 |
| 10 | Ficote 360 TE | 5 | 3.50 | 2.0 | 6 | 3.78 |
| 11 | Ficote 360 TE | 6 | 3.44 | 2.0 | 0 | 4.22 |
| 12 | Ficote 360 TE | 7 | 3.72 | 2.0 | 0 | 3.89 |
| 13 | Os. Plus 8-9 | 2 | 3.39 | 1.9 | 0 | 3.89 |
| 14 | Os. Plus 8-9 | 3 | 3.41 | 2.0 | 33 | 3.77 |
| 15 | Os. Plus 8-9 | 4 | 3.73 | 2.0 | 28 | 4.24 |
| 16 | Os. Plus 12-14 Sp. | 3 | 3.54 | 2.0 | 6 | 3.38 |
| 17 | Os. Plus 12-14 Sp. | 4 | 3.72 | 1.9 | 0 | 4.00 |
| 18 | Os. Plus 12-14 Sp. | 5 | 3.89 | 2.0 | 0 | 3.44 |
| 19 | Os. Plus 12-14 At. | 4 | 3.78 | 2.0 | 0 | 3.78 |
| 20 | Os. Plus 12-14 At. | 5 | 3.58 | 2.0 | 6 | 4.38 |
| 21 | Os. Plus 12-14 At. | 6 | 3.67 | 2.0 | 0 | 3.89 |
| 22 | Os. 16-18 | 7 | 2.22 | 2.0 | 61 | 3.67 |
| 23 | Os. 16-18 | 8 | 2.77 | 2.0 | 50 | 4.53 |
| 24 | Os. 16-18 | 9 | 3.11 | 2.0 | 72 | 4.56 |
| | *d.f. =45* *SED* = ± | | *0.308* | *0.268* | | *0.504* |
| | *LSD(5%)* = ± | | *0.622* | *0.542* | | *1.019* |

# APPENDIX II

## Growth Records

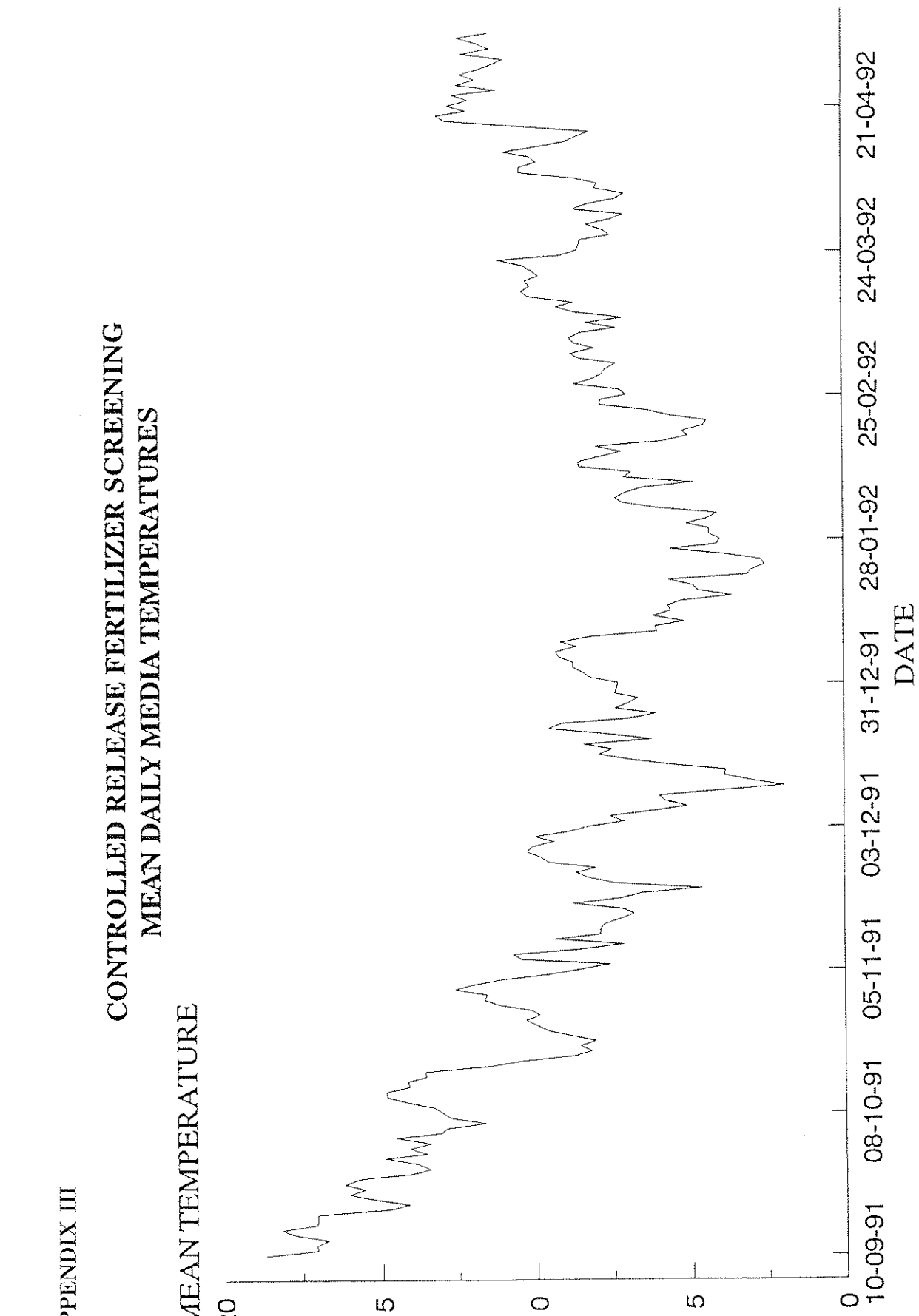
Table 16 *Elaeagnus pungens* 'Maculata' - October 1993

(figures are a mean of 18 plants less dead plants)

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | Size Score (1-5) 5=largest | Colour Score (1-5) 5=darkest green | %Dead | %Root Cover | Flower Score 1=flowering 0=no flowering |
|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 2 | 2.00 | 2.22 | 0 | 46.1 | 0.33 |
| 2 | Ficote 140 TE | 3 | 1.89 | 2.04 | 6 | 29.2 | 0.36 |
| 3 | Ficote 140 TE | 4 | 2.69 | 3.11 | 11 | 49.8 | 0.07 |
| 4 | Ficote 180 TE | 3 | 2.14 | 2.16 | 6 | 42.7 | 0.39 |
| 5 | Ficote 180 TE | 4 | 1.89 | 2.11 | 17 | 44.4 | 0.33 |
| 6 | Ficote 180 TE | 5 | 2.76 | 3.98 | 6 | 42.2 | 0.22 |
| 7 | Ficote 270 TE | 4 | 3.00 | 3.00 | 0 | 55.0 | 0.44 |
| 8 | Ficote 270 TE | 5 | 2.77 | 3.22 | 6 | 49.4 | 0.07 |
| 9 | Ficote 270 TE | 6 | 2.40 | 3.49 | 6 | 41.4 | 0.12 |
| 10 | Ficote 360 TE | 5 | 2.72 | 3.40 | 6 | 45.4 | 0.40 |
| 11 | Ficote 360 TE | 6 | 3.17 | 2.78 | 0 | 38.6 | 0.22 |
| 12 | Ficote 360 TE | 7 | 3.33 | 4.11 | 0 | 47.5 | 0.33 |
| 13 | Os. Plus 8-9 | 2 | 2.22 | 2.67 | 0 | 47.8 | 0.50 |
| 14 | Os. Plus 8-9 | 3 | 2.86 | 2.93 | 33 | 45.3 | 0.45 |
| 15 | Os. Plus 8-9 | 4 | 2.64 | 2.73 | 28 | 48.0 | 0.80 |
| 16 | Os. Plus 12-14 Sp. | 3 | 2.17 | 3.00 | 6 | 39.9 | 0.43 |
| 17 | Os. Plus 12-14 Sp. | 4 | 2.44 | 3.11 | 0 | 64.2 | 0.33 |
| 18 | Os. Plus 12-14 Sp. | 5 | 3.28 | 2.89 | 0 | 55.6 | 0.50 |
| 19 | Os. Plus 12-14 At. | 4 | 2.61 | 3.00 | 0 | 48.1 | 0.50 |
| 20 | Os. Plus 12-14 At. | 5 | 2.83 | 3.51 | 6 | 54.5 | 0.32 |
| 21 | Os. Plus 12-14 At. | 6 | 2.89 | 3.78 | 0 | 51.9 | 0.33 |
| 22 | Os. 16-18 | 7 | 1.22 | 3.67 | 61 | 39.4 | 0.11 |
| 23 | Os. 16-18 | 8 | 1.70 | 3.93 | 50 | 44.0 | 0.07 |
| 24 | Os. 16-18 | 9 | 2.11 | 3.00 | 72 | 46.7 | 0.33 |
| *d.f. = 45* | *SED = ±* | | *0.540* | *0.445* | | *11.73* | *0.283* |
| | *LSD(5%) = ±* | | *1.092* | *0.899* | | *23.71* | *0.573* |

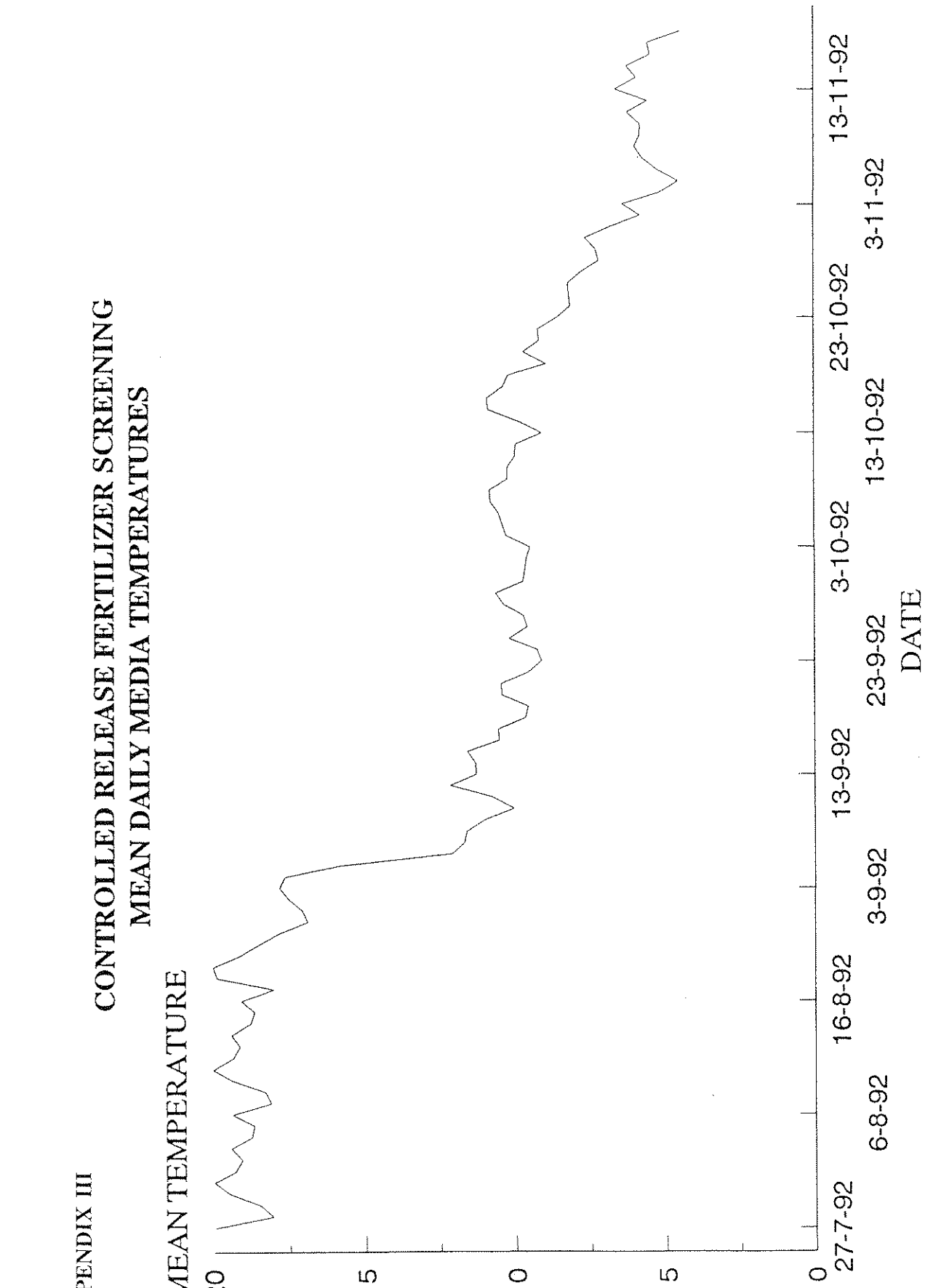
APPENDIX III

## CONTROLLED RELEASE FERTILIZER SCREENING
## MEAN DAILY MEDIA TEMPERATURES



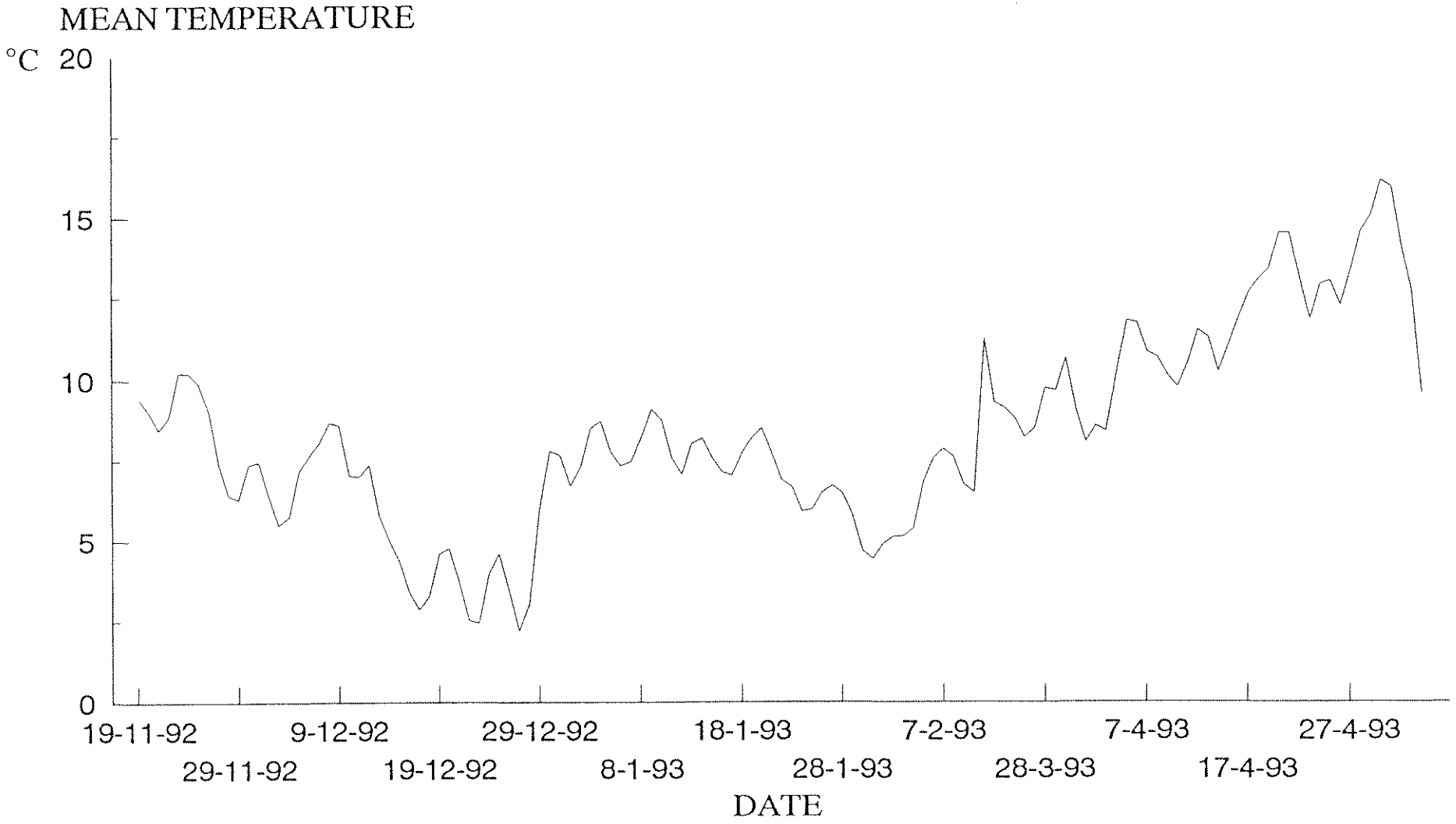
APPENDIX III

# CONTROLLED RELEASE FERTILIZER SCREENING
## MEAN DAILY MEDIA TEMPERATURES



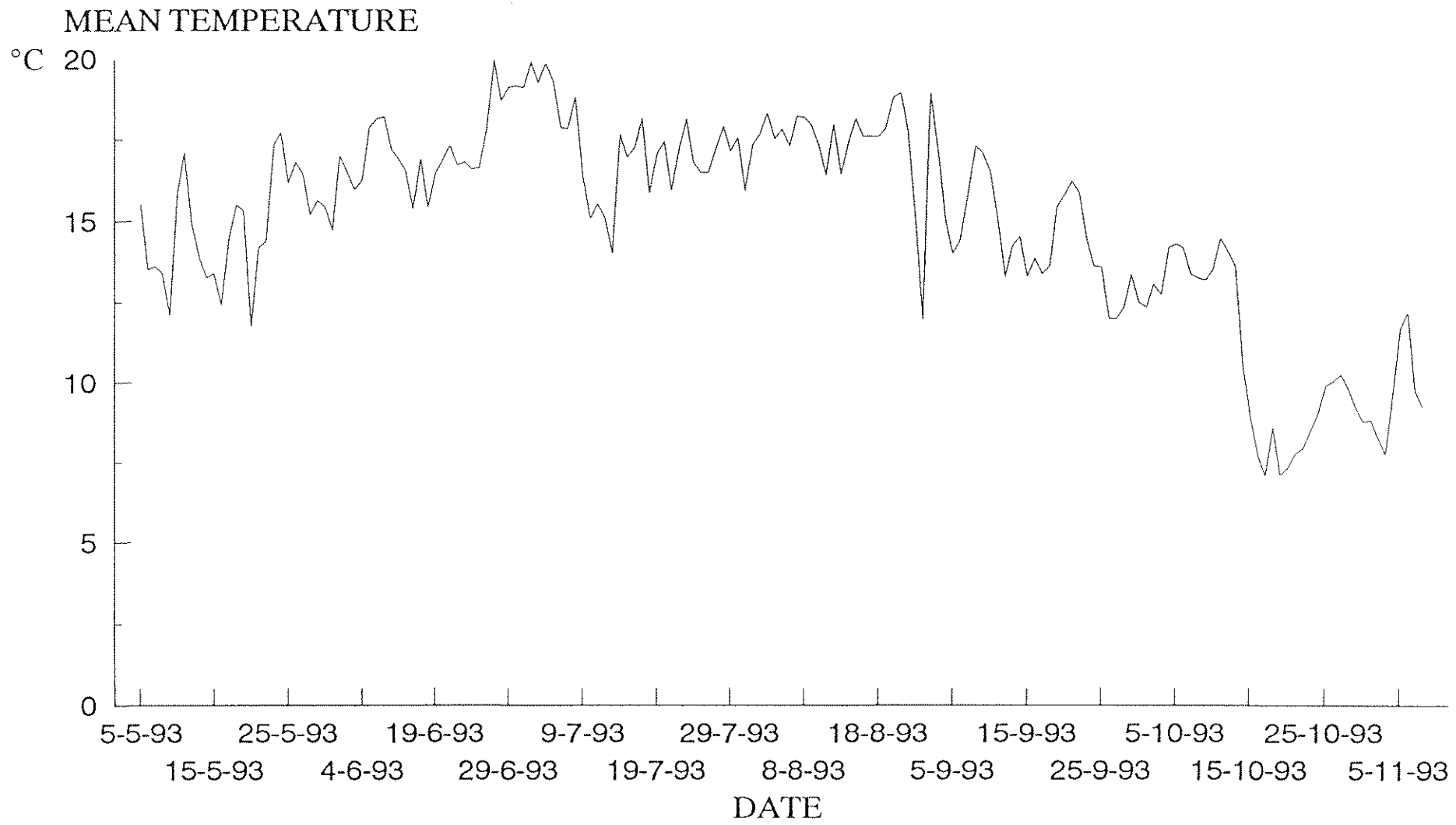
APPENDIX III

# CONTROLLED RELEASE FERTILIZER SCREENING
## MEAN DAILY MEDIATEMPERATURES



APPENDIX III

# CONTROLLED RELEASE FERTILIZER SCREENING
## MEAN DAILY MEDIA TEMPERATURES



# APPENDIX IV

## Media Analyses - Available

## At Potting (6 August 1991)

*(samples frozen until analysed February 1992)*

Table 17 *Azalea* 'Rose Greeley' and *Pieris* 'Forest Flame'

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | pH | P (mg/l) | K (mg/l) | Mg (mg/l) | Cond. ($\mu s$) | $NO_3$ (mg/l) | $NH_4$ (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 1 | 4.0 | 8 (2) | 18 (0) | 9 (1) | 98 (0) | 33 (2) | 24 (1) |
| 2 | Ficote 140 TE | 2 | 4.0 | 8 (2) | 18 (0) | 11 (2) | 130 (0) | 54 (3) | 34 (1) |
| 3 | Ficote 140 TE | 3 | 4.1 | 3 (0) | 6 (0) | 5 (0) | 58 (0) | 14 (0) | 9 (0) |
| 4 | Ficote 180 TE | 2 | 4.1 | 3 (0) | 6 (0) | 4 (0) | 68 (0) | 18 (1) | 10 (0) |
| 5 | Ficote 180 TE | 3 | 4.0 | 3 (0) | 6 (0) | 6 (1) | 59 (0) | 16 (1) | 11 (0) |
| 6 | Ficote 180 TE | 4 | 4.0 | 3 (0) | 6 (0) | 6 (1) | 82 (0) | 24 (1) | 15 (0) |
| 7 | Ficote 270 TE | 3 | 3.9 | 14 (3) | 36 (1) | 16 (3) | 204 (1) | 91 (4) | 63 (2) |
| 8 | Ficote 270 TE | 4 | 3.9 | 14 (3) | 36 (1) | 22 (3) | 209 (1) | 78 (3) | 57 (2) |
| 9 | Ficote 270 TE | 5 | 3.8 | 21 (4) | 54 (2) | 19 (3) | 269 (1) | 126 (4) | 88 (2) |
| 10 | Ficote 360 TE | 4 | 3.9 | 5 (1) | 12 (0) | 10 (1) | 112 (0) | 43 (2) | 32 (1) |
| 11 | Ficote 360 TE | 5 | 3.9 | 6 (1) | 12 (0) | 10 (1) | 101 (0) | 35 (2) | 27 (1) |
| 12 | Ficote 360 TE | 6 | 3.8 | 35 (5) | 90 (2) | 33 (4) | 402 (3) | 203 (6) | 175 (4) |
| 13 | Os. Plus 8-9 | 1 | 3.9 | 33 (5) | 54 (2) | 22 (3) | 200 (1) | 69 (3) | 62 (2) |
| 14 | Os. Plus 8-9 | 2 | 3.9 | 83 (8) | 180 (4) | 42 (5) | 478 (3) | 181 (5) | 188 (4) |
| 15 | Os. Plus 8-9 | 3 | 3.9 | 68 (7) | 162 (3) | 42 (5) | 480 (3) | 182 (5) | 183 (4) |
| 16 | Os. Plus 12-14 Sp. | 2 | 3.9 | 36 (5) | 60 (2) | 24 (3) | 257 (1) | 89 (4) | 76 (2) |
| 17 | Os. Plus 12-14 Sp. | 3 | 3.9 | 42 (6) | 72 (2) | 25 (3) | 280 (1) | 101 (4) | 88 (2) |
| 18 | Os. Plus 12-14 Sp. | 4 | 3.9 | 90 (8) | 192 (4) | 42 (5) | 543 (4) | 235 (6) | 173 (4) |
| 19 | Os. Plus 12-14 At. | 3 | 3.9 | 27 (4) | 54 (2) | 21 (3) | 250 (1) | 94 (4) | 78 (2) |
| 20 | Os. Plus 12-14 At. | 4 | 3.8 | 50 (6) | 120 (3) | 31 (4) | 418 (3) | 184 (5) | 171 (4) |
| 21 | Os. Plus 12-14 At. | 5 | 3.7 | 41 (6) | 96 (2) | 27 (4) | 380 (2) | 160 (5) | 150 (3) |
| 22 | Os. 16-18 | 4 | 3.7 | 83 (8) | 108 (3) | 30 (4) | 461 (3) | 149 (5) | 203 (5) |
| 23 | Os. 16-18 | 5 | 3.7 | 96 (8) | 96 (2) | 33 (4) | 470 (3) | 158 (5) | 215 (5) |
| 24 | Os. 16-18 | 6 | 4.0 | 140 (9) | 156 (3) | 45 (5) | 690 (5) | 245 (6) | 347 (5) |

# APPENDIX IV

## Media Analyses - Available

## At Potting (6 August 1991)

*(samples frozen until analysed February 1992)*

Table 18 *Elaeagnus pungens* 'Maculata'

| Code | Treatments Fertilizer | Rate ($kg/m^3$) | pH | P (mg/l) | K (mg/l) | Mg (mg/l) | Cond. ($\mu s$) | $NO_3$ (mg/l) | $NH_4$ (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ficote 140 TE | 2 | 3.7 | 15 (3) | 48 (1) | 23 (3) | 259 (1) | 131 (5) | 87 (2) |
| 2 | Ficote 140 TE | 3 | 3.8 | 12 (3) | 30 (1) | 17 (3) | 190 (1) | 93 (4) | 58 (2) |
| 3 | Ficote 140 TE | 4 | 3.7 | 15 (3) | 48 (1) | 24 (3) | 253 (1) | 126 (4) | 81 (2) |
| 4 | Ficote 180 TE | 3 | 3.8 | 3 (0) | 12 (0) | 9 (1) | 92 (0) | 42 (2) | 21 (1) |
| 5 | Ficote 180 TE | 4 | 3.8 | 14 (3) | 48 (1) | 18 (3) | 225 (1) | 113 (4) | 72 (2) |
| 6 | Ficote 180 TE | 5 | 3.7 | 14 (3) | 54 (2) | 19 (3) | 245 (1) | 119 (4) | 78 (2) |
| 7 | Ficote 270 TE | 4 | 3.8 | 8 (2) | 24 (0) | 16 (3) | 173 (1) | 73 (3) | 50 (1) |
| 8 | Ficote 270 TE | 5 | 3.8 | 9 (2) | 24 (0) | 16 (3) | 170 (1) | 79 (3) | 50 (1) |
| 9 | Ficote 270 TE | 6 | 3.8 | 15 (3) | 48 (1) | 20 (3) | 250 (1) | 126 (4) | 88 (2) |
| 10 | Ficote 360 TE | 5 | 3.8 | 9 (2) | 30 (1) | 18 (3) | 174 (1) | 87 (4) | 52 (2) |
| 11 | Ficote 360 TE | 6 | 3.8 | 8 (2) | 18 (0) | 19 (3) | 135 (0) | 65 (3) | 38 (1) |
| 12 | Ficote 360 TE | 7 | 4.0 | 12 (3) | 36 (1) | 30 (4) | 208 (1) | 102 (4) | 68 (2) |
| 13 | Os. Plus 8-9 | 2 | 3.9 | 30 (5) | 78 (2) | 35 (4) | 248 (1) | 105 (4) | 82 (2) |
| 14 | Os. Plus 8-9 | 3 | 3.9 | 75 (7) | 180 (4) | 54 (6) | 490 (3) | 219 (6) | 176 (4) |
| 15 | Os. Plus 8-9 | 4 | 4.0 | 111 (9) | 288 (5) | 60 (6) | 720 (6) | 325 (7) | 279 (5) |
| 16 | Os. Plus 12-14 Sp. | 3 | 3.9 | 56 (7) | 102 (3) | 37 (5) | 319 (2) | 138 (5) | 116 (3) |
| 17 | Os. Plus 12-14 Sp. | 4 | 3.9 | 63 (7) | 156 (3) | 30 (4) | 436 (3) | 202 (6) | 158 (4) |
| 18 | Os. Plus 12-14 Sp. | 5 | 3.9 | 60 (7) | 138 (3) | 26 (4) | 386 (2) | 169 (5) | 145 (3) |
| 19 | Os. Plus 12-14 At. | 4 | 3.8 | 26 (4) | 54 (2) | 18 (3) | 260 (1) | 117 (4) | 81 (2) |
| 20 | Os. Plus 12-14 At. | 5 | 3.9 | 30 (5) | 84 (2) | 29 (4) | 340 (2) | 155 (5) | 126 (3) |
| 21 | Os. Plus 12-14 At. | 6 | 3.8 | 36 (5) | 84 (2) | 28 (4) | 351 (2) | 158 (5) | 128 (3) |
| 22 | Os. 16-18 | 7 | 3.8 | 102 (9) | 174 (3) | 53 (6) | 609 (5) | 208 (6) | 257 (5) |
| 23 | Os. 16-18 | 8 | 3.8 | 152 (9) | 162 (3) | 48 (5) | 670 (5) | 233 (6) | 335 (5) |
| 24 | Os. 16-18 | 9 | 4.2 | 165 (9) | 246 (4) | 87 (7) | 908 (7) | 287 (6) | 436 (5) |